

# **Closeout Report**

on the

*Department of Energy  
Review Committee Report*

on the

Technical, Cost, Schedule, and  
Management Review

of the

# **LINAC COHERENT LIGHT SOURCE (LCLS) PROJECT**

October 24-26, 2006

United States Government  
Department of Energy

---

# memorandum

DATE: September 6, 2006

REPLY TO

ATTN OF: SC-22

SUBJECT: DOE Review of the Linac Coherent Light Source (LCLS) Project

TO: Daniel R. Lehman, Director, Office of Project Assessment, SC-1.3

I would like to request that you organize and lead an Office of Science (SC) semi-annual status review of the Linac Coherent Light Source (LCLS) project at the Stanford Linear Accelerator Center (SLAC) during October 24-26, 2006. The purpose of this review is to evaluate progress in all aspects of the project: technical, conventional facilities, cost, schedule, management, and environment, safety and health (ES&H). In addition, the Committee should provide a thorough assessment of existing SLAC laboratory and office space, and judge whether this space would be adequate to support the operation of the LCLS facility and other reasonably foreseeable activities at SLAC beyond FY2008 without a LCLS Central Laboratory and Office Complex (CLOC).

During the past several months, substantial progress has been made in fabricating the LCLS technical hardware, and overall, the project was about 29 percent complete as of June 30, 2006. Although limited civil construction began in March 2006, the project has just recently begun to award fixed-price subcontracts (via its Construction Management contractor – Turner Construction) for the bulk of the civil construction work, including tunneling. Cost growth and contingency usage in this area have been an ongoing cause for concern, and the final group of civil construction subcontract bids due in early October 2006 will enable the project to determine the full extent of the cost impact. These bids are mainly associated with construction of the CLOC.

In carrying out its charge, the Committee should respond to the following questions:

1. Are the project's cost, schedule, and technical baselines consistent with those in the FY2007 LCLS Construction Project Data Sheet and the current DOE-approved LCLS Project Execution Plan (i.e., Total Project Cost of \$379 million and CD-4 in March 2009) and is there adequate progress to meet the baseline objectives? Is the information in the DOE Project Assessment Reporting System consistent with physical progress?
2. Are the designs of the technical systems sufficiently mature to support the hardware procurements planned in FY2007? Will the procurement plans and equipment installation and commissioning plans support the project schedule?
3. Is there a credible scenario that allows the LCLS operations to be fully functional without a LCLS Central Laboratory Office Complex?

4. Is there adequate contingency (cost and schedule) to address the risks inherent in the remaining work and is it being properly managed? Is the contingency supported by and consistent with an appropriate project-wide risk analysis?
5. Is the project being managed (e.g., properly organized, adequately staffed) as needed to proceed with construction? Is there adequate support from SLAC in all necessary areas (e.g., procurement, human resources)?
6. Are ES&H aspects being properly addressed given the project's current stage of development?
7. Has the project responded appropriately to recommendations from prior DOE/SC reviews?

Jeff Hoy, the LCLS Program Manager, and Tom Brown, the LCLS Ultra-fast Science Instruments Program Manager, will serve as the Basic Energy Sciences point of contacts for this review. I would appreciate receiving your committee's report within 60 days of the review's conclusion.

Patricia M. Dehmer  
Associate Director of Science  
for the Office of Basic Energy Sciences

cc:

N. Sanchez, SSO  
H. Lee, SSO  
J. Dorfan, SLAC  
K. Hodgson, SLAC  
J. Galayda, SLAC  
M. Reichanadter, SLAC  
S. Tkaczyk, SC-1.3  
P. Montano, SC-22.3  
J. Hoy, SC-22.3  
T. Brown, SC-22.3  
L. Cerrone, SC-22.3  
M. Martin, SC-22  
E. Rohlfing, SC-22.1  
P. Debenham, SC-25.1

