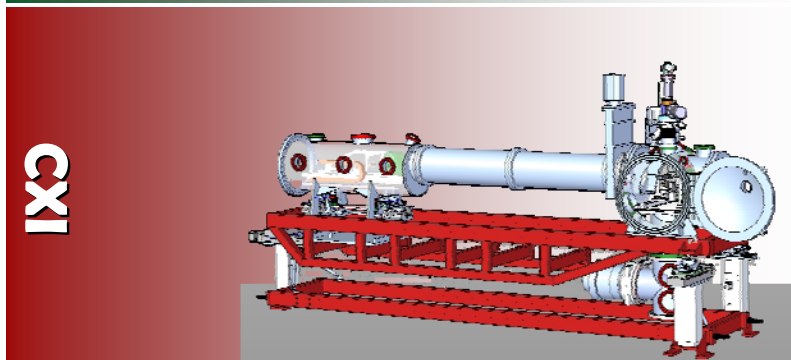
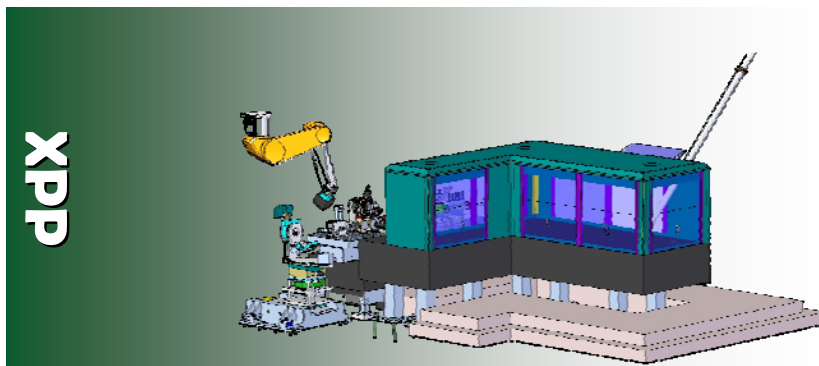


## LCLS Ultrafast Science Instruments Monthly Report March 2009



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## WBS 1.1 and 2.1 Project Management

- Management and Safety

LUSI staff has started draft planning for early funding provided by the American Recovery and Re-investment Act (RA). We expect that LUSI will receive \$33.6M of RA funds this FY. Total Project Cost will still be \$60M. The RA funding would be used to accelerate the LUSI project.

There is an Independent Project Review by the DOE Office of Project Assessment scheduled for April 20-22. This is a status review with emphasis on the LUSI plans to utilize the RA funding.

LUSI staff continues to participate in the FEH Hutch 4 and 5 design reviews and coordination. This is an on-going effort and significant LUSI interaction will continue through construction of the hutches.

A highlight this month was the placement of the first purchase order for the advance procurement of the XPP goniometer on March 31.

The major highlight this month was the DOE FPD approval of fabrication readiness for the “Early Science” configuration of the XPP instrument (a Level 2 Milestone). This happened on March 12.

- Assessment and Issues:

The March 2009 Cost Performance Report is the 6<sup>th</sup> month of reported earned-value on LUSI. MIE cumulative obligations to date (actual costs + open commitments) are \$7,284K. Schedule and cost indices for the MIE are 0.96 and 1.02 respectively.

WBS 1.1 cumulative obligations to date (actual costs + open commitments) are \$2,236K. Schedule and cost indices for WBS 1.1 are 1.00 and 0.98, respectively.

All planned OPC (WBS 2) work has been completed. OPC cumulative actual costs to date are \$4,852K.

## WBS 1.2 X-ray Pump Probe (XPP) Instrument

- Management and Safety

WBS 1.2 cumulative obligations to date (actual costs + open commitments) are \$1,901K. Schedule and cost indices for WBS 1.2 are 0.97 and 1.02, respectively.

An installation manager was assigned for XPP activities (Ben Poling) to coordinate all installation efforts.

A meeting was held with the chairman of the Hazardous Experimental Equipment Committee (HEEC) to discuss the safety system for the robotic detector mover.

- General

Interviews for the XPP 2<sup>nd</sup> Scientist position concluded this month. The LCLS Experimental Facilities Division convened and candidates were ranked. An offer is in preparation for the top candidate.

