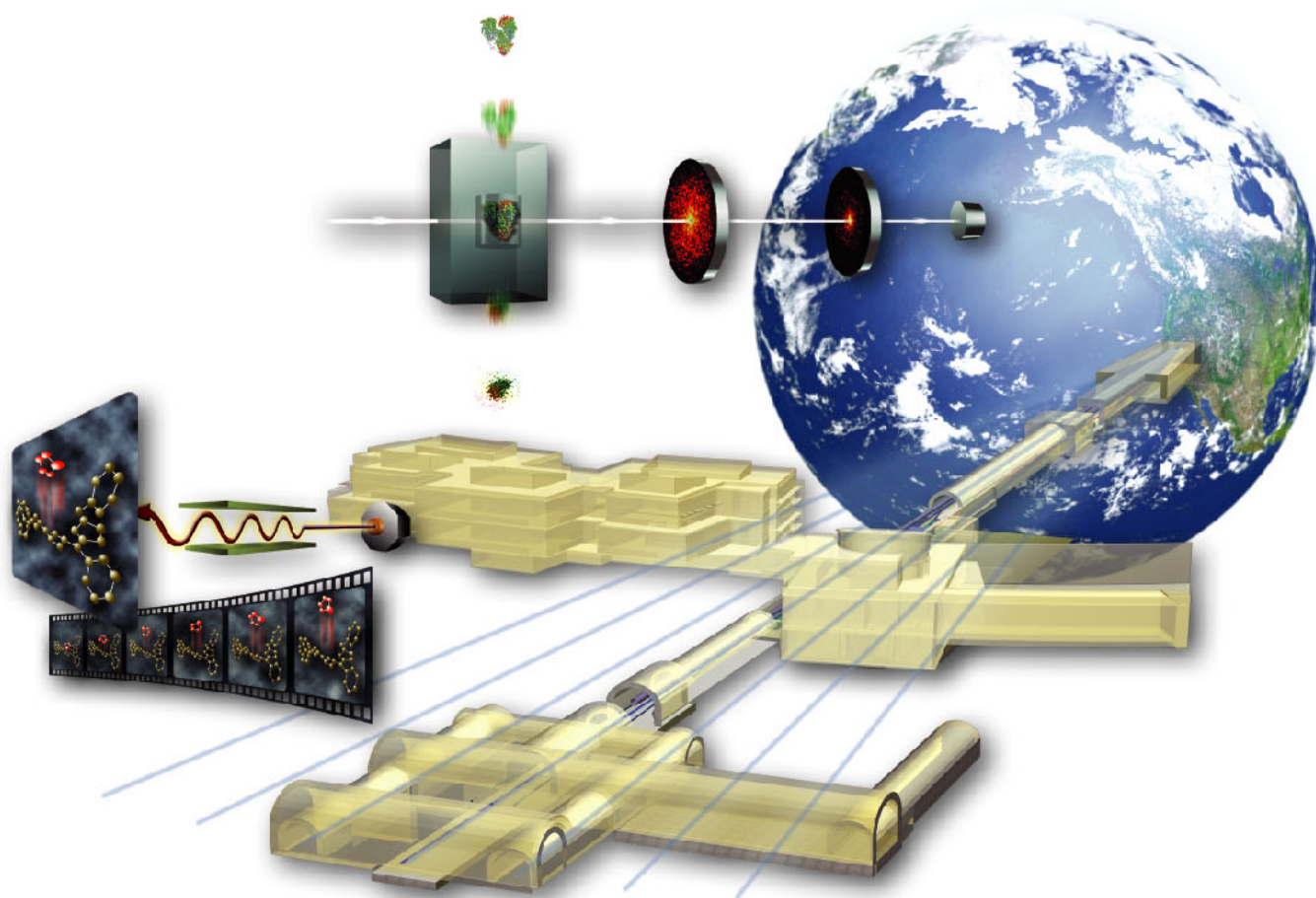


MONTHLY REPORT

November-December 2005



CONTENTS

PROJECT OVERVIEW AND ASSESSMENT	3
TECHNICAL AND PROGRAMMATIC PROGRESS	
<u>LCLS Project Office & Support</u>	
WBS 1.1, 2.1 Project Planning, Management & Administration	5
<u>Electron Beam Systems</u>	
WBS 1.1.3, 1.X.3 Global Controls	6
WBS 1.2, 2.2 Injector	8
WBS 1.3, 2.3 Linac	9
WBS 1.4, 2.4 Undulator	10
<u>Photon Beam Systems</u>	
WBS 1.5, 2.5 X-Ray Transport & Diagnostics	13
WBS 1.6, 2.6 X-Ray Endstations	14
<u>Conventional Facilities</u>	
WBS 1.9, 2.9 Conventional Facilities	15
COST PERFORMANCE REPORT	
-Cost/Schedule Variance Narrative	17
-Change Control Activity	
-Milestone Performance	
GLOSSARY	25

Project Overview and Assessment

Highlights:

- A one-day DOE Status mini-review of the LCLS Project was held at SLAC on November 17, 2005. The purpose of the review was to do an interim assessment of the project's progress in preparation for planning a full review in February 2006. That February 2006 review is to support CD-3b (Approve Start of Full Construction) approval. The Committee found that the project "has made significant progress...and many of the concerns expressed at the May 2005 review have already been addressed satisfactorily." Copies of the Review Summary are available through the LCLS Project Office.
- The LCLS Project Management Oversight Group (PMOG) met on November 20, 2005 to assess overall progress and provide feedback on the project team's approach to cost risks in Conventional Facilities. Overall, the PMOG found good progress on the technical systems and a sound strategy in place to address cost risks to the project.
- LCLS has completed two refurbishment projects preparatory to construction in March 2006: (1) Sector 24 Stairway and PPS, and (2) BSY Vertical Wall. In addition, the long-lead acquisitions of Sector 20 Injector Facility (S20) and the Magnetic Measurement Facility (MMF) are making good progress toward completion in early March 2006. All projects have no injuries to date, are on schedule and reporting good cost control.