**Department of Energy Review of the  
Linac Coherent Light Source (LCLS) Project  
October 24-26, 2006**

**Daniel R. Lehman, DOE/SC, Chairperson**

**SC1**

**Accelerator Physics**

\* Sam Krinsky, BNL  
Glenn Decker, ANL

**SC2**

**Injector/Linac**

\* George Neil, TJNAF  
Richard Sheffield, LANL

**SC3**

**Undulator**

\* Kem Robinson, LBNL  
Erik Johnson, BNL  
Will Oren, TJNAF

**SC4**

**Photon Beam  
Handling Systems**

\* Dennis Mills, ANL  
Chi-Chang Kao, BNL

**SC5**

**Control Systems**

\* Dave Gurd, ORNL  
Michael Thout, Consultant

**SC6**

**Conventional Facilities**

\* Dixon Bogert, Fermilab  
Jerry Hands, SNL  
Valerie Roberts, LLNL

**SC7**

**Cost and Schedule**

\* Suzanne Herron, ORNL/SNS  
Steve Tkaczyk, DOE/SC  
Bob Simmons, PPPL

**SC8**

**Project Management  
Procurement/Pre-Ops**

\* Les Price, ORO  
Jeff Atherton, LLNL/NIF  
Ed Temple, Fermilab

**SC9**

**ES&H**

\* Don Gregory, ORNL

**SC10**

**Lab Space**

\* Jim Krupnick, LBNL  
John DiNicola, BNL  
Randy Ortgiesen, FNAL

**Observers**

Jeff Hoy, DOE/SC  
Pedro Montano, DOE/SC  
Tom Brown, DOE/SC  
Hanley Lee, DOE/SSO  
Nancy Sanchez, DOE/SSO

**LEGEND**

SC Subcommittee  
\* Chairperson  
[ ] Part-time Subcom. Member

**Count: 25 (excluding observers)**

DATE: 10-5-2006

**Department of Energy Review of the  
Linac Coherent Light Source (LCLS) Project**

**REPORT OUTLINE/WRITING ASSIGNMENTS**

Executive Summary .....	Tkaczyk
1. Introduction .....	Hoy
2. Technical Systems Evaluations	
2.1 Accelerator Physics (Charge Question #2) .....	Krinsky/Subcommittee 1
2.1.1 Findings	
2.1.2 Comments	
2.1.3 Recommendations	
2.2 Injector/Linac (CQ# 1,2,7) .....	Neil/Subcommittee 2
2.3 Undulator (CQ# 1,2,7) .....	Robinson/Subcommittee 3
2.4 Photon Beam Handling Systems (CQ# 1,2,7) .....	Mills/Subcommittee 4
2.5 Control Systems (CQ# 1,2,7) .....	Gurd/Subcommittee 5
3. Conventional Facilities (CQ# 1,2,7) .....	Bogert/Subcommittee 6
4. Cost and Schedule (CQ# 1,2,4,7) .....	Herron/Subcommittee 7
5. Project Management (CQ# 1-5,7) .....	Price/Subcommittee 8
6. Environment, Safety and Health (CQ# 6,7) .....	Gregory/Subcommittee 9
7. Lab Space (CQ#3) .....	Krupnick/Subcommittee 10

Appendices

- A. Charge Memorandum
- B. Review Participants
- C. Review Agenda
- D. Cost Table
- E. Schedule Chart
- F. Management Table
- G. Action Items

## 2.1 Accelerator Physics

Samuel Krinsky  
Glenn Decker

## 2.1.1 Findings

- The Commissioning and Installation plan is being carefully developed to characterize hardware and accomplish physics goals.
- Safety is well integrated into the accelerator design work.
- There is good cooperation between LCLS and the SLAC operation group.
- The new LCLS/SLAC controls group is fully engaged in addressing a large backlog of required tasks.
- There is very little float left in the commissioning schedule.

## 2.1.2 Comments

- LCLS must more carefully utilize the system integration and shutdown planning process to avoid bottlenecks leading to further delay.
- LCLS must carefully schedule and prioritize the implementation of diagnostics and controls critical to the commissioning effort.
- The use of MatLab scripts for simple physics application development is a good approach. However, we are concerned that the short-term strategy for implementing high-level applications may delay development of the necessary long term capabilities.



## 2.1.3 Recommendations

- Implement start-to-end modeling from the gun through the FEL in a manner useful in the control room to interpret diagnostics data and to optimize total system performance. Start evaluation of this task by initiating collaboration between physics and controls groups by January 31, 2007.

# SC2 Linac/Injector

■ **Team: George Neil  
Richard Sheffield**

## Findings

- **No major concerns**
- **Comfortable with cost contingency; it reflects risks as presently understood. There has been some movement of TEC costs to OPC. The OPC scope should be reviewed to make sure this is appropriate.**
- **While injector has experienced overruns in many systems the combined Injector/Linac cost is generally under control because of component duplication**
- **Major progress since last review: delivery of drive laser, fabrication of gun with hot tests underway. This substantially reduces cost and schedule risk**
- **Risk mitigation plan is under control. A spare gun is in assembly.**

## Findings

- The gun load lock is not in present budget or contingency allocation. A decision was made to not pursue this. Such a system would reduce schedule risk for operation of the whole system.
- A 2 month slip occurred in first beam delivery due to fabrication schedule conflicts and communication issues. This is disappointing, depleted the commissioning schedule float, and puts pressure on the injector commissioning schedule.
- Maintenance of the injector/linac schedule will require access to the linac tunnel on a weekly to biweekly basis for the next year. This is in conflict with the linac operation schedule for PEP-II but is essential to keep the commissioning off the critical path.

