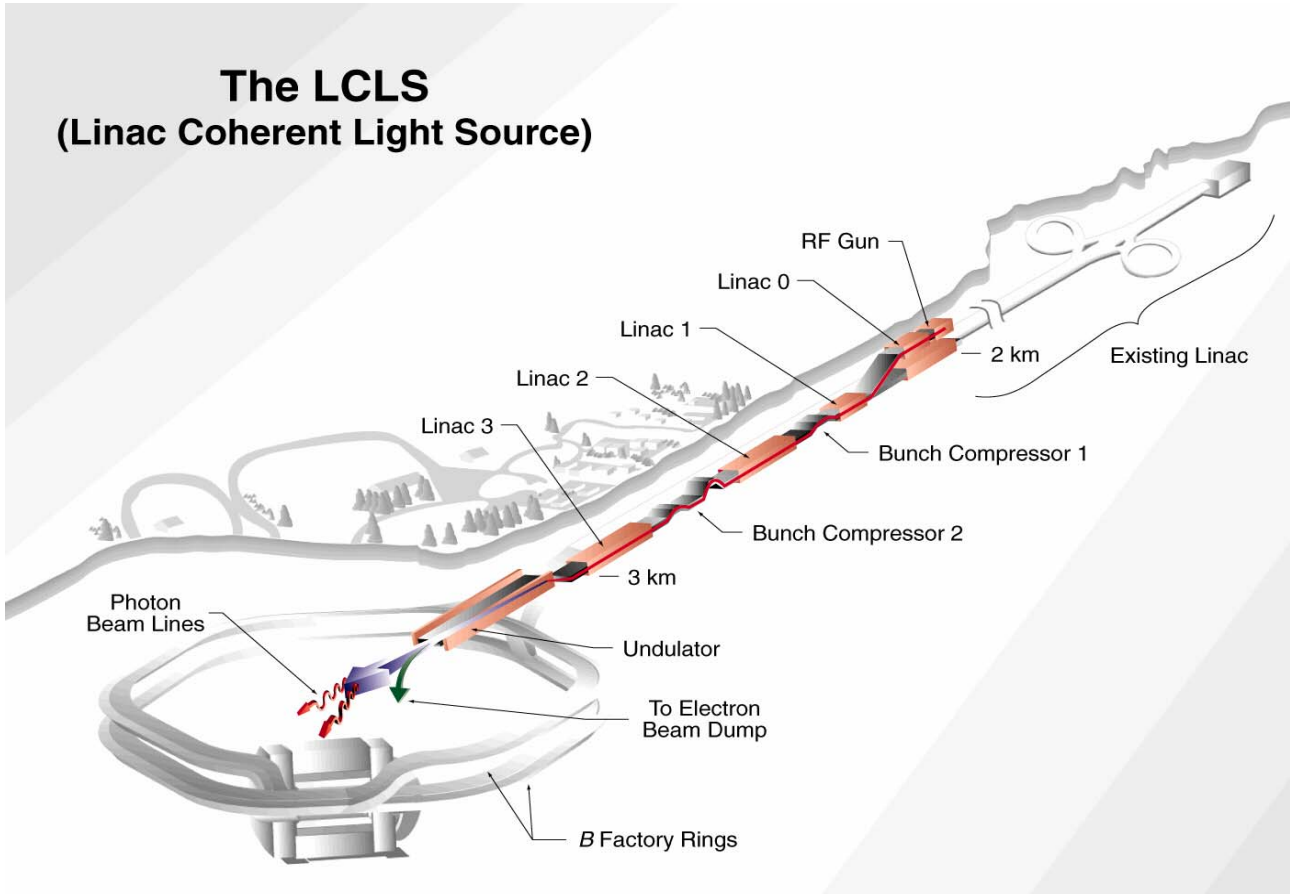


# Linac Coherent Light Source Monthly Report

## March 2004





# CONTENTS

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PROJECT OVERVIEW AND ASSESSMENT	3
TECHNICAL AND PROGRAMMATIC PROGRESS	
WBS 1.1, 2.1    Project Planning, Management & Administration	4
WBS 1.2, 2.2    Injector System	5
WBS 1.3, 2.3    Linac System	6
WBS 1.4, 2.4    Undulator System	7
WBS 1.5, 2.5    X-Ray Transport & Diagnostics System	8
WBS 1.6, 2.6    X-Ray Endstations System	9
WBS 1.9, 2.9    Conventional Facilities	10
COST/SCHEDULE PERFORMANCE REPORT	12
GLOSSARY	15

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## **Project Overview and Assessment**

### **Highlights:**

- The bottoms-up resource loaded schedule for the LCLS Project is now complete. Seven LCLS systems have been integrated into the master LCLS schedule. The Total Project Cost for the LCLS has been fixed at \$315 million Actual-Year (MAY) dollars, with a Total Estimated Cost (TEC) of \$273MAY, and Other Project Cost of \$42MAY, and is consistent with a CD-4 milestone of September 30, 2008.
- For March 2004, LCLS has adopted an internal baseline for the project and is preparing to present its resource-loaded cost and schedule to an External Independent Review (EIR) Committee for validation in preparation of a Critical Decision (CD)-2b (Performance Baseline Approved).
- The first meeting of the LCLS Facilities Advisory Committee (FAC) is scheduled for April 29-30, 2004. The FAC is a standing committee charged to advise the LCLS Project Director on the technical capabilities and potential risks associated with the LCLS. The specific charge of this first meeting is to address the technical scope of the LCLS and to consider the LCLS as an Integrated Facility and its ability to support the presently envisioned experiments.
- The third of three A/E Design Reviews, 'charrettes', was held on March 12-13. This review was the mid-Title I review (~50% complete) of the LCLS Conventional Facilities, which included an independent cost estimate of the LCLS Conventional Facilities. The cost estimate was slightly higher than internal LCLS cost estimates.