Assessment and Issues:

- The November and December 2005 Cost Performance Reports (CPR) are the 21st and 22nd months of reporting earned-value on the LCLS TPC. For December 2005, the LCLS cost and schedule indices are 1.01 and 0.92, respectively. Total obligations to date (actual costs + open commitments) are \$72,227K. The overall project critical path is through the Undulator Facility Beneficial Occupancy followed by the installation of the undulators. Total project float with respect to CD-4 remains at 213 days.
- With the award of the CM/GC procurement (Turner Construction), the highest risks to LCLS are; maintaining progress on the Title II CF design (Jacobs Facilities) and gaining confidence that the CF cost estimate is reliable and affordable.
- The Title II 30% construction cost estimate as provided by JE was estimated 50% higher than the JE Title I Estimate. The areas of greatest increase include Site-work, Mechanical and Electrical areas of discipline. The cost estimate at the

- end of Title I was used to determine the WBS budget for 1.9.3 (construction cost of Research Yard thru CLOC). The significant increase between the Title I and Title II phases to date requires that the project review its current scope.
- Initial findings of scope reductions have been identified to offset a portion of the cost increases associated with the 30% estimate.
 - The CF group continues to pursue cost savings measures and identifying unnecessary equipment and over-engineered design features.
 - An Independent Cost Estimate was provided by WDDC on the JE 30% design submittal, which was lower than the JE estimate.
 - Both JE and the WDDC cost estimates have been reconciled to ~10%.
- Weekly Owner-Architect-Constructor meetings are being held between SLAC, Jacobs Facilities and Turner Construction. Some recent progress is;
 - Turner presented a draft revision 2 to the project schedule. A final version with narrative has been requested for review after the holiday shutdown.
 - (Turner) Subcontract modification No. 1 to properly incorporate RFP Addendum 3 (among other things) is pending.
 - The senior management pre-partnering session was held, between SLAC, Jacobs and Turner, with a follow-on meeting scheduled for early January prior to the larger group session.

Project Office and Support

WBS 1.1, 2.1 Project Planning, Management and Administration

Highlights:

- The LCLS IT Manager (Andrea Chan) is developing a web-based system that can be used to deposit requirements documentation (SOWs, Specifications (ESDs), and Drawings) and track documents used for Purchase Orders. Rollout was delayed due to other priorities. The new system features were demonstrated in December to the project management team while the system was still in the beta test stages. A fully functional system is expected in January.
- LCLS Procurement Status – December 2005;
 - The consulting agreement type PO/Subcontract for the services of a Procurement Consultant was extended.
 - S20/K10B/MMF – Weekly status meetings are held for S20/K10B and MMF with minutes distributed by XL. Several small change orders have been authorized with PO modifications issued or pending. Completion date for all 3 projects need to be extended due to the holiday shutdown.
 - Independent CM/GC Cost Estimates – A second independent cost estimate for the CLOC building was awarded to Davis Langdon. The estimate will be based on the 60% design.
 - Injector Linac Solenoid Magnets – Awarded 12/16, Due 2/3/06.
 - Linac BC1 Chicane Dipole Magnets – Proposal received and under evaluation.
 - Injector Laser Heater Chicane Dipole Magnets – Solicitation issued. Proposal due 1/6/06.
 - Optical Tables – Awarded 12/6. Due 2/28/06.
 - Linac Tweaker Quadrupole Magnets – Bid proposals due 1/6/06.
 - BC2 Chicane Dipole Magnets – Bid proposals due 1/18/06.
 - BY Vertical Bend Dipole Magnets – Bid proposals due 1/18/06.
 - BYD Vertical Bend Dump Magnets – Bid proposals due 1/18/06.
 - LTU Quadrupole Magnets - Solicitation issued. Proposals due 1/18/06.
 - Electrical Feeder Upgrade for MMF – Bid proposals due 1/3/06.

Assessment and Issues:

- Response to an opening for a Procurement/Subcontract Administrator in the LCLS Procurement Group has been disappointing to date with no qualified applicants identified. If no acceptable candidate is found, LCLS will seek support from SLAC's Purchasing Group.

Electron Beam Systems

WBS 1.1, 1.x.3 Controls

Highlights:

- High Level Applications: A GUI for LCLS Query Manager has been designed. Work continues on getting XAL fully operational and understood well enough for us to wield it effectively.
- Laser Control: A test stand is in place and waiting for some mechanical pieces. The driver for the camera is written and appears to be taking image data near 120 Hz.
- PPS: The Allan-Bradley PLC has been programmed for access control. One of the two Pilz PLCs has been programmed for safety interlocks. The second Pilz PLC is 70% completed. The laser safety system was complete, but there have been changes to the specification that require some programming. This should not take long because the code is very modular. The transfer data array for EPICS is specified.
- MPS: The requirements for performance and mitigation are complete. The signal list is a work in progress. The PLC that will provide MPS for the 2006 installation is started. Ion chamber locations, PLICS, Stopper Locations, and toroids are in the signal list. PMTs may be used in MPS. MPS Input Module Input Card block diagram created. The FPGA for the final version of MPS is well underway. All inputs into the MPS will be digital.
- Timing: The Event Generator (EVG) and Event Receiver (EVR) have been delivered. Orders for the remainder of the EVRs and a spare EVG for the 2006 installation are being put together now. The driver is not complete.
- BPMs: Found misrouted attenuator control lines on the four-channel prototype PC board that are now rewired and appear to work properly. Gain, noise figure, linearity, and bandwidth have been measured and look good. The measured noise figure is about 1 dB above the spec for the first amp, which is reasonable. Linearity is excellent; the measured IP3 is a few dB below the spec for the final amplifier, meeting the linearity spec for the system.
- LLRF: The Phase/Amplitude Detector (PAD) board is in hand and being evaluated, tested and integrated. There are a couple of issues with the PAD board. The driver is a fundamental state – reading the fifo into the core processor. A test board is feeding data successfully through the fifo while the actual board is being modified to fix the data transfer from the ADC to the fifo. CAPTAR .xls cable list for LLRF completed 12/01.