Preparations for the upcoming DOE status review were started at the end of the month.

- Design

Fabrication and installation drawings for the support tables, strongbacks, earthquake restraints and miscellaneous piece parts were completed and released.

The design effort for the robot mounting base is continuing.

- Detector

The sensors with the new bonding pad layout, needed for the tiled array, are in fabrication. The probe card boards for the automated device tester are being designed.

For DAQ and controls the PCB including the Munich Switcher chip have not yet been delivered by the vendor. Delivery is now expected early April. This is roughly 2 weeks late.

All the software modules for the PCI-Express board to be compatible with the SLAC RCE board have been tested. Combining them to make the test system is progressing.

The analog board for the full detector is complete and PCB layout is underway. The digital board schematic is underway.

A mechanical design change requested by SLAC is being explored. This change would make a small, fixed-size central hole in the detector to allow the direct beam to pass through the entire detector and its housing.

The FEXAMPS (ASIC) redesign is close to completion (one channel layout complete; needs replicating for whole chip). Expected submission schedule is April or May.

- Procurement

The proposal review panel for the XPP sample goniometer convened and the two proposals were evaluated and scored. A vendor was selected and the PO was issued on March 31, 2009.

A single vendor responded to the robotic detector mover call for proposals. The Purchase Order is being prepared and is expected to be issued in early April.

Procurement requisitions were submitted for the X-ray optics support tables, laser optical tables, hutch workbenches and tool storage.

- Component Status

There are currently no manufactured components at this time.

- Assessment and Issues:

None.

## WBS 1.3 Coherent X-ray Imaging (CXI) Instrument

- Management and Safety

WBS 1.3 cumulative obligations to date (actual costs + open commitments) are \$926K. Schedule and cost indices for WBS 1.3 are 0.92 and 1.15, respectively. The relatively large positive cost variance indicates the time saved by being able to take advantage of the work done for the 1 micron mirror system to generate the specification documents for the 0.1 micron mirror system.

All necessary documentation and presentations were prepared ahead of the DOE Status Review scheduled for April 20-22.

- General

The CXI team reviewed the 100% drawings for the Far Experimental Hall.

The CXI scientist participated in AMO beamtime preparation workshop. During the first AMO run, some experiments were approved for coherent imaging. These experiments are precursors to the CXI experiments and lessons learned on AMO will be crucial for CXI. The CXI scientist is a member of the team for some of the approved AMO experiments.

- Design

The design efforts were primarily concentrated on the Reference Laser and the 1 micron Sample Chamber in order to prepare the Preliminary Design Reviews.

Work continued on the CXI layout to optimize the use of space while allowing flexibility. The components in the X-ray Transport Tunnel have been coordinated with the LCLS group building the transport line in order to minimize the effort required to install the CXI devices.

The CXI layout continues to be updated as the Diagnostics and Common Optics designs mature. This month, some clarifications were provided to the LCLS project regarding the CXI plans in the X-ray Tunnel. Also, some CXI devices in Hutch 5 were moved to account for modifications to the slit design. A single quad stand used for the electron beamline was placed in the model to support all optics upstream of the KB mirrors inside Hutch 5.

Differential pump pressure/pumping calculations were completed and a range of throttle internal diameters that will satisfy the requirements for sustaining a windowless HV-to-UHV environment were identified. A ray-tracing is now required to select the pump throttles with the correct internal diameters.

- Detector

The CXI detector, which falls under the LCLS construction project, is progressing as planned. Communication is ongoing between the CXI team and the group working on the mechanical design of the detector. Specifically, both groups are pushing forward to finalize the interface between the detector and the CXI Detector Stage.

An interface drawing between the Cornell detector and the CXI Detector Stage was generated and the Interface Control Document was updated.

- Procurement

The proposals for the two CXI KB systems were received on March 24 2009.

A purchase order was placed with a mechanical design firm for the design and drafting of the CXI Detector Stage.

- Component Status

- **1 micron Sample Chamber**

The CXI 1 micron Sample Chamber Preliminary Design Review was held on Tuesday March 4. The design was presented and validated with mechanical analysis.