### **Assessment and Issues:**

- The A/E schedule for the LCLS Title I design is very compressed due to delay in award of A/E contract, and is the current critical path for advance documentation for the LCLS Performance Baseline review. Every effort is being made to ensure that the full documentation is available prior to the CD-2b review.

## **Technical & Programmatic Progress**

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

#### **Highlights:**

- The bottoms-up resource loaded schedule for the LCLS Project is now complete. Seven LCLS systems have been integrated into the master LCLS schedule and a contingency assessment of the LCLS has been evaluated at the lowest WBS. The Total Project Cost for the LCLS has been fixed at \$315 Million Actual-Year (MAY) dollars, with a Total Estimated Cost (TEC) of \$273MAY, and Other Project Cost of \$42MAY. LCLS has internally adopted the \$315MAY TPC as its current baseline and is preparing to present its resource-loaded cost and schedule to an External Independent Review (EIR) Committee for validation in preparation of a Critical Decision (CD) -2b (Performance Baseline Approved).
- The LCLS project and SLAC's Procurement Department are jointly interviewing candidates for the LCLS Procurement Manager position. This is a key position for the LCLS Project which will help to direct and coordinate the LCLS technical procurements over the construction project. Construction-type procurements will continue to be managed by the SLAC Purchasing Construction Contract Administrators.
- The programming for the LCLS Central Lab Office Complex (CLOC) was conducted on March 29, 2004. This exercise investigated the long-term operational needs of the LCLS as well as space to support LCLS research. The CLOC Building Data Sheets have been submitted to Jacobs Engineering to initiate the Title I effort.