- **Wire Scanner:** The motor will be controlled using a Hytec Industry Pac motion controller. This is the highest performance interface to an encoder and should give much better position read-back resolution than needed. The motion control portion is ordered.
- **Power Supplies:** All of the power supplies for the 2006 installation are ordered. The total cost is over budget about \$20K for the injector and \$300K to the linac. The CCB has been informed and a BCR is in process.
- **Vacuum Control:** Information is being collected to complete rack layouts and wiring. A breakout box in the injector could be completed without all locations of devices and allow us to get on with the wiring. Control components are ordered.
- **Temperature Control:** We are planning capability for 64 temperature signals in each sector. We are working to complete the wire list.
- **Network:** There is an updated IOC list and we are putting together the location information for them. The development subnet has been set up for bldg 280, server not ready yet. We are getting very good support from ESD on this.
- **Rack and Wiring:** The power supply rack order is complete. Work is going on to complete the signal lists and routing for the 60% design completion. This will include the vacuum, power supplies, LLRF, BPM, and timing information. Some subsystems will be determined later as they only mildly impact conduit – and do not change the overall design of the system.
- Hamid Shoaee accepted the offer to become the Head to the Controls group.

Assessment and Issues:

- The Controls schedule for the '06 installation in the Injector and Linac has very little float with respect to the 2006 shutdown schedule. A rescheduling of activities will be done to reconcile the schedule with installation needs and to provide schedule float.
- The cable plant which is to be installed above the drive laser may delay the installation of the laser and so needs to be expedited. The key cabling managers are working the issue. This is a near-term critical path item which is pushing the laser commissioning.

WBS 1.2, 2.2 Injector System

Highlights:

- Specification of all cables from the gun through BC1 is about 75% complete. Tray installation in the injector vault will start in mid-April.
- Cathode launch system final design review has been scheduled for mid-February. An alignment procedure must be written for the in-vault optics.
- The L1 solenoid design review has been scheduled for Monday January 23. The outside vendor will present the design at SLAC.
- Two waveguide valves will be installed in the Injector T-Cav waveguide run. One will be installed on the Linac side of the shielding wall and the other on the vault side. This will take care of T-Cav PPS concerns.
- Unigraphics consultants are assisting in solving the implementation problems of the CAD PDM.
- The design of the beam phase monitor cavity is complete. This will finalize the position of L0a and L0b for the integration effort.
- A BCR was finalized to correct scheduled effort in Injector and Linac integration and in Linac Diagnostics.

Assessment and Issues:

- Laser commissioning is likely to be delayed by Injector Cable plant installation. This is being expedited. The key cabling managers are working the issue. This is a near-term critical path item.
- The tracking of design performance needs to be improved to better assess status toward the '06 installation. The Injector team is conducting weekly readiness meeting and developing better tracking tools.
- The installation schedule for the Injector and Linac need to be replanned to bring the schedule details in line with the laboratory schedule. This is being performed by the installation coordinator.

WBS 1.3, 2.3 Linac System

Highlights:

- A Baseline Change Request (BCR) is being prepared to update the installation sections for the Injector and Linac systems. Design status for components is being compared to installation required-by dates to verify readiness for installation activities. This is also to coordinate the LCLS installation activities with SLAC's downtime planning.
- Bunch Length Monitor engineering is starting here at SLAC. The Engineer has met with a senior diagnostics scientist to work on the design. An estimate for building the BC1 and BC2 bunch length monitors was prepared. A BCR will be written to incorporate the estimate into the manpower loaded schedule.
- Meetings are being held to assemble data collected on existing electrical loads for Linac sectors 21-30. LCLS requirements will be compared to existing loads and capacities.
- A components based cable list was produced to define the cable plant going to the Injector Vault.
- Tune-up dumps TD23 North and South were removed from the North and South SLC Final Focus beamlines. The Tune-up dumps will be used as stoppers for BC1 and SAB beamlines.
- Venkat Srivinishan was hired as a Mechanical Engineer for LCLS and is starting this week working on Injector and Linac diagnostics under Tim Montagne.
- MFD has increased its manpower to support LCLS component assembly and installation. The increase personnel will decrease the shop rate.

Assessment and Issues:

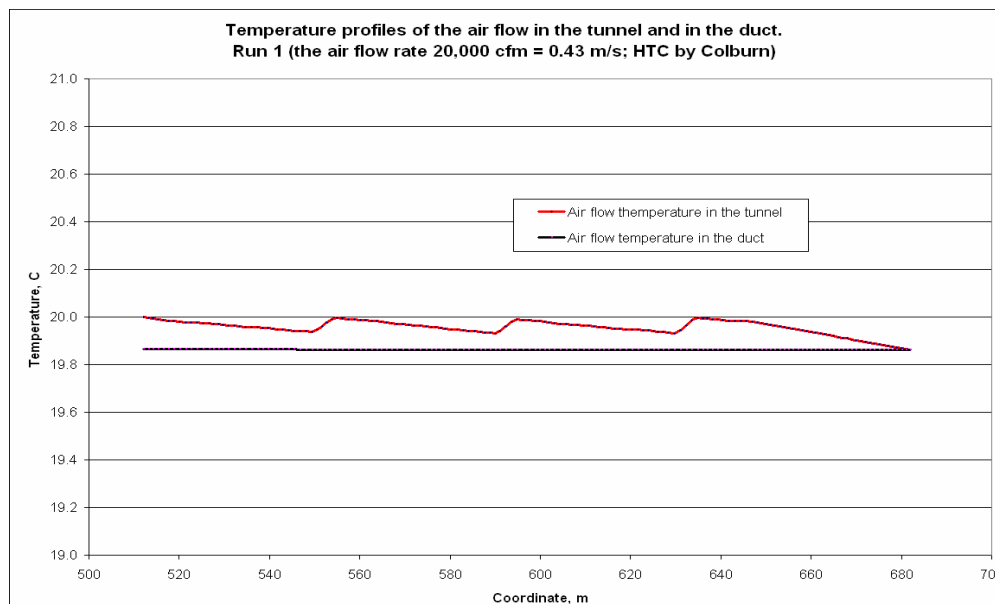
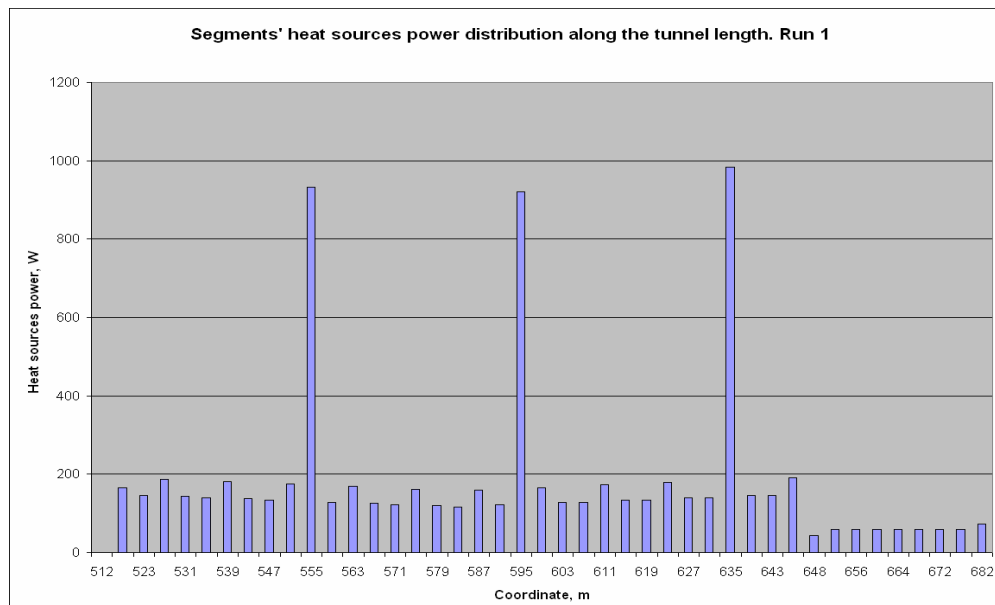
- The tracking of design performance needs to be improved to better assess status toward the '06 installation. The Linac team is conducting weekly readiness meetings and developing better tracking tools.
- The installation schedule for the Injector and Linac must be replanned to align with the laboratory schedule. This is being performed by the Installation Coordinator.
- The fabrication of the BC1 articulation vacuum was put on hold to make modifications to increase the acceptance aperture for the BLM. This will not have an impact on the '06 downtime.