The report from the Preliminary Design Review (PDR) of the Sample Chamber was received and overall the comments were very positive. The CXI team will proceed to finalize the design consistent with the review comments. Minor modifications to the vacuum tank were made following the PDR and a drawing was generated for obtaining a quote from vendors. The design of the aperture holders was modified.

- **0.1 micron KB/Sample Chamber System**

A conceptual design for the 0.1 micron System (which includes the 0.1 micron KB mirrors, the 0.1 micron Sample Chamber and the 0.1 micron Precision Stand) was developed. This conceptual design will be the starting point for the vendor who will design and fabricate this system.

- **Precision Stands**

A conceptual design was developed for the 1 micron Instrument Stand.

- **Detector Stage**

A purchase order was placed with a mechanical design firm for the design and drafting of the CXI Detector Stage. This firm will deliver all fabrication drawings and 3D models. The design and drafting company began working on the Detector Stage design in mid-March.

- **Particle Injector**

The design of interface flange of the Particle Injector in the Sample Chamber was modified from a 6 inch to 8 inch flange. The modification allowed a reentrant bellows design to bring the injector nozzle into the interaction region. Previously, the closest point of approach was roughly 6 inches. This reentrant bellows will be included in a custom made manipulator that will position the Particle Injector.

The Particle Injector Engineering Specifications Document was completed and released.

- **KB Mirrors**

The proposals for the two CXI KB systems were received on March 24 2009. Three vendors responded for the mechanical system while proposals received included responses from 4 mirror vendors. The CXI team, as well as external evaluators, are in the process of reviewing the proposals and will meet on April 9 to select the winning bid.

- **Ion Time-Of-Flight**

No update.

- **Reference Laser**

The CXI Reference Laser Preliminary Design Review was held on Tuesday March 3. The design was presented and validated with mechanical analysis.

The report from the Preliminary Design Review of the Reference Laser was received and overall the comments were very positive. The major concern of the committee was laser safety. The concerns will be addressed in the final design. The CXI team will proceed to finalize the design consistent with the review comments.

- Assessment and Issues:

None.



## WBS 1.4 X-ray Correlation Spectroscopy (XCS) Instrument

- Management and Safety

WBS 1.4 cumulative obligations to date (actual costs + open commitments) are \$ 718K. Schedule and cost indices for WBS 1.4 are 0.94 and 0.98, respectively. Split and Delay Memorandum of Understanding (MOU)

No progress this month

- General

The XCS Instrument Team proceeded with the relocation of the Large Offset Monochromator and the scope addition of a post monochromator. Both elements are now integrated in P3 and Cobra financial system.

XCS Instrument Team has started intensive planning to accelerate design activities enabled by the Recovery Act which will provide the balance of LUSI project funds in April 2009. The goal is to achieve CD3 readiness by late Spring/early summer, 2009. The progress on design effort is being closely monitored on a weekly basis.

The XCS instrument has one job opening for a second instrument Scientist position, provided by the Experimental Facility Division of LCLS. Action has been taken to identify qualified candidates.

- Design

The XCS Instrument Team continued to interact with LCLS Conventional Facility staff regarding the design effort for the hutches located in the Far Experimental Hall. The XCS Instrument Team received the “100% design complete drawings” in March 2009. A meeting with various project coordinators took place where all the comments/concerns from the XCS Instrument Team were addressed. The corrected “100% design complete drawings” are expected to be ready for bid by April.

During month of March, the XCS Instrument Team intensified the design efforts related to the main components contained in its WBS 1.4 (i.e. the diffractometer, the support tables for the optical elements and the large angle detector mover) as well as the Large Offset Monochromator. The Large Offset Monochromator, located in the Diagnostics and Common Optics WBS 1.5, is now completely managed by the XCS Instrument Team.

The XCS Instrument Team intends to conduct an Advanced Procurement Review (April 23<sup>rd</sup>) for the major components of the XCS instrument including the Diffractometer, the Large Angle Detector Mover, and the Large Offset Monochromator. This requires providing all the proper documentation (e.g., updated PRD's, ESD's, Statement of Work, Evaluation Guide Bid Criteria, and Procurement Specifications) to the independent technical review committee.