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

- The LCLS Project Office has prepared Technical Addenda (TA) 'C' to the LCLS MOU describing the FY04 work scope for ANL and LLNL. Finalizing the FY04 TA 'C' for both ANL and LLNL have been delayed due to the last minute iterations of the baseline and a lack of financial resources in the LCLS Project Office. Disruptions to available funding to the LCLS partner labs at ANL and LLNL have adverse impacts on the schedule performance of the LCLS, and the LCLS Project Office is seeking to add a Financial Manager to the LCLS Project Office to improve this process immediately. Additionally, since the baseline for the LCLS is now established the time to prepare the detailed TA documentation is anticipated to be much faster in subsequent years.

## WBS 1.2, 2.2 Injector System

### Highlights:

- The cost/schedule plan for the Injector system is complete. All milestones have been identified and a contingency assessment at the lowest WBS has been submitted to the LCLS Project Office.
- A joint internal review of the LCLS Injector and LCLS Linac cost/schedule was held on March 18 to compare common costs and design strategies that might lead to economies of scale. The committee members were Nadine Kurita and Brian Langton, both experienced engineers with major construction project experience from PEP-II and SPEAR3. The half-day review covered the WBS structure, dictionary and cost estimates, and closed with a verbal report. Follow-up items were to evaluate make versus buy decisions across both projects, and to procure higher quantity components in bulk. A common set of specifications for the controls and vacuum system was also recommended.
- The Injector Laser group met with Coherent, the third and final prospective laser company to gather basic information on their design approach. Similar to KMLabs, Coherent proposes a fully diode pumped system with a cryogenically cooled Ti:Sapphire crystal in the final amplifier state. The diode lasers for the pump lasers will be operated in quasi-continuously (QCW) in which the diode bars are pulsed at 120hz in order to increase their peak power for pumping the YAG lasers. This idea is an interesting approach, but the issues of diode lifetime and stability need to be addressed. Comparing the cost and schedule estimates received from Coherent, Continuum and KMLabs, all are similar and within our estimates.

### Assessment and Issues:

- The initial budget estimate for the total project cost for the LCLS Injector System project was larger than the guidance provided by the Project Office, which required a ‘scrubbing’ of the injector costs and scope of work was by ~\$1.4M. The savings was found by removing all three wire scanners and two of the three EO bunch diagnostics and their respective controls. In addition, \$250K was saved in design effort by using the same style quadrupoles in the LCLS Injector as are used at the Gun Test Facility. Magnetic measurements are in progress to verify these quadrupoles designs meet the LCLS requirements.

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

### **Highlights:**

- The activity and cost inputs to the Linac manpower loaded schedule were completed in March. Resource leveling was performed in order to match the projected funding.
- Work was started in organizing the documents supporting the manpower loaded schedule.
- The electron dump vault and dump entrance chicane radiological design was specified as input to the conventional facilities Title I design.
- Linac system beamline schematics were developed. Beamline layouts were revised to agree with the optics and conventional facilities definitions.
- The definition of controls feedback requirements for linac operations was started.

### **Assessment and Issues:**

- Some effort was made in coordinating design efforts for common devices in the linac and injector subsystems (see details on the Injector – Linac review in the Injector report). Further coordination is required in order to optimize the overall systems costs.

## WBS 1.4, 2.4 Undulator System

### **Highlights:**

- A review of the complete undulator system was conducted. In the close out the committee addressed the question, “Is the (undulator system) project progressing adequately?” Their response was, “Yes, with the resources and funding available considerable progress has been made. Progress since the November review is particularly noteworthy.”
- Engineering of a rollaway undulator mechanism have begun and first tests will begin within a month.
- A new idea to support the magnetic poles has been conceived and might result in a sizable simplification and cost savings on the undulators.
- Work progressed on the WBS dictionary. To simplify entry and achieve consistency a web-based input template was used and coupled to the local Oracle database. We will use this as a foundation for further expanding our online documentation. Work on the cost book was also done.
- Negotiations were entered into for a reduction in the M&S overhead rates and fixing of all other overhead rates. The laboratory believes its policy on “Indirect Expense Assessment on Large Construction Projects” is applicable to the ANL LCLS undulator system project.