WBS 1.4, 2.4 Undulator System

Highlights:

- The status of the Undulator Magnet procurements are as follows;
 - Titanium Strongbacks
 - 22 of 40 forgings in-house at the vendors with the remaining raw material planned for delivery by the end of April
 - 5 of 40 completed and accepted and 4 more ready for inspection
 - 5 are rough machined
 - All others are staged for rough machining
 - Magnet Poles
 - 12,500 out of 19,200 blanks machined
 - 5000 in grinding
 - 2100 ready to anneal
 - 5000 completed
 - Magnet Blocks
 - Lots 1 and 2 (enough for one undulator apiece) delivered to the assembly vendors
 - Lots 3 and 4 completed and undergoing final sorting before shipping to assembly vendors
 - Next lot in progress
 - 1st Articles Assembly (1 each from 2 vendors)
 - Long lead parts have been ordered
 - Other parts being constructed
 - Assembly areas prepared and ready
 - Expect 1st Article assembly to begin February 1.
- The status of the Single Undulator Test (SUT) is as follows;
 - Fixed supports are ordered for SUT, base stands ready for assembly before end of January. Connecting/interface plates mid-February
 - Two girders are in house – one for SUT, one for testing
 - Miscellaneous parts for the support mover system are at ANL
 - “Fake” undulator (to be used as a physical model) is at ANL
- Undulator Quadrupole Internal Design Review completed
- Work continues on the RF cavity beam position monitor (RFBPM). Brazing tests were performed and a brass body RFBPM was fabricated and will be delivered during the holiday period. All parts for the cold fixture test have been either constructed or order and most parts will be in by the end of the month.
- All parts for the prototype beam finder wire are procured and a large portion of the parts for the optical transition radiation monitor prototype have arrived.

- Work continues on the prototype vacuum chamber components. A report on the laser welding tests has been completed as well as measurements of the surface roughness over a large (10x10 mm) area. Further tests are underway on larger vacuum chambers.
- A preliminary analysis of the thermal performance of the Undulator Hall has been completed. This initial analysis covers essentially static calculations for a variety of load conditions, including different tunnel wall temperatures. This system engineering effort was identified in Risk Registry 1.4-019 (Undulator Tunnel Temperature) and included compiling all power loads in the Undulator Hall followed by a tunnel heat transfer analysis and HVAC performance study. The results are shown in the graphs below;



The results of the UH thermal analysis show that the reduced HVAC system exceed the performance specifications of the undulator system (+/- 1F). For further details see LCLS Technical Note TN-06-2 at;
<http://www-ssrl.slac.stanford.edu/lcls/technotes/lcls-tn-06-2.pdf>

Design effort will continue on the Undulator HVAC system and its performance. Next steps will include refinement of heat loads, transients, and the effect of air on equipment,

- The status of the Undulator Metrology Group at SLAC is as follows;
 - Using a GPS system, coordinates were assigned to the 4 new monuments for LCLS Conventional Facilities as described in ESD 1.9-107.
 - ESD 1.4-113 on undulator hall monumentation was submitted.
 - A decision was reached on the alignment sighting holes requirements and locations (J. Welch memo to D. McDonald of 12/13/05).
 - A visit was made to Kugler, the manufacturer of the MMF main bench for undulator tuning. The group is now working on the pre-acceptance procedure, the shipping options and the on-site installation and qualification of the bench.
 - The prototype undulator was put on the test stand. The test stand was prepared for measurements. Software development effort continues.
 - Progress was made on the engineering for the integration of the stretched wire components into the undulator segment.
 - A presentation of the HLS system in the undulator hall was given on December 15th: For more info, see; <http://www-group.slac.stanford.edu/met/Align/LCLS/Undulator/HLS121505.pdf>

Assessments and Issues:

- APS will be reorganized on April 1st, and has begun moving forward with a voluntary Reduction in Force (RIF). An involuntary RIF is possible. The impact on the ANL LCLS project has not yet been fully assessed.
- In an effort to better control the overall schedule management, all CAM schedules will come under the control of the ANL LCLS Project Director. This will free the CAMs from this responsibility and should improve the overall consistency of the schedule and reporting methodologies.

