

General Closeout Comments

- The project is appears to be doing very well
- Organization has “baroque” appearance, lines of authority aren’t clear
- Risk registry is in good shape and it is good to see that it is being updated monthly
 - Incorporate additional items that are still in trade off
 - Floor stability vs. BBA timeframe
 - Operational and commissioning approach
 - These trades present a schedule and/or cost risk
 - Incorporate items identified in this and previous FAC meetings
- Communication seems good, but still may still have a few “holes”
- Matrix MOUs are good
- The project is in the phase of maximum gradient (“boost phase”)
 - Timeliness of decisions may become critical
 - The decision making process is not transparent and may need to accelerate.
 - Often “position papers” (risk assessments) will assist in reaching a decision
 - Inefficiencies from rapid staff increases can stall progress and burn funds
 - Near critical paths can quickly become critical paths

General Comments (cont.)

- Need to put contingency into planning packages in the EVMS resource loaded schedule
- Include fiscal year funding profiles in EVMS schedules
- Global trades need to be aggressively pursued
 - Floor stability / alignment / various forms of BBA and other optimization, etc.
 - Conventional facilities / X-ray end station hutch location
 - Planning and execution of commissioning and early operations.
- Strong team, great enthusiasm with momentum
- Gotten through EIR and CD-2b today!
- FAC needs access to LCLS internal website before meeting to be more effective
- See you in 6 months

Electron systems

- MANAGEMENT

- The committee once again recognizes the excellent accelerator team supporting LCLS
- The appointment of Paul Emma to lead the Accelerator Team is applauded

Electron systems

- PHOTOINJECTOR

- Laser

- Selection of a vendor is a significant step
 - Laser pulse shaping remains an R&D item
 - Activities at LLNL and ANL in pulse shaping and THG are applauded
 - Coordination of these activities should avoid conflicting demands on the systems
 - Purchase of a second laser has been postponed until after experience has been gained with the first system
 - A decision on a new GTF may influence this timescale
 - Details of operational stability remain to be determined
 - Strengthening of the laser team remains an important goal

Electron systems

- PHOTOINJECTOR
 - RF gun
 - In-house fabrication will begin soon, based on the completed physics design
 - Expect first gun April 2006
 - Gun wakefield effects should be investigated
 - Prompt completion of a second gun is encouraged
 - H- cleaning of the cathode surface shows promise in improving QE

Electron systems

- PHOTOINJECTOR
 - Beam dynamics
 - The 3-D ellipsoidal distribution is a novel approach for photoinjectors with promising capabilities
 - Continued study of practical aspects is encouraged

Electron systems

- GTF
 - Committee understands management decision to phase-out activities at GTF
 - Results from GTF have provided useful guidance in improving the gun design for LCLS, and have given confidence in gun performance parameters
 - A permanent facility for gun test and R&D is strongly encouraged

Electron systems

- LINAC
 - Physics studies of low charge operations indicate a regime with several advantages
 - Reduced wakefields in linac and in undulator vacuum chamber
 - More uniform current and FEL output distribution
 - No impact on engineering issues
 - The committee applauds this initiative that increases confidence in performance and flexibility in choice of operational parameters

Electron systems

- COLLIMATORS
 - Comprehensive studies of dark current, beam loss, and collimation are providing a significantly deeper understanding of the radiation levels along the linac and the undulator
 - Proposed collimation systems appear to be suitable in providing protection to the undulators
 - Nice work
- Radiation produced by scattering from OTR foils in the undulator is a concern
 - Develop plan to minimize risk of damage to undulators from OTR screen use