## Findings

- **ISM being addressed at all stages of the planning. It was obvious that safety is being taken seriously by staff and they are constantly attentive to their working environment. Kudos!**
- **The primary technical risk remains the drive laser performance. It is presently sufficiently operational to proceed with injector commissioning but does not yet meet the requirements to satisfy beam brightness needs for full performance lasing.**
- **Laser phase lock needs testing and remains a risk item. Achieving design laser operation is key to alleviating performance concerns.**
- **Another technical risk is the absolute calibration of the cavity field probes. If the fields are lower than required, additional conditioning may be required during commissioning phase.**
- **A more realistic changeover time between SLAC and LCLS operational mode has been adopted since last review.**

## Comments

- Commissioning plans are key to keeping on track. This is good work in progress at excellent detail!
- Providing lots of commissioning time for the injector/linac will pay off in reduced schedule for commissioning and early performance of the FEL. Need to make sure group gets priority to do this.
- The schedule slip in the injector points out a problem that the project schedule does not provide sufficient detail to be useful. Detailed interface schedules are now being worked but are not yet complete. It is important to determine schedule conflicts and slips early enough to deal with them.

## Comments

- **There has been good progress in working the diagnostic/controls issues that were evident last time. Still tight but they believe that it is off the critical path.**
- **Procedures and documentation on track with required readiness reviews and approvals for commissioning**
- **1 week loss for vacuum qualification of gun. Is this really needed since the photoinjector delivers better vacuum than the SLAC requirements?**
- **Is the straightness of accelerator sections known well enough to estimate the impact on beam emittance?**

## Recommendations

- **Establish method and priority to ensure sufficient access to the linac will be provided to allow commissioning to proceed per the required schedule (March 2007)**
- **Establish detailed integration plans to identify schedule impacts early enough to ameliorate potential issues (May 2007)**



## 2.3 LCLS Undulator

DOE Review 24-26 October 2006

Erik Johnson, Will Oren,  
Kem Robinson

## 2.3.1 Findings

- Undulator Systems demonstrates strong organization and solid progress
  - 7 undulator magnetic structures have been delivered; 9 more have been accepted at the suppliers
  - Magnetic Measurement Facility (MMF) is nearing complete operation
  - Single Undulator Test (SUT) has been used for extensive design verification tests for supports, movers, integrated system
  - Cavity RF Beam Position Monitors (RF-BPM) have demonstrated solid performance and stability
  - Installation, integration and workflow on equipment delivered to SLAC is progressing
  
- The Undulator Team has identified the following issues
  - Vacuum chamber behind schedule and has not demonstrated baseline performance in full length prototype
  - Quadrupole pole material hysteresis
    - Will likely preclude the use of electromagnetic dipole correction
    - Compensate with physical movement of quadrupoles for correction

## 2.3.1 Findings (2)

- Undulator Team has been responsive to previous recommendations
  1. SUT test suite ✓
  2. Accelerated RF-BPM ✓
  3. Roles and Responsibilities ✓
  4. SLAC work flow sequence ✓
  5. Completion plan for remaining specification/interface/technical baseline requirements documentation (In process)
  6. Kinematic mount system for undulator magnetic structure ✓
  
- Specific *integrating* and *development* activities have gone significantly over budget
  - SUT (-\$198k Cost Variance [CPI 0.58])
  - MMF (-\$983k Cost Variance [CPI 0.70])
  - Vacuum chamber  
(-\$167k Cost Variance [CPI 0.60] so far on \$249k BCWS  
WBS 1.4.4.2 is \$1.9M BAC...)

## 2.3.1 Findings (3)

- Vacuum Chamber is largest single area of concern
  - Not yet demonstrated full length prototype with required performance
  - Remaining development schedule **success oriented**
  - LCLS has begun consideration of alternative designs
    - Al extrusion
    - Al clamshell
    - Elliptical drawn tube
  - Costs for the alternative design development are not captured in the ETC
    - Alternative concept selection review imminent
  - Decision on how to proceed must be made by beginning February 2007
  - The alternative chamber is viewed by the project as principally a schedule risk mitigation strategy

## 2.3.1 Findings (4)

- Elements of the Review Charge
  - Cost/Schedule baselines? (TEC WBS 1.4)
    - BCWP \$17.8M, ACWP \$19.3M, BAC \$40.6M
    - SPI 0.95, CPI 0.93
    - ETC \$22.7M, Contingency \$4.3M

*Some concerns related to integration but with vigilance should meet baseline objectives*
  - Designs Mature?
    - Well advanced in most areas
    - Vacuum chamber development an identified issue
  - Responded to recommendations from previous reviews?
    - Responsive as previously noted