### **Assessments and Issues:**

- The late signing of the MOU TA ‘C’ in late March 2004 created an available funding shortfall at ANL. The entire LCLS team will need to work harder in the future to ensure that this important document is generated in a timely manner.

## **WBS 1.5, 2.5 X-ray Transport, Optics & Diagnostics System**

### **Highlights:**

- The cost/schedule plan for the X-Ray Transport, Optics & Diagnostics (XTOD) system is complete. All milestones have been identified and a contingency assessment at the lowest WBS has been submitted to the LCLS Project Office.
- The XTOD engineering team developed cable tray requirements for the FEE and hutches. The XTOD team attended the Jacobs charrette on March 12 and 13 and the value engineering meeting on March 30th. The XTOD engineering team began developing new layout drawings for the XTOD instrumentation based on the Jacobs conventional facilities layout.
- A Technical Design Review was held XTOD technical design review on March 26, 2004 at LLNL to evaluate the full scope of the XTOD System. A report on the findings and recommendations from the review committee will be made available in April 2004.
- A description of the XTOD components and deliverables to be incorporated in the LCLS scope were evaluated for safety hazards and documented in the LCLS Preliminary Safety Assessment Document (PSAD).
- Initial discussions with UCLA on formats for the Near-Field spontaneous calculations have begun. Data from these discussions will be incorporated into the XTOD simulations.

### **Assessment and Issues:**

- The XTOD project at LLNL has approximately six weeks of funds remaining. A signed TA 'C' is required to transfer funds from SLAC to LLNL. This document for LLNL has been finalized and is in the signature process, and is estimated to be signed and processed (funds transferred) by mid-May.



## WBS 1.6, 2.6 X-Ray Endstations System

### Highlights:

- The cost/schedule plan for the X-Ray Endstation system is complete. All milestones have been identified and a contingency assessment at the lowest WBS has been submitted to the LCLS Project Office.
- A plan for staffing the X-Ray Endstation throughout the project duration has been nearly finalized. The long-range staffing plan, which includes a transition to operating mode, is under development.
- The Atomic Physics advisory group met in early March. The group indicated that the funding for this area (WBS1.6.7) could benefit ~\$1M. It is hoped that additional funding can eventually be added, but this is not a critical issue at this time.
- A workshop on technical issues for proposed single-molecule imaging experiments was held at SLAC in mid-March. This workshop emphasized the need for detector R&D, and the development of a particular type of new detector for LCLS. Detector development consistent with this need is still included in the scope of the detector effort.

### Assessment and Issues:

- To meet project funding guidelines, \$0.8M of scope was removed from the X-Ray Endstations Detector (WBS 1.6.5). Work on two of the prototype detectors will be limited to design, rather than continuing through construction and testing. Should the project perform well with respect to contingency usage, this scope can be reconsidered later in the project (FY07).
- Schedule must continue to be coordinated with x-ray transport and conventional facilities groups. A specific plan for XTD-XES inter-group meetings needs to be set up.
- The long-range staffing plan needs to continue to be developed, defining the transition to an appropriate staffing arrangement for facility operation.

## **WBS 1.9, 2.9 Conventional Facilities**

### **Highlights:**

- The cost/schedule plan for the LCLS Conventional Facilities is complete. All milestones have been identified and a contingency assessment at the lowest WBS has been submitted to the LCLS Project Office.
- The third of three A/E Design Reviews, 'charrettes', was held on March 12-13. This review was the mid-Title I review (~50% complete) of the LCLS Conventional Facilities. Key SLAC management was present to provide detailed information about the SLAC site (i.e., cable utilities, road allowances, life safety regulations, etc.) such that the A/E firm has adequate information to finalize the Title I effort. The mid-Title I review also included an independent cost estimate of the LCLS Conventional Facilities, which showed modest cost growth from earlier internal cost estimates.
- The LCLS team and Jacobs Engineering held a two-day Value Engineering session on March 30-31, which resulted in a ~\$4 million reduction in the overall cost estimate without a reduction in technical scope. A report identifying those items that were optimized or removed without impact to the LCLS is due in mid-April 2004.
- The new SLAC site for the LCLS Magnetic Measurements Facility has been identified at Building #081. This site will require less infrastructure development than the previous candidate, Building #032.
- Jacobs Engineering provided a construction scheduler on site to review the overall LCLS construction schedule. A written analysis is expected in mid-May but the scheduler provided some early encouragement that the overall assumptions made by the LCLS team were reasonable.