Photon Beam Systems

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

Highlights:

- Management and Safety – The XTOD group was heavily involved in the review of the Jacobs 60% design, particularly as it applied to grounding issues. Also, an XTOD Baseline Change Request was initiated for adding the offset mirror system to the project and to implement an improved schedule for the slit, gas and solid attenuator, total energy measurement system, and controls.
- Tunnel - The final response to the X-Ray Vacuum Transport System (XVTS) review was discussed at the XTOD technical meeting, and changes were implemented in response to the concerns raised at the review including: simpler, less expensive stands, elimination of the turbo roughing system, and a new design for the transition region just downstream of the flipper mirror. The new stand design has been incorporated into the seismic review report for the tunnel, ERD05-500141-AA “LCLS X-Ray Tunnel Review Seismic Safety”, a draft of which has been completed and is now circulating for final comments.
- Slit – The XTOD group continues to work on changes in the slit design in response to the “UHV” requirement elucidated in the draft XTOD Mechanical & Vacuum Physics Requirements Document (PRD).
- Gas Attenuator – The Gas Attenuator prototype components have been procured. There is serious consideration to merge the gas and solid attenuator into a single unit to save space in the FEE. Tradeoffs between using nitrogen gas versus argon are also being investigated. A Conceptual Design Review (CDR) of the Gas Attenuator is scheduled for February 2006.
- Beam Simulation – A model for the FEL grating spectrometer with Monte Carlo simulations of the response of the FEL spectrometer to single-segment undulator radiation is underway. The results showed good ability to detect K/K differences of 10^{-3} between the first and the last undulator segments but marginal ability to detect $\Delta K/K$ differences of 10^{-4} . This was due mainly to the poor statistics caused by the small aperture of the FEL spectrometer. A design change has significantly expanded the aperture which predicts greatly increased sensitivity at $\Delta K/K = 10^{-4}$. These results are being documented.

Assessment and Issues:

- None

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

Highlights:

- The XES team participated in the review of the Jacobs Engineering 60% submittal of the drawings and has been involved in resolving a number of issues resulting from this review. XES continues to work with the SLAC Radiation Physics group on issues that have a direct impact on the CF design such as shielding, penetrations.
- The XES has interviewed and filled the positions for the Atomic Physicist and the Detector Physicist. John Bozek from LBL will start as the Atomic Physicist in mid-January and Niels van Bakel from SLAC (BaBar) will be starting in February as the Detector Physicist. XES is also interviewing for a Personnel Protection System (PPS) engineer who will support Photon System and Electron System jointly. This effort is expected to start early next year.
- 2-D X-ray Detector Project: We have been receiving monthly reports from Cornell and communicating with them about some reporting details. Cost and schedule are on target. We are in the process of scheduling a review for the status after the first year as outlined in the development plan and working on a TA for the second year of the program.
- The streak camera project is getting underway with discussions between LBL and SLAC. Howard Padmore's group at LBL is the primary contact person at LBL. A SLAC-LBL MOU and Technical Addendum is in preparation for a first year effort.
- XES also participated in the Design Review of the x-ray tunnel presented by XTOD.

Assessment and Issues:

- 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 continues on the construction for the Sector 20 Injector Facility (S20) project. The project is 50% complete and is on schedule for a successful completion of the current Level 3 Milestone date of March 31, 06. Change orders to date for the S20 project have resulted in \$27K or 1.3%.
- Progress continues on the construction of the Magnetic Measurement Facility (MMF) project. The project is 60% complete and is on schedule for a successful completion of the current Level 3 Milestone date of April 3, 06. Change orders to date for the MMF project have resulted in \$54K or 2.1%. After continued value engineering by the CF staff a savings of \$119K has been realized.
- A draft construction schedule was presented by Turner Construction. In general, the schedule is in line with SLAC's internal schedule estimates. In some areas, the schedule is improved. This schedule will be reviewed and integrated with lab activities for a final submission by and approved by LCLS.
- Weekly Owner-Architect-Constructor (OAC) meetings are ongoing. Turner Construction conducted Constructability and Value Engineering reviews of the LCLS 60% design submitted by Jacobs Facilities. A final report is due in January 2006.
- A candidate, Lam Chan, was selected to fill one of the open positions for a Field Construction Manager. A second opening for a Field Construction Manager is expected to be filled by the February 2006 timeframe.
- Title II 100% review submittal has been extended to January 30, 2006, with a final completion date of February 17, 2006.

Issues and Assessments

- Turner Construction's key staff moving onto the SLAC site has proceeded slowly, resulting in a slow ramp up on the Phase One activities (pre-construction). LCLS has informed Turner of the pressing need to have their staff on-site to gain a better understanding of the site/lab conditions and daily activities, and Turner has committed to having its key staff at SLAC in January.
- The LCLS Title II 60% design package was submitted by Jacobs on schedule. The estimate of construction as provided by Jacobs Facilities was in line with

- expectations (see details on Baseline Change Requests under Cost and Schedule Performance). Details of the submittal are;
- Title II drawings and specifications were submitted by Jacobs Facilities (483 drawings). There were ~1000 comments and corrections on the package. Quality control and integration between engineering disciplines particularly with respect to the design specifications remains an issue. SLAC has set up interim status reviews between the 60% and 100% submittals to ensure that the final design package meets SLAC requirements.
 - Title II 60% construction estimated cost was in line with the 30% submittal after removing scope approved by SLAC. Turner Construction and Wightman provided independent of the 60% design package. A reconciliation meeting between Jacobs, Turner and Wightman was held on Dec 16. At this meeting, the WDDC estimate contributed primarily on tunneling, while JE and TC focused on the remaining scope of the project. A final reconciliation of costs brought Jacobs and Turner with a 10% difference. Both Jacobs and Turner will submit final cost estimates on the final package in mid-February 2006.
- Construction activities at Sector 20 and the Magnet Measurement Facility were halted during the lab shutdown. This does not appear to impact the Level 3 milestones.
 - SLAC experienced a one day strike by Stanford University union workers. S20 and MMF construction projects had no construction activity performed during this time. The strike conditions may continue in January.