## 2.3.2 Comments

- Single Undulator Test (SUT) work has been ***most commendable***
  - The team knowingly exceeded estimates and continued work on the SUT for the overall benefit of the project
  - Previously primarily a design tool now becoming an integration and installation tool
  
- Alignment Diagnostic System (ADS) seems to be progressing steadily and as planned
  
- The Assemblies, Sub-assemblies, Kit (ASK) system looks ***REALLY COOL . . .***
  - Hopefully it will grow into a very useful tool
  
- Both ANL and SLAC teams appear to be working cohesively
  - Integration activities are still only beginning

## 2.3.2 Comments (2)

### ■ Undulator Vacuum Chamber

- Mitigation strategy includes development of alternative chamber design
  - Relaxation of chamber specifications is under consideration for alternative design
  - Approach to consider: Aluminum extrusion half shells, polished and friction stir welded
  - Evaluate options quickly and narrow focus of alternative approach
- Must exercise care in handling of vacuum chamber issues to avoid disruption of the main effort

### ■ Integration Issues

- The risk registry does not appear to influence or drive project decision making. It is not a tactical or strategic tool for Undulator Systems
- Transfers of scope between ANL and SLAC is of concern since it may create unrecognized gaps in the handoffs
- The overrun on the MMF, which was principally labor, is disconcerting with respect to future *integrating* activities

## 2.3.3 Recommendations

1. Within two weeks of the selection of a backup vacuum chamber concept, explicitly add the cost of the backup vacuum chamber design and development work to the LCLS project plan.
2. Advance the development of the backup vacuum chamber design sufficiently that it could become a viable production option if the baseline chamber design is not successful by 31-Jan-2007.
3. Advance the development of the baseline vacuum chamber as much as possible and convene an independent set of third-party experts to recommend the selection of a design (baseline or back-up) to move into production before 15-Feb-2007.
4. To broaden the exposure and involvement of SLAC personnel in the undulator installation planning, consider installing or duplicating the Long-term Test Setup (LTS) at SLAC. A plan for this transition should be prepared before the next DOE review ( Date TBD)



## **2. 4 Photon Beam Handling Systems**

- 1.5 X-ray Transport, Optics, and Diagnostics (XTOD)
- 1.6 X-ray End Stations (XES)

Chi-Chang Kao (BNL) and Dennis Mills (ANL)

## 2.4.1 Findings (1)

### General:

- Progress, in general, has been good in Photon Systems.

### Front End Enclosure:

- The Front End Enclosure designs have been frozen (except the orientation of the high energy off-set mirror), allowing engineering and design work to progress in an effective manner.

### Diagnostics:

- Most of the diagnostics are state-of-the-art instruments and will require extensive commissioning and testing, but the team is confident that they will work.

### X-Ray Endstation Systems:

- The (XES) group has taken on the responsibility to coordinate all safety-related aspects for the user experiments and user environment.
- AMO endstation design is sound.

## 2.4.1 Findings (2)

### Controls:

- Although the reviewers were assured by the Controls Department Leader that the needs of the Photon Systems would be met, the task seems to be vulnerable to delay due to other demands on the controls team.

### Off-set Mirrors:

- Low energy mirror system design is on schedule.
- Orientation of the high energy mirrors (vertical vs horizontal) is yet to be determined, but still on the planned schedule.
- The detailed design of mirror holder, chamber and support is very important to minimize mirror pointing error and that design depends on the orientation decision.
- Feedback may be necessary to ensure mirror figure.
- Figure error achievable (*at the state-of-the art, not beyond*), but delivery time by vendor is optimistic.
- Cost and contingency (45%) is reasonable

## 2.4.2 Comments (1)

### Diagnostics:

- The team has done a very good job and is confident that their instruments will work. However since these instruments are unique, and most likely require considerable commissioning to get the bugs out, it may be prudent to think about backup plan should the performance of some not meet expectations.
- If not already happening, the accelerator commissioning team should be brought into the discussions on the diagnostic tools to share information on what is being developed by the photon systems staff.

### Interfaces/Integration of Photon Systems and LUSI:

- Continue the very important interactions between the Photon Systems and LUSI management (co-location of staff, common engineers/designers, shared participation in reviews, etc.) to ensure a seamless integration of the two teams.

## 2.4.2 Comments (2)

### General:

- The working relationship between LLNL and SLAC has improved.
- In some cases installation/alignment schedules seemed optimistic. (not spend much time looking at this during this review - next time)
- There is the ongoing concern by reviewers that changes to other elements of the project will continue to erode the scope of the XTOD/XES and to cause schedule delay.
- There are a lot of reviews/meetings between Lehman reviews. It would seem to be useful to:
  - (1) clearly identify the scope of these reviews to reduce overlap/duplication and
  - (2) provide Lehman Committee members with copies of review reports.