### **Issues and Assessments:**

- Due to the late selection of the site for the LCLS Magnetic Measurements Facility, the completion schedule for Title I design may be delayed to as late as June 15. This is not anticipated to have an adverse impact on the overall schedule. The start of MMF construction remains scheduled for January 2005.

- The LCLS Conventional Facilities group will need to establish and post two job openings: Facilities Project Engineer and a Designer. Both will support the Title II and Title III effort for the LCLS.
- Title I AE design schedule remains very compressed due to delay in award of contract, and remains the critical path for the LCLS External Independent Review.
- The Title II AE effort will be delayed until the start of FY2005 due to lack of funding. Sufficient slack exists in the current schedule to absorb this delay in the Title II effort, however there will be an additional cost impact associated with this delay.



## LCLS Cost and Schedule Performance

LCLS Cost Performance Report - Work Breakdown Structure													31-Mar-04			
WBS	Current Period (\$K)					Cumulative to Date (\$K)							At Completion (\$K)			
	Budgeted Cost		Actual Cost Work Performed	Variance		Budgeted Cost		Actual Cost Work Performed	Variance		Performance Indices		Budget	Latest Revised Estimate	Variance	
	Work Scheduled	Work Performed		Schedule	Cost	Work Scheduled	Work Performed		Schedule	Cost	SPI	CPI				
1.1 Project Management	435	435	435	0	0	2,910	2,910	2,910	0	0	1.00	1.00	19,008			
1.2 Injector	150	150	150	0	0	1,454	1,454	1,454	0	0	1.00	1.00	20,561			
1.3 Linac	114	114	114	0	0	674	674	674	0	0	1.00	1.00	26,617			
1.4 Undulator	193	193	193	0	0	1,419	1,419	1,419	0	0	1.00	1.00	45,221			
1.5 X-ray Transport	84	84	84	0	0	1,180	1,180	1,180	0	0	1.00	1.00	24,038			
1.6 X-ray Endstations	26	26	26	0	0	71	71	71	0	0	1.00	1.00	16,291			
1.9 Conventional Facilities	300	300	300	0	0	612	612	612	0	0	1.00	1.00	62,016			
<b>1 LCLS Baseline Cost</b>	<b>1,302</b>	<b>1,302</b>	<b>1,302</b>	<b>0</b>	<b>0</b>	<b>8,320</b>	<b>8,320</b>	<b>8,320</b>	<b>0</b>	<b>0</b>	<b>1.000</b>	<b>1.000</b>	<b>213,752</b>			
												<b>LCLS Total Estimated Cost</b>		<b>273,000</b>		
												<b>Avail. Contingency</b>		<b>59,248</b>		
												<b>% Contingency / Rem. Work</b>		<b>28.8%</b>		
												<b>% Complete LCLS Base Cost</b>		<b>3.9%</b>		
2.1 Project Management (OPC)	0	0	0	0	0	1,516	1,516	1,516	0	0	1.00	1.00	20,441			
2.2 Injector (OPC)	0	0	0	0	0	0	0	0	0	0			6,529			
2.3 Linac (OPC)	0	0	0	0	0	0	0	0	0	0			1,991			
2.4 Undulator (OPC)	0	0	0	0	0	0	0	0	0	0			5,746			
2.5 X-ray Transport (OPC)	0	0	0	0	0	0	0	0	0	0			4,796			
2.6 X-ray Endstations (OPC)	0	0	0	0	0	0	0	0	0	0			2,497			
<b>2 LCLS Other Project Cost</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>1,516</b>	<b>1,516</b>	<b>1,516</b>	<b>0</b>	<b>0</b>	<b>1.000</b>	<b>1.000</b>	<b>42,000</b>			
<b>LCLS Total Project Cost</b>	<b>1,302</b>	<b>1,302</b>	<b>1,302</b>	<b>0</b>	<b>0</b>	<b>9,836</b>	<b>9,836</b>	<b>9,836</b>	<b>0</b>	<b>0</b>			<b>315,000</b>			
												<b>% Complete LCLS TPC</b>		<b>3.1%</b>		