LCLS Cost and Schedule Performance – November 2005

LCLS Cost/Schedule Status Report - Work Breakdown Structure										30-Nov-05	
WBS	Cumulative to Date (\$K)							At Completion (\$K)			
	Budgeted Cost		Actual Cost Work Performed	Variance		Performance Indices		Budgeted	Latest Revised Estimate	Variance	
	Work Scheduled	Work Performed		Schedule	Cost	SPI	CPI				
1.1 Project Management	11,382	10,591	11,865	-791	-1,274	0.93	0.89	29,774	29,774	0	
1.2 Injector	9,195	7,677	8,756	-1,518	-1,078	0.83	0.88	19,485	19,485	0	
1.3 Linac	4,448	4,261	3,221	-187	1,040	0.96	1.32	26,217	26,217	0	
1.4 Undulator	9,950	8,661	8,427	-1,289	234	0.87	1.03	43,052	43,052	0	
1.5 X-ray Transport	5,889	5,531	5,264	-358	267	0.94	1.05	27,062	27,062	0	
1.6 X-ray Endstations	782	782	728	0	53	1.00	1.07	14,762	14,762	0	
1.9 Conventional Facilities	10,937	9,516	8,478	-1,421	1,038	0.87	1.12	88,337	88,337	0	
1 LCLS Total Base Cost	52,584	47,020	46,740	-5,565	280	0.89	1.01	248,690	248,690	0	
								LCLS Total Estimated Cost	315,000	315,000	
								Avail. Contingency	66,310	66,310	
								% Contingency / Rem. Work	32.9%	32.9%	
								% Complete LCLS Base Cost	18.9%	18.9%	
2.1 LCLS Project Mgmt, Planning & Admn (OPC)	4,728	4,819	4,820	91	-1	1.02	1.00	32,636	32,636	0	
2.2 Injector (OPC)	660	604	601	-56	3	0.92	1.00	5,754	5,754	0	
2.3 Linac (OPC)	1	1	1	0	0	1.05	1.00	2,545	2,545	0	
2.4 Undulator (OPC)	747	744	902	-2	-157	1.00	0.83	5,337	5,337	0	
2.5 X-ray Transport (OPC)	489	489	456	0	33	1.00	1.07	3,792	3,792	0	
2.6 X-ray Endstations (OPC)	185	174	130	-11	44	0.94	1.34	5,220	5,220	0	
2.9 Conventional Facilities (OPC)	0	0	0	0	0			0	0	0	
2 LCLS Total Other Project Cost	6,810	6,831	6,910	21	-79	1.00	0.99	55,286	55,286	0	
								LCLS Other Project Cost	64,000	64,000	
								Avail. Management Reserve	8,714	8,714	
								% Contingency / Rem. Work	18.0%	18.0%	
								% Comp LCLS Other Project Cost	12.4%	12.4%	
Total Obligations to Date = \$69,509K											
LCLS Total Project Cost	59,394	53,851	53,650	-5,543	201	0.91	1.00	379,000	379,000		
								% Complete LCLS TPC	17.7%	17.7%	



LCLS Cost and Schedule Performance – December 2005

LCLS Cost/Schedule Status Report - Work Breakdown Structure										31-Dec-05
WBS	Cumulative to Date (\$K)							At Completion (\$K)		
	Budgeted Cost		Actual Cost Work Performed	Variance		Performance Indices		Budgeted	Latest Revised Estimate	Variance
	Work Scheduled	Work Performed		Schedule	Cost	SPI	CPI			
1.1 Project Management	11,396	11,392	12,407	-4	-1,014	1.00	0.92	27,741	27,741	0
1.2 Injector	10,038	9,183	9,173	-855	10	0.91	1.00	20,584	20,584	0
1.3 Linac	4,559	4,203	3,495	-356	708	0.92	1.20	25,200	25,200	0
1.4 Undulator	11,364	9,458	9,381	-1,906	77	0.83	1.01	43,052	43,052	0
1.5 X-ray Transport	5,833	5,843	5,799	10	44	1.00	1.01	24,797	24,797	0
1.6 X-ray Endstations	876	807	744	-70	62	0.92	1.08	15,354	15,354	0
1.9 Conventional Facilities	12,882	11,107	10,589	-1,776	518	0.86	1.05	105,931	105,931	0
1 LCLS Total Base Cost	56,948	51,993	51,587	-4,956	406	0.91	1.01	262,659	262,659	0
LCLS Total Estimated Cost								315,000	315,000	
Avail. Contingency								52,341	52,341	
% Contingency / Rem. Work								24.8%	24.8%	
% Complete LCLS Base Cost								19.8%	19.8%	
2.1 LCLS Project Mgmt, Planning & Admn (OPC)	4,848	4,934	4,966	86	-33	1.02	0.99	33,425	33,425	0
2.2 Injector (OPC)	697	636	635	-61	1	0.91	1.00	5,754	5,754	0
2.3 Linac (OPC)	1	1	1	0	0	1.05	1.00	2,545	2,545	0
2.4 Undulator (OPC)	747	744	797	-2	-52	1.00	0.93	5,337	5,337	0
2.5 X-ray Transport (OPC)	489	489	456	0	34	1.00	1.07	3,515	3,515	0
2.6 X-ray Endstations (OPC)	194	194	130	0	63	1.00	1.49	5,246	5,246	0
2.9 Conventional Facilities (OPC)	0	0	0	0	0			621	621	0
2 LCLS Total Other Project Cost	6,976	6,999	6,985	22	13	1.00	1.00	56,444	56,444	0
LCLS Other Project Cost								64,000	64,000	
Avail. Management Reserve								7,556	7,556	
% Contingency / Rem. Work								15.3%	15.3%	
% Comp LCLS Other Project Cost								12.4%	12.4%	
LCLS Total Project Cost	63,925	58,991	58,573	-4,933	419	0.92	1.01	379,000	379,000	
% Complete LCLS TPC								18.5%	18.5%	



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 November and December 2005 Cost Performance Reports (CPR) are the 21st and 22nd months of reporting earned-value on the LCLS TPC. For December 2005, the LCLS cost and schedule indices are 1.01 and 0.92, respectively. Total obligations to date (actual costs + open commitments) are \$72,227K. The overall project critical path is through the Undulator Facility Beneficial Occupancy followed by the installation of the undulators. Total project float with respect to CD-4 remains at 213 days.