- Detector

The recommended revision of the pixel size requirement for the XCS Detector (under development at BNL) will be presented at the upcoming LDAC Review Committee (May 2009). The XCS mask design of the pixel is close to completion. Lithography tests are needed in order to see if BNL can further shrink the design rules for the pixel.

The XCS readout ASIC design is progressing well.

In the context of possible acceleration of the LUSI ‘early science’ capabilities (as enabled by the RA funds), the XCS Instrument Scientist started to evaluate (in consultation with the team leaders) the impact of the delivery of the XCS detector on a possible XCS early science milestone. The XCS Instrument Team will explore various options to accommodate a possible XCS early science milestone. Several scenarios are being discussed with N. van Bakel, LUSI Detector Physicist, and Brookhaven National Laboratory.

- Procurement

There are no ongoing procurements for the XCS instrument.

- Component Status

There is no specific status to report on any XCS component.

- Assessment and Issues:

None.

## WBS 1.5 Diagnostics and Common Optics (DCO)

- Management and Safety

WBS 1.5 cumulative obligations to date (actual costs + open commitments) are \$1,045K. Schedule and cost indices for WBS 1.5 are 0.92 and 0.97, respectively.

- General

This month's activities were concentrated on preparation for the Monitors and the Attenuator/Pulse picker final design reviews. These reviews are scheduled for the middle of April. The Pulse picker testing continues.

- Design

- **Monitors:**

The staff continued detailing models and drawings on the alignment stages, chamber, target and diode assemblies for the IPM, PIM and PM based on the recommendations from the PDR.

A detailed static and dynamic analysis effort was started on the chamber monitor assemblies, with the six degree of freedom alignment stand, in preparation for the FDR. Report on the results will be presented at the FDR.

- **X-Ray Lenses:**

In house effort is now focusing on detailed design of the x-ray lenses, now that the design of the Monitors, Chamber and Stand has matured. Models have been updated for the instruments to use in the beam line.

- **Slits:**

No major design changes. Stand and assembly drawings will be needed after the vendor is selected.

- **Attenuator/Pulse Picker:**

Pulse Picker test program continues to be the focus. However it is requiring more time and resources than planned. The performance is in question and there might need to be some compromise on desired working parameters (aperture, opening/closing times, repetition rate, and continuous operation time). This effort is being coordinate closely with the controls group. As a consequence, the controls group has been working on the control's interface software for this device earlier than they had planned.

We explored the option of bonding silicon nitride to the pulse picker blade. This almost eliminates the bending associated with brazing. Some testing needs to be done to evaluate the bond strength and vacuum compatibility.

Updated the six degree of freedom stand model and created drawings. Started work on detailing the chamber assembly in preparation for the FDR and DOE status review.

We were able to run repeatability tests on an attenuator actuator. The test results are very encouraging. Result details will be presented at the FDR.

- **Harmonic Rejection Mirrors:**

Engineering efforts on the HRM system continue. Designer activity expected to start at the end of February or early March is scheduled to start on April 6. This continues to impact the schedule on the HRMs.

- Procurement

- Slides for IPM prototype are due early May.
- Received additional bearings and another Aluminum body from AZSOL
- Received one pulse picker SS body
- Received one attenuator linear actuator
- RFP 2611 was sent to ADC and JJ X-ray. Responses are due April 29.
- Ordered and received one double slit coupler

- Component Status

- Attenuator/Pulse picker final design review scheduled for April 16.
- IPM, PIM, and PM final design review is scheduled for April 17.

- Assessment and Issues:

Pulse Picker performance is in question. We are working with the vendor, scientific staff and controls group to find solutions. We feel the effort is necessary since other experiments before LUSI will be using this same design.

## WBS 1.6 Controls and Data Acquisition (CDA)

- Management and Safety

WBS 1.6 cumulative obligations to date (actual costs + open commitments) are \$458K. Schedule and cost indices for WBS 1.6 are 1.01 and 1.07, respectively.

- Design

The XPP Controls and Data Systems Preliminary Design Review was conducted on February 7. Material and the review report are posted at <http://confluence.slac.stanford.edu/display/PCDS/XPP+Preliminary+Design+Review> . Included with this review were the Diagnostics and Common Optics Controls required for XPP.