# Response to Charge Questions

1. *Is there adequate progress to meet the baseline objectives?*

- The reviewers believe that progress is sufficient in the Photon Systems area to meet the project's baseline objectives.

2. *Are the designs of the technical systems sufficiently mature to support the hardware procurements planned in FY2007?*

- XTOD - important to make decision on high energy mirror design soon so that mirror substrate procurement can get out this FY.
- XES - nearly all major procurements will occur in FY08 and beyond.

7. *Has the project responded appropriately to recommendations from prior DOE/SC reviews?*

- In general, YES
  - Physics requirements for FEE components are now complete
  - Simulations of mirror performance have been made
  - TTF/FLASH and SSRL being used to test some concepts/ideas in diagnostics area

### 2.4.3 Recommendations

#### Off-set Mirrors:

- Finalize the orientation (vertical vs horizontal deflection) of the high energy mirrors by 1/1/07 so that the procurement packages for both the low energy and high energy mirror systems can be released no later than May 2007 (early start date on the current schedule).

# Section 2.5 – Controls

Dave Gurd and Mike Thuot



# Findings and Comments

## ■ Controls Reorganization

- SLAC controls has been reorganized into one department which includes members of the former LCLS controls team.
- This integrated Controls Department includes ~80 people, of which ~60 people are assigned, at least part time, to LCLS, for a total of ~45 FTEs. This is consistent with requirements of the LCLS resource-loaded schedule.
- Hamid Shoaee now leads both the SLAC Controls Department, and the LCLS Controls Project Team, giving him control over most of the resources necessary to meet LCLS control system goals. His deputy will have primary responsibility for other systems, such as PEP, SPEAR and ILC.
- The LCLS project controls team has been organized into small project teams to address both short- and long-term objectives. Personnel requirements have been identified and hiring is currently underway to fill these needs.
- This reorganization largely addresses the concern about resource availability expressed at the last review.

## Findings and Comments (2)

### ■ Cost and Schedule

- In the recent ETC, the Controls TPC increased by ~\$3M, made up of a large number of “puts and takes.” The new estimate appears credible so long as there are no unexpected scope increases.
- It now appears likely that the control system will be ready to support injector commissioning next March. This turnaround was achieved by redeploying some resources, by making temporary performance compromises in the MPS and timing systems and by delaying the XAL implementation of high-level applications.
- Still, several subsystems, including Timing, MPS and BPMs, require aggressive schedules to meet injector commissioning dates.
- The focus on this early milestone does little to alleviate concerns about the very large amount of work remaining to achieve later milestones, notably, but not exclusively, for X-Ray controls and diagnostics. The new organization and available resources should position the controls team to meet these demanding schedule requirements, which would otherwise have been impossible.

## Findings and Comments (3)

### ■ PPS

- The long-favored PLC-based PPS system has been approved by the SLAC "Citizen's Committee." The approval delay had been a schedule concern, as well as a draw on resources to maintain a back-up approach. A certification procedure is being prepared.
- The schedule and reliability benefits of this approach are already evident in the materials presented.

### ■ Timing

- The new global timing (event) system, still under development, is required in order to obtain beam synchronous data. There is no back-up plan for the March commissioning schedule. Unexpected technical difficulties could result in a schedule delay.
- A new project manager for this critical system was appointed only last week. Schedule-critical activities should be identified immediately, and personnel assigned as required.

# Findings, Comments and a Recommendation

## ■ High-Level Applications

- Successful demonstration of the “SLC-aware IOC” makes available to LCLS the rich suite of SLAC accelerator physics applications, as well as a model for most of the machine. For devices using non VME-based IOCs, a manual has been prepared to assist in the development of MATLAB applications by the Physics Group.
- *However*, models and applications do not yet exist for important aspects of LCLS that were not already a part of SLAC – including space charge effects, the photo injector and X-Ray handling and diagnostic systems. Many of these applications will be required for successful commissioning.

## ■ Recommendation

- Starting January 31, 2007, identify and specify the high-level applications required for those systems for which applications do not yet exist, and mobilize by April 1, 2007 the forces necessary to begin the design and implementation of those applications.

## **3.0 LCLS Conventional Facilities DOE Review 10/24-26/06**

Dixon Bogert  
Jerry Hands  
Valerie Roberts

## Finding and/or Comment

1. A Groundbreaking ceremony has been held and the Turner construction is underway. **GREAT!!!**

Four “bid group” packages covering essentially all the remaining civil construction were prepared by Turner Construction and bids were received. The bids exceeded the estimates by significant factors, continuing the project experience of bids at or above 30% over engineering estimates. Considerable effort was expended to achieve some cost savings on the “beam track” bids (Bid Groups 1 and 2.) Bid Group 1 (including the rock tunneling) was awarded and construction began September 11, 2006. Bid Group 2 has been accepted but not yet awarded. Bid Groups 3 and 4 included the work for the Central Laboratory and Office Complex (CLOC). If accepted, the cost of this work would have jeopardized the completion of the rest of the work. A decision to eliminate the CLOC from the project scope was made, and the implementation of this decision is underway.