## **Cost and Schedule Narrative**

The LCLS Project has established a performance baseline for the LCLS project that captures all costs, scheduled activities and resources to complete the LCLS project, as shown in the March 2004 LCLS Cost Performance Report (CPR). The LCLS baseline is consistent with a CD-4 milestone of September 30, 2008 and with a Total Estimated Cost (TEC) of \$273M and a Total Project Cost of \$315M. 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). All LCLS TEC and OPC actual costs for the project are captured in the CPR with the Cost and Schedule Variances set to zero. The LCLS will begin reporting earned value based upon the complete LCLS TPC starting with its month-ending April 2004 report.



## DOE (Level 1 - 2) Milestones

Milestone Level	Milestone Description	Scheduled Date
1	CD-0 Approve Mission Need	June-01 (A)
1	CD-1 Approve Preliminary Baseline Range	October-02 (A)
1	CD-2a Approve Long-Lead Procurement Budget	July-03 (A)
1	CD-2b Approve Performance Baseline	July-04
1	CD-3a Approve Start of Long-Lead Procurement	September-04
1	CD-3b Approve Start of Construction	September-05
1	CD-4 Approve Start of Operations	October-08
2	DOE External Independent Review (EIR) Complete	June-04
2	Sector 20 Alcove Beneficial Occupancy	July-05
2	Preliminary Safety Assessment (PSAD) Document Approved	August-05
2	Start Drive Laser Commissioning	September-05
2	Magnetic Measurement Facility (MMF) Qualified & Ready to Measure Production Undulators	September-05
2	Start Injector Commissioning	May-06
2	Shutdown of Final Focus Test Beam (FFTB) Operations	June-06
2	Research Yard Modifications Beneficial Occupancy	June-06
2	Near Experimental Hall (NEH) Beneficial Occupancy	September-06
2	Delivery of Undulator 1st Article to MMF	October-06
2	Dog-Leg-1 (DL1) Installation Completed	October-06
2	Drive Laser: UV Beam to Cathode	November-06
2	Undulator Facility Beneficial Occupancy	December-06
2	Front-End Enclosure Beneficial Occupancy	April-07
2	Linac Facility Beneficial Occupancy	April-07
2	First Beam on Linac Axis	June-07
2	Undulator Production Units Received	June-07
2	Beam Transport Hall Beneficial Occupancy	July-07
2	X-Ray Transport Beneficial Occupancy	July-07
2	Far Experimental Hall Beneficial Occupancy	August-07
2	Start Bunch Compressor-1 (BC1) Commissioning	September-07
2	Start Bunch Compressor-2 (BC2) Commissioning	January-08
2	Final Safety Analysis Analysis Document (FSAD) Approved	March-08
2	Central Lab Office (CLO) Complex Beneficial Occupancy	March-08
2	Accelerator Readiness Review (ARR)	April-08
2	Undulator System Installation Complete	April-08
2	Start Linac-to-Undulator (LTU) Commissioning	May-08
2	Start Undulator Commissioning	June-08
2	Start X-Ray Transport, Optics and Diagnostics Commissioning	June-08
2	LCLS Start Operations	October-08

## 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.