We also began preparing for the XCS and CXI Controls Preliminary Design Reviews to be held in May. This also involves iterating and reviewing the ESD and ICD documents with the respective instrument scientists and updating the controls item lists of items to be ordered and configured.

In regards to offline data management, work continued on defining the data-format translator to convert online data formats to HDF5 data formats.

We are continuing the discussions with LUSI scientists regarding data processing. A drafted ESD was prepared for the common portion of the data processing system for the three instruments.

- Detector

Noise measurements on XPP detector readout integrated circuit are continuing. We are also interacting with BNL to bring up their test setup which also has one of the circuits. We continue to work in parallel to modify schematics and lay-outs of integrated circuit. This will take another month.

- Procurement

We are starting to prepare order lists and requisitions in anticipation of receiving approval for XPP controls procurements.

- Status

We are fabricating and loading printed circuit boards for the intensity-position and position monitors for diagnostics and beginning functionality testing. The VHDL has been prepared for the on-board FPGA.

- Assessment and Issues:

None.

## LUSI Cost and Schedule Performance- March 2009

SLAC Linear Accelerator Center Menlo Park, California	LUSI Cost/Schedule Status Report (March 2009)							Date:	4/27/2009	
Performance Data										
WBS[2]	Cumulative to Date					At Completion			Indices	
	Budgeted Cost		Actual Cost Work Performed	Variance		Budgeted	Latest Revised Estimate	Variance	SPI	CPI
	Work Scheduled	Work Performed		Schedule	Cost					
1.1 PROJECT MANAGEMENT	2,198,852	2,198,852	2,236,294	0	-37,442	5,355,823	5,380,453	-24,630	1.00	0.98
1.2 X-RAY PUMP PROBE (XPP)	1,997,352	1,938,851	1,900,817	-58,501	38,034	5,784,211	5,400,944	383,267	0.97	1.02
1.3 COHERENT X-RAY IMAGING (CXI)	1,166,955	1,067,834	925,671	-99,121	142,163	10,071,585	9,615,670	455,915	0.92	1.15
1.4 X-RAY CORRELATION SPECTROSCOPY (XCS)	749,956	704,405	717,545	-45,551	-13,140	7,227,371	7,138,674	88,697	0.94	0.98
1.5 DIAGNOSTICS & COMMON OPTICS	1,099,369	1,012,930	1,045,338	-86,439	-32,408	6,816,222	6,541,780	274,442	0.92	0.97
1.6 CONTROLS AND DATA ACQUISITION	482,757	488,725	458,119	5,968	30,606	7,380,671	7,396,023	-15,352	1.01	1.07
Gen. and Admin.	0	0	0	0	0	0	0	0		
Undist. Budget						0	0	0		
Sub Total	7,695,241	7,411,597	7,283,784	-283,644	127,813	42,635,883	41,473,544	1,162,339		
Management Resrv. (MIE)						12,464,117	13,626,456	-1,162,339		
Total MIE	7,695,241	7,411,597	7,283,784	-283,644	127,813	55,100,000	55,100,000	0	0.96	1.02
2.0 Other Project Costs (OPC)	4,851,861	4,851,861	4,851,861	0	0	4,851,861	4,851,861	0		
Management Resrv. (OPC)						48,139	48,139	0		
Total OPC	4,851,861	4,851,861	4,851,861	0	0	4,900,000	4,900,000	0		
Sub Total (MIE+OPC)	12,547,102	12,263,458	12,135,645	-283,644	127,813	47,487,744	46,325,405	1,162,339		
Total Management Reserve						12,512,256	13,674,595	-1,162,339		
Total Project Cost (TPC)	12,547,102	12,263,458	12,135,645	-283,644	127,813	60,000,000	60,000,000	0		

<b>March 2009 Performance</b>	<b>AYK\$</b>
Total Project Cost (TPC)	\$60,000
Planned % Complete (MIE)	18.6%
Actual % Complete (MIE)	17.9%
Total Estimated Cost (MIE)	\$42,636
Cost and Commitments to Date (MIE)	\$7,284
Estimate at Complete (MIE)	\$41,474
Work Remaining (MIE)	\$34,062
MIE Remaining Management Reserve (Based on EAC)	\$13,626
% Contingency on Uncommitted Work Remaining (MIE)	40.0%

The LUSI cost and schedule are consistent with the approved baseline with a Total Estimated Cost (TEC) of \$42.7M and a Total Project Cost (TPC) of \$60M. The CD-4 milestone is August 2012. All costs are in actual-year dollars and out-year costs are escalated.