## Finding and/or Comment

The CF project management team has been augmented over the past six months in preparation for the start of construction. LCLS Project Management has added an experienced Associate Project Director for Civil Construction. Further staffing actions are anticipated, specifically for University Technical Representatives.

LCLS has engaged Jacobs Facilities Inc to perform the Title III A/E services for the construction phase of the work. Jacobs has provided an on-site full-time liaison to expedite handling of construction documentation such as RFIs, submittals and change orders.

## Recommendation

None.

## Finding and/or Comment

2. Turner's project manager alleged that the work is behind schedule. It is already difficult to evaluate Turner's progress because of the absence of a current resource loaded schedule.

## Recommendation

Obtain from Turner a current resource loaded project schedule. Discuss the schedule with DOE next Thursday November 2<sup>nd</sup>.



## Finding and/or Comment

3 Project float, as well as cost and schedule contingency, are difficult to evaluate.

## Recommendation

Reevaluate cost and schedule contingency after accepting the Turner resource loaded schedule and completing contract renegotiations.

## Finding and/or Comment

4. The “Group 2” bid packages must be awarded before November 15<sup>th</sup> when the fixed price guarantees expire. There is a problem obtaining DOE approval because of the increase of the Turner work under contract to over \$75M. This must not result in the loss of the current fixed pricing.

## Recommendation

Obtain DOE approval for **the award of the Group 2 contract before the November 15<sup>th</sup> price expirations.**

## Finding and/or Comment

- 5 The LCLS Project Management has decided to eliminate the Central Laboratory Office Complex to maintain the Project TPC below the authorized amount. The technical details of this decision have not yet been fully worked out, including secondary impacts.

## Recommendation

Define what the elimination of the CLOC includes, and fix any secondary impacts.

## Finding and/or Comment

6. The Turner contract does not include the elimination of the CLOC and many accepted Value Engineering (VE) changes. This makes it difficult to calculate cost and schedule contingency with accuracy, and it is difficult to calculate the percent of work complete.

## Recommendation

Finalize and complete renegotiation of the Turner contract. If possible include more powerful incentive methods. Complete all VE changes, including the CLOC deletion, as quickly as possible, no later than the end of November.

## Finding and/or Comment

7. The draft Turner schedule is constructed with weather delays added at the end of the work. Unless dynamically modified, this schedule will always show the work as late. It will be difficult to separate such “artificial” delays from any actual delay requiring consideration and possible mitigation.

## Recommendation

Adjust the Turner schedule to eliminate any false indicators of delay.

## Finding and/or Comment

8. It is necessary to understand the obligations profile required by the Turner schedule in order to maintain the schedule in the face of any uncertainties such as possible additional continuing resolutions.

## Recommendation

Prepare an obligations profile for the Turner contract work. This might be necessary to work around the effects of possible ongoing continuing resolutions in FY07.

## Finding and/or Comment

9. Some technical groups are still revising their designs. In some instances these designs will impact CF requirements for work areas already under contract and under construction. The ongoing LUSI planning also may have an impact on some of the existing civil design.

## Recommendation

Complete the technical designs and consider LUSI impacts as quickly as possible and evaluate these designs for additional impact on CF work under contract.

# **4.0 COST and SCHEDULE**

Suzanne Herron

Steve Tkaczyk

Bob Simmons



# Findings

- TPC: \$379M                      TEC: \$315M                      OPC: \$64M
- % complete of TPC:    31.3% (thru 8/2006)
- Completion: Baseline -    Mar 2009  
                    Early finish - Aug 2008
- Contingency: 24.7% based on the remaining TEC and pending baseline changes, plus \$7.4M (15.5%) mgt reserves on remaining OPC
- Project's contingency assessment indicated 19.7% contingency needed on remaining TEC work
- Performances Indices (as of 8/2006)  
                                    CPI: 0.96                      SPI: 0.97

# Findings (continued)

- A bottoms-up estimate to complete was performed, and incorporated in the baseline, in July/August 2006, along with a risk based contingency analysis. An ETC will be performed annually and the contingency analysis will be performed every 6 months.
- The EAC is a calculated value based on variances and pending baseline changes; it does not include an evaluation of the project risk registry
- The Project Risk Registry contains 48 remaining risks; the probability of occurrence and the impacts are not kept current
- Through FY06, the Project received \$149 million in funding. \$106M has been requested for FY07. The funding profile is consistent with the baseline schedule. It appears that the Continuing Resolution will not impact the project, unless the CR continues into 2007.
- The project's PARS data is consistent with the project earned value reporting and is current through Aug 2006