Approved Baseline Change Requests (BCR's) for November and December 2005 are shown in the tables below. BCR CF-34 approved \$17.2M of contingency funds to the LCLS baseline to reconcile the CF subcontract cost estimates with the Jacobs-Turner-Wightman 60% cost estimates. Returns to contingency were identified across the project to offset CF-34. Additional savings will be processed in January 2006 business which is estimated to bring contingency above 27% on work remaining. A statistical contingency analysis on the project and a review of the 'bottoms-up' contingency assessments have been conducted to ensure that adequate contingency remains to complete the LCLS project on cost and on schedule.

The unfavorable cost variance in WBS 1.1 is due to larger than anticipated start-up costs in office and infrastructure support for the LCLS team. A BCR was approved to address future costs incurred in this area.

Schedule variances in WBS 1.2 are driven by delayed purchases (power supplies, diagnostics, and PPS), which are driven by slower than expected design in the controls area. A PPS/BCS Integration Manager will start in January. This new hire, in addition to the new Controls Manager are expected to resolve the slow design progress in Controls.

Additional delays in the Undulator (WBS 1.4) are related to the delivery of equipment to the Magnetic Measurement Facility (MMF). The schedule variance in Conventional Facilities (WBS 1.9) is due late deliveries of equipment to S20 and MMF which have now been resolved. 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*

November 2005

BCR #	WBS #	Signature Level	DCN #	Approval Date	BCR Description	Originator	TEC Base Cost Estimate		
							Previous Estimate	Increase (Decrease)	New Estimate
PM-20	2.01	4		11/01/05	Additional Effort for planning Experiment Startup	J. Galayda	\$29,775,057	\$0.00	\$29,775,057
PM-23	1.01.02.01.02	4		11/01/05	Slight re-profile of PMCS baseline to accommodate phased funding.	P. Mast	\$29,775,057	(\$869.00)	\$29,774,188
IJ-30	2.02.04.01.01	4		11/01/05	INJECTOR SYSTEM - GTF and Cathode Cleaning Process	Schultz/Chan	\$19,442,203	\$0	\$19,442,203
IJ-24	1.02.04	4		11/01/05	6 month plan corrections - RF	Schultz/Chan	\$19,442,203	\$42,886	\$19,485,090
LN-25	1.03.05.xx	4		11/01/05	LINAC - Diagnostics Cost-to-complete	T.E. Montagne	\$26,296,325	\$16,892	\$26,313,217
LN-29	1.03.05.04.04	4		11/01/05	LINAC -Cable plant and Racks Cost-to-complete	B. Dalesio	\$26,313,217	\$13,120	\$26,326,337
LN-23	1.03.06.05.06	3		11/01/05	6 month plan corrections - Xband Structure	Schultz/Chan	\$26,326,337	(\$108,962)	\$26,217,375
UN-33	1.04.02	4		11/01/05	Corrections to Undulator Controls Schedule	D. Schultz/J. Stein	\$43,052,293	\$25	\$43,052,318
UN-34	1.04.03/ 2.04.03	4		11/01/05	Update baseline schedule with new vendor payment schedule for magnet blocks	D. Schultz/M White	\$43,052,318	\$0	\$43,052,318
UN-35	1.04.03.03.01	4		11/01/05	Corrections to Metalex/Dial budgets.	D. Schultz/M White	\$43,052,318	\$0	\$43,052,318
XE-07	1.06	3		11/01/05	Request new Milestone Dates for XE Laser System	J. Arthur-S. Moeller	\$14,743,385	\$0	\$14,743,385
XE-08	1.06	4		11/01/05	Move Network start date earlier, correct activities after 3/31/09	J. Arthur-S. Moeller	\$14,743,385	\$18,784	\$14,762,169
CF35	1.09	4	DCNs 193, 202, 205, 209, 175, 177, and 206	11/01/05	Replan CF: Increased in Title 2 A&E Design cost for approved DCNs 193, 202, 205, & 209 (Base is \$70k). Provide alternative design for UH HVAC (\$60k base), provide civil engr road conceptual design (\$10k base). Approved DCNs 175, 177, 206 (\$48,705 base). Total base cost for A&E Title 2 Design cost impact is \$188,705. In addition, Descope Fire protection Engineer to excludes other LCLS Systems \$52,000 decreased).	D. Saenz	\$88,335,042	\$1,838	\$88,336,880
October 2005 Total Base Cost Estimate							\$248,705,848		
Total Delta Base Cost Change								(\$16,285)	
November 2005 Total Base Cost Estimate									\$248,689,563

*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.