The March 2009 Cost Performance Report is the sixth month of reported earned-value on LUSI. Schedule and cost indices are 0.96 and 1.02, respectively.

The projected Estimate at Complete (EAC) provides the most current estimate of the TEC final cost. Contingency on EAC is considered adequate for this stage of the project. LUSI is evaluating possible scope changes to the approved baseline. Scope changes will be presented to the LUSI Technical Configuration Control Committee (TCCC) and the LCLS Change Control Board for approval prior to being added to the baseline.

## LEVEL 1 & 2 MILESTONES

MILESTONE DESCRIPTION	Baseline	Projected	Variance		CY 2008	CY 2009	CY 2010	CY 2011	CY 2012
<b>LUSI - Project Management</b>									
<b>Level 1 DOE HQ Milestones</b>									
CD-0 MISSION NEED APPROVAL	08/10/05A	08/10/05A	0 days						
APPROVED: CD-1 COST RANGE	09/27/07A	09/27/07A	0 days	▼					
APPROVED: CD-2 PERFORMANCE BASELINE	10/22/08A	10/22/08A	0 days		▼				
APPROVED: CD-3 FABRICATION START	4/12/10	10/12/09	120 days				▼		
APPROVED: CD-4 START OF OPERATIONS	8/31/12	8/31/12	0 days						▼
<b>Level 2 - DOE Local Milestones</b>									
COMPLETE: CD-2 REQUIREMENTS - XPP / CXI / XCS	08/18/08A	08/18/08A	0 days		▼				
APPROVED: ADVANCE PROCUREMENT-XPP&CXI	01/30/09	12/19/08A	20 days (A)			▼			
APPROVED: FAB START - XPP	05/07/09	3/12/2009A	37 days (A)			▼			
APPROVED: ADVANCE PROCUREMENT-XCS&DCO	08/03/09	06/03/09	40 days			▼			
COMPLETE: CD-3 REQUIREMENTS	01/15/10	09/24/09	72 days			▼			
COMPLETE: XPP PHASE 1 INSTL-START EARLY SCIENCE	10/20/10	10/20/10	0 days				▼		
COMPLETE: CXI PHASE 1 INSTL-START EARLY SCIENCE	08/05/11	08/05/11	0 days					▼	
APPROVED: FINAL INSTRUMENT READINESS REVIEW	07/06/12	07/06/12	0 days						▼

BASELINE - ▼  
 PROJECTED (Early) - ▼  
 PROJECTED (Late) - ▼  
 ACTUAL - ▼



## GLOSSARY

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

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

**Budget at Completion (BAC)** – The total budgeted cost at completion for a given WBS, 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 WBS#, subproject, or project physically accomplished.

**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 to subcontractors where work has been authorized but not yet expensed.

**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** – Forecast of the final cost for a specific WBS#, subproject, or project based on the current ACWP plus a management assessment 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.

**Major Item of Equipment (MIE)** - Capital equipment or automated information system components with a total estimated purchase value of \$2,000,000 or more, including costs that are capitalized and not related to construction.

**Other Project Cost (OPC)** – LUSI “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 remaining contingency dollars to remaining line item (TEC) work calculated as follows: the numerator is equal to the contingency available (after consideration of the EAC) less 5% of outstanding technical phase-funded awards and less 10% of outstanding conventional facilities phase-funded awards. The denominator is the EAC less ACWP less outstanding phase-funded awards.

**Percent Planned** – The ratio of the current plan to the Budget at Completion.  $\% \text{ Planned} = BCWS/BAC$ .

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

**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 MIE budget authorized for the LUSI project for the construction phase of the project. TEC includes contingency but does not include OPC.

**Total Project Cost (TPC)** – The total budget authorized for the LUSI project, including MIE 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 LUSI work plan which is used to track all resources, schedules, and cost.