# Findings (continued)

- “Early occupancy” dates have been proposed by the project to allow installation to begin prior to beneficial occupancy; this has not been negotiated with Turner
- The project schedule controlling path starts from the Undulator Hall early occupancy to installing the Undulators to first light to commissioning. This controlling path has not changed since Feb 2006, but the schedule float has decreased from ~10 months to ~ 8 months.
- The re-negotiated resource loaded civil construction schedule has not been incorporated in the project baselines; construction started 9/11/2006, yet craft construction progress performance has not been reported

# Comments

- The contingency funds appear adequate to complete the remaining project scope, but will need continual management attention
- Maintaining a current EAC is extremely important to ensure sufficient contingency funds remain
- With the current plans, FY07 activities could become BA constrained. It will be essential to continue focus on BA management, phase fund procurements, and be prepared to re-plan as needed

# Comments (continued)

- The project identified several “false” cost variances in their earned value reporting that need to be corrected with cost transfers within the TPC through the SLAC accounting system
- The committee believes the project early finish schedule is optimistic, and in two areas, extremely optimistic: civil construction and undulators; However, the early finish schedule provides ~8 months of total float and CD-4 should be achievable
- The re-negotiated resource loaded construction schedule from Turner needs to be integrated into the project cost and schedule baselines to understand impacts and so that accurate progress reporting can be performed

# Recommendations

- Update the EAC monthly based on a management assessment of variances, key risks, and upcoming changes (especially those in CF)
- The SLAC financial office needs to support the project with timely financial/accounting actions to ensure accurate reporting of earned value data (by the next SC review)
- Integrate the re-negotiated Turner resource loaded construction schedule into project plans, and determine the impact to the project cost estimate, schedule, contingency assessment and FY07 obligation plan (by Nov 30, 2006)

# 5.0 Management

Les Price

Ed Temple

Jeff Atherton

# 5.1 Findings

- The LCLS Project team has made good progress on a large number of work fronts
  - ***The Project Director and his Deputy are providing diligent, focused leadership of the Project***
- In addition, SLAC has significantly strengthened the LCLS management team
  - ***Hired Associate Project Director for Civil Construction***
  - ***Established APD position for Engineering***
  - ***Senior Procurement management expertise brought on board***



## 5.1 Findings (cont.)

- SLAC management has established LCLS as the top priority of the Lab
  - ***Commitment of Laboratory Director's Office in staffing***
  - ***Organization of SLAC Controls and Linac commissioning***
  - ***Project Management Oversight (PMOG) and Facilities Advisory Committee (FAC) actively engaged***
  - ***Ombudsman to resolve issues between LCLS and other groups at SLAC***

## 5.1 Findings (cont.)

- Significantly strengthened the System Integration (SI) aspects of the Project
  - ***Initiated detailed planning on installation and commissioning***
- Established explicit SI management team to:
  - ***Assist in overall integration of activities***
  - ***Address management and technical interfaces***
  - ***Ensure good communication to ensure responsible owners***

# 5.1 Findings (cont.)

- Turner Civil Construction contract is on the critical path of the Project, and is in turn being impacted by DOE review and approval of the Bid Group 2 release
- LCLS has removed the Central Laboratory Office Complex (CLOC) from its baseline EVMS scope
  - Civil Construction bids have come in ~50% over estimate, including the CLOC
  - Explicit response by SLAC management to help ensure that the LCLS has adequate budget to deliver on its scientific commitments for the Project
  - SLAC has formed a Space Working Group to help identify suitable alternatives

## 5.2 Comments

- The LCLS Project's cost, schedule, and technical baseline is generally consistent with the FY2007 Project Data Sheet and the Project Execution Plan
  - *Recently completed update of Estimate to Complete (ETC)*
  - *Contingency estimated at ~20% and seems to be sufficient*
  - *Internal schedule is aggressive, with slips of ~2 months in initial phases of Civil and Commissioning*
  - *Float relative to CD-4 reported to be ~8 months appears to be adequate*
- The project is being managed adequately to proceed with construction. Support from SLAC overall is good, but some attention may be needed in some areas, e.g. financial.*

## 5.2 Comments (cont)

- DOE needs to take prompt action to resolve the Turner subcontract approval issue
- DOE and LCLS management should consider options for preserving essential CLOC functionality in the baseline that are also prudent with respect to budget and contingency and consistent with the Project Data Sheet
- The management relationship with Turner has been somewhat strained but seems to be improving. Because of the importance of the civil construction to the LCLS Project, this situation should continue to receive close SLAC/LCLS management attention

## 5.2 Comments (cont.)

- Working with Citizen Committees to get their input into pre-construction work activities seems to be working. LCLS management should work to ensure that there is adequate time for this review as part of its overall work planning.
- As LCLS moves closer to installation and commissioning, other SLAC groups will have an increasing impact on the Project. It is important that SLAC management continue to assure that appropriate support and resources are provided to keep the Project on cost and schedule while not confusing accountability.
- The System Integration management team has been in place for approximately 1 month. SLAC/LCLS management should ensure that appropriate staffing of this group is maintained as the installation and commissioning efforts ramp up.