December 2005

BCR #	WBS #	Signature Level	DCN #	Approval Date	BCR Description	Originator	TEC Base Cost Estimate		
							Previous Estimate	Increase (Decrease)	New Estimate
PM-24	2.01.03	4		12/01/05	Move Travel from 2.01.03.03 to 2.01.03.01	M. Reichanadter	\$29,774,188	\$0.00	\$29,774,188
PM-27	1.01.03.05.03	4		12/01/05	Replan the Controls EO Diagnostics account.	B. Dalesio	\$29,774,188	\$34.00	\$29,774,222
PM-25	1.01.02.01, 2.01.03.01	3		12/01/05	Increase burnrate to match current labor mix	M. Reichanadter	\$29,774,222	\$335,914.00	\$30,110,136
PM-26	1.01, 2.01	2		12/01/05	Project Management Office Support for LCLS Commissioning and Pre-Operations	M. Reichanadter	\$30,110,136	(\$2,374,142.00)	\$27,735,994
PM-28	1.01.03.05	4		12/01/05	6-month plan corrections - Controls	B. Dalesio	\$27,735,994	\$4,752.43	\$27,740,746
IJ-25	1.02.07	3		12/01/05	Profile Monitors and BPM ETC	Schultz/Montagne	\$19,485,090	\$252,325	\$19,737,415
IJ-28	1.02.01	2		12/01/05	IJ Management and Integration ETC	Schultz/Bong	\$19,737,415	\$829,531	\$20,566,946
IJ-30	1.2.02	4		12/01/05	6-month plan corrections - Controls	B. Dalesio	\$20,566,946	\$16,633	\$20,583,579
LN-27	1.03.01	2		12/01/05	LN Management and Integration ETC	Schultz/Bong	\$26,217,375	(\$1,025,007)	\$25,192,368
LN-32	1.03.02	4		12/01/05	6 month plan corrections - Controls	B. Dalesio	\$25,192,368	\$7,935	\$25,200,303
XT-07	1.05 and 2.05		3	12/01/05	Remove Crystals & Gratings workspace, combine Solid and Gas Attenuators	J Arthur, R Bionta	\$43,136,779	(\$382,900)	\$42,753,879
XT-08		1.05	2	12/01/05	Remove the Flipper Mirror work and reduce the Tunnel beamlines from three to one.	J Arthur, R Bionta	\$42,753,879	(\$1,881,365)	\$40,872,514
XE-09		1.06	3	12/01/05	Add milestones and Crystals & Gratings to X-Ray Endstations	J. Arthur-S. Moeller	\$14,762,169	\$591,370	\$15,353,539
CF36		1.09	3	12/01/05	Increased scope for ICE, Structural and Electrical Design for LCLS. and MMF Construction Cost. Replan S20 and MMF plans to re-distribute original COR from General Requirements to appropriate WBS and replan CF Management and Integration.	D. Saenz	\$88,336,880	\$112,890	\$88,449,770
CF34		1.09	2	12/01/05	Increased CF "Hard Cost and Escalation" based on reconciled JE 60% Design Cost Estimate and Restructure CF T3 WBS Structures. There are also credits for CLOC third floor deletion, reduce scope for Access Road, SB 8.1, move FEH Access Tunnel West 60', delete parking lot across Pep Ring Rd, and maintain spoils adjacent to project site. Additional scopes for construction power for tunnelling only, gas line (guest house to CUP), and 12kv construction cost (MH 48 - CUP Substation) and Sales Tax.	D. Saenz	\$88,449,770	\$17,232,558	\$105,682,328
CF37		1.09	3	12/01/05	AE Title 2 Design for Monte Carlo Analysis, 12kv Design (MH 48 to CUP Substation), AE Title 3 Support (CLOC design change PO mod 2). Reproduction costs, Turner 30% cost estimate, Tunnel rescue team/equipment, and EBD Shielding. Descope Furnishings (delete CLOC third floor)	D. Saenz	\$105,682,328	\$249,690	\$105,932,018
November 2005 Total Base Cost Estimate								\$248,689,563	
Total Delta Base Cost Change									\$13,970,219
December 2005 Total Base Cost Estimate									\$262,659,782

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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
1			Level 1 DOE (SC1) Milestones	8/29/08	3/31/09	140 days																
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	2/28/06	0 days																
8	DOE	ML1	CD4 - Approve Start of Operations	3/31/09	3/31/09	0 days																
9			Level 2 DOE (SSO) Milestones	8/29/08	11/10/08	51 days																
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	2/28/06	0 days																
14	UN	ML2	Delivery of Undulator 1st Articles to MMF	7/3/06	7/3/06	0 days																
15	CF	ML2	Sector 20/Alcove Beneficial Occupancy	7/21/06	7/21/06	0 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																
28	XE	ML2	2-D Pixel Detector Production Start	1/3/08	1/3/08	0 days																
29	CF	ML2	Beam Transport Hall Beneficial Occupancy	1/3/08	1/3/08	0 days																
30	LN	ML2	Linac ARR (Li20-Li30) Complete	3/7/08	3/7/08	0 days																
31	PM	ML2	Final Safety Analysis Document (FSAD) Approved	3/31/08	3/31/08	0 days																
32	LN	ML2	Start Linac (Li20-Li30) 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																

Milestone Report

Milestone ID/Name	ML3_IJ010 “Wall Region Installation Complete”
Milestone Level	ML3
Baseline Date	12/16/05
New Projected Date	11/15/05
Completed	Yes
Impacts:	Cost: No L1 Schedule: No Other: No
Comments (Reason for Change): Completion Criteria Revision: This milestone is complete when the Injector beamline tubes, stoppers and waveguide that cross through the two shielding walls is installed in the accelerator.	

Milestone ID/Name	MSC_LN000 “CRIT: Rel RFP Linac Cableplant Installation Proc”
Milestone Level	ML3
Baseline Date	11/14/05
New Projected Date	3/1/06
Completed	No
Impacts:	Cost: No L1 Schedule: No Other: No
Comments (Reason for Change): Additional time needed to gather specifications and identify component types from various groups.	

Milestone ID/Name	MSC_UN030 “ CRIT: Release RFP - Fixed Supports”
Milestone Level	ML3
Baseline Date	11/18/05
New Projected Date	5/9/06
Completed	No
Impacts:	Cost: No L1 Schedule: No Other: No
Comments (Reason for Change): When the undulator supports were changed from Granite blocks to steel cradles the fixed supports were also modified. The schedule has adequate float to accommodate this milestone change.	

Milestone Report (continued)

Milestone ID/Name	MS3_CF005, A&E Design Support (excludes S20, MMF, and MCC) Title 2 Complete
Milestone Level	ML3
Baseline Date	1/20/06
New Projected Date	2/17/06
Completed	No
Impacts:	Cost: No L1 Schedule: No Other: No
Comments (Reason for Change): A&E Final Design Submittal to SLAC has been delayed.	

Milestone ID/Name	MS3_XT015 – Flipper Mirror Design Review Complete
Milestone Level	ML3
Baseline Date	7/5/06
New Projected Date	N/A (milestone deleted)
Completed	No
Impacts:	Cost: No L1 Schedule: No Other: No
Comments (Reason for Change): Flipper mirror has been removed from baseline.	

Milestone ID/Name	MS3_XT035 – Spectral Measurement Design Package
Milestone Level	ML3
Baseline Date	6/7/06
New Projected Date	1/2/07
Completed	No
Impacts:	Cost: No L1 Schedule: No Other: No
Comments (Reason for Change) Revised schedule to prioritize instruments with beneficial occupancy and commissioning schedules.	

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 funds 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 – Funds 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 at Completion (EAC) – Forecast of the final cost for a specific WBS#, subproject, or project based on the current ACWP plus a management assessment (ETC) of the cost to complete the remaining scope of work.

Estimate to Complete (ETC) – A realistic appraisal 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. $\% \text{ Complete} = BCWP/BAC$.

Percent Contingency Remaining – The ratio of available contingency dollars ($TPC - EAC$) to remaining work ($EAC - BCWP$).

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 funds 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 funds 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.