## 5.2 Comments (cont.)

- More attention is needed to assure that appropriate interfaces between the LUSI Project and LCLS are established.
- SLAC management should assure that priorities for the APD for Civil Construction are aligned with the most urgent needs of the project.
- The Project Execution Plan (PEP) needs to be updated (same comment as last Lehman Review).

## 5.3 Recommendations

- Resolve the CLOC issue to develop a plan that maintains the required functionality by 11/30/06
- Resolve the Turner contract approval issue ASAP, i.e. 10/26/06
- Update the Integrated Project Schedule (IPS) to reflect actual status, particularly with respect to CF, by 12/15/06.



# 6. Environment, Safety, & Health

Donald C. Gregory

# Findings

- The previous review had one recommendation – implementation of an ES&H tracking system. LCLS has implemented use of a Corrective Action Tracking System in response to this recommendation.
- The LCLS project is preparing for its first Accelerator Readiness Review, covering the Injector. A Safety Analysis Document, an Accelerator Safety Envelope, and a Shielding Policy are available, as specifically required by DOE Order for the ARR.
- ES&H oversight of the prime contractor (TurnerCCo) is provided primarily through project safety professionals and University Technical Representatives (UTRs).

# Findings

- Integrated Safety Management is evidenced by project and contractor walk-downs, safety briefings, surveillances, and feedback pathways.
- LCLS has adopted existing SLAC rad protection procedures, practices, and review processes (including ALARA programs) during planning and design phases, and plans to utilize existing rad protection personnel and programs for the operations phase.
- “Citizen Committees” review projects for specific specialized hazards (electrical, radiation, etc) on behalf of the Chair of the Safety Oversight Committee (SOC).

# Comments

- The Corrective Action Tracking System is evolving into a more useful tool for tracking noncompliances. At the same time, Preliminary Notification Reports are being used to follow and correct low-level unsatisfactory situations.
- The project will not be ready to begin commissioning operations for a couple of months after the Readiness Review. The project is preparing a list of remaining activities to be completed before commissioning for presentation to the ARR.
- The SAD for LCLS should be incorporated into the SLAC SAD before the next commissioning phase.
- ES&H oversight on the part of project personnel and Turner is effective and continues to improve.

# Comments

- Citizen Committees operate under charters which do not always specify their authority or authorizing entity. These details are specified in a safety procedure but should be incorporated into the Charters.
- Safety surveillances, walk-downs, and briefings conducted by LCLS and Turner safety professionals are documented and tracked as appropriate. The safety atmosphere of the project is positive and continues to improve.
- ES&H aspects are being properly addressed given the project's current stage of development.
- The project has responded appropriately to previous recommendations.

# Recommendations

- None

# 7.0 Lab Space

Jim Krupnick, LBNL

John DiNicola, BNL

Randy Ortgiesen, FNAL

**Charge: Is there a credible scenario that allows the LCLS operations to be fully functional without a LCLS CLOC?**

## **Findings**

**CLOC provided office space (primarily) for:**

**170 LCLS Operations & Users**

**65 PULSE (+ 4 labs)**

**25 SSRL**

**20 Photon Sciences Directorate**



# 7.0 Lab Space

## Findings

**Scenario presented involves 2 Phases:**

**#1: Relocate existing functions, then refurbish existing space in CEH and Bldg. 28 for LCLS operations and users - \$4.0M**

**to be funded “within anticipated program funding”**

**#2: Relocate existing functions, then renovate existing space to provide labs and office for PULSE - \$13.7M. (Not required for LCLS operations)**

**requires additional funding “from some source”**

## 7.0 Lab Space

### Comments

- 1. The formation of the Space Working Group is a positive step to identify space to meet current and future needs.**
- 2. Space identified for LCLS operations and users (Phase I) will allow LCLS operations to be fully functional. (Credible scope and estimate)**
- 3. SLAC management has committed to funding Phase 1, using FY07 & FY08 funding.**
- 4. Funding for PULSE offices and labs (not required for LCLS operations) is yet to be identified.**

## 7.0 Lab Space

### **Recommendations**

- 1. Generate a detailed plan for accomplishing Ph. 1 scope (space required for LCLS operations), including detailed scope, engineering estimate and schedule, and present to the Federal Project Director by the end of December 2006 to determine appropriate funding source's.**