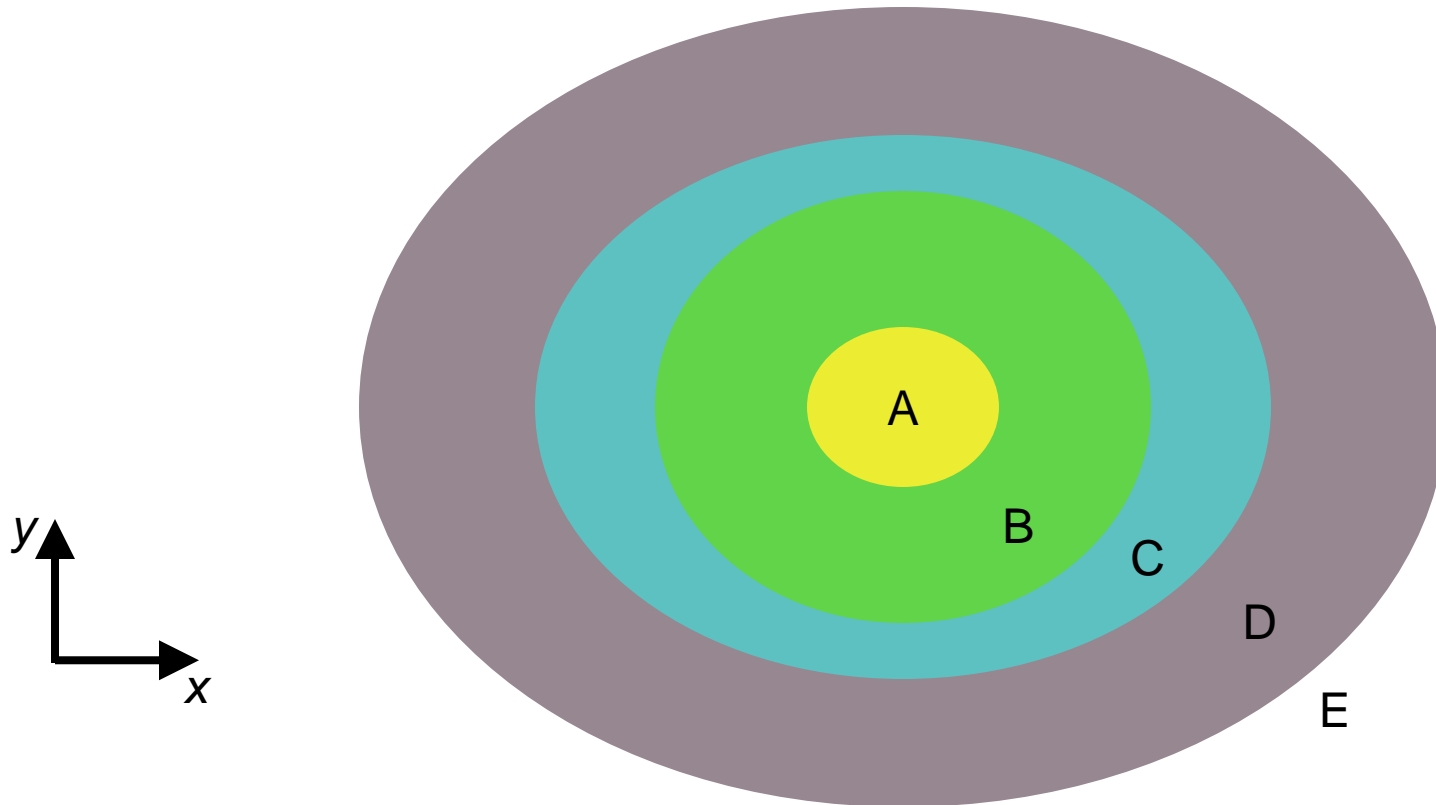
Electron systems

- FEL PHYSICS
 - Major progress in understanding and alleviating the effects of the ac resistive wall impedance
 - Resistive wall wakefields have been thoroughly analyzed
 - Theory, computation, measurement
 - Impact on design
 - Desirability of low-charge option
 - Undulator tapering an additional tool in this regime
 - Design of undulator vacuum chamber
 - Rectangular Al coated st. st.

Electron systems

- UNDULATOR
 - Comprehensive wakefield budget developed
 - Alignment
 - The system is well instrumented and the depth of studies bodes well for achieving the required tolerances
 - The procedure to align the undulator is feasible and offers additional redundancy - is the upstream beam monitor needed?
 - Concern remains about the ground settlement and stability of the undulator hall floor
 - Need to quantify the allowable motion given the range of instrumentation available
 - Provide specifications on ground motion based on realistic day-to-day alignment and periodic beam-based alignment
 - Study the extent to which the systems can accommodate movements beyond the survey tolerances

Zones of *Grabbability*



- A. No detectable change in FEL performance
- B. Optimization (“grabbed”) by controls or operators
- C. BBA-*lite* (no tunnel access required)
- D. Full BBA
- E. Resurvey

Undulator Stuff

General

Undulator system is more and more rounded up.

The design consisting of cradles, movers, cradle base, support of quads; diagnostics; vacuum chambers and translatable undulator segments meets requirements and gives the degrees of freedom needed for operation of the LCLS:

The undulator system can be aligned with accuracy of 70 micron vertical and 180 micron horizontal over the whole length of the system. Tapering of K is possible as well.

The AC resistive wall wake field has been elegantly solved by reducing the bunch charge to 0.2nC.

Remarks:

Diagnostics: There is a high degree of redundancy in diagnostics proposed in the undulator segments:

Ruhland provides two stretched wires plus HLS. Additional BPMs (alternatively wire flags or cavity monitors fiducialized to the undulator axis are proposed) for segment alignment using BBA.

Alignment of undulator segments presented by Nuhn (train links etc.) can be done with the equipment presented by Ruhland. Additional diagnostics, requiring a large effort has to be well justified.

Vacuum chamber

The vacuum aperture needs not be changed. Thanks to the 0.2nC working point this is not needed anymore.

The beam will see Al, which gives the best performance for AC resistive wall wake fields. The shape flat 'semi-elliptical' further reduces wakefields.

The design is not worked out yet.

Floor, ground support

Ground motion and BBA capabilities need to be adjusted to each other. See remarks in the other working groups.

BBA will play an important role in the LCLS alignment process. The time needed for one BBA cycle is essential.

A balance has to be found between floor settlement rate and BBA cycles intervals

Concern

The radiation doses by beam intercepting OTR screens seems

The radiation doses caused by beam intercepting OTR screens are considerable even if the diamond foils can be made considerably thinner than 100 micron. It can lead to severe degradation of the undulator life time. This has to be observed carefully. Other sources of radiation, which count on top were not taken into account have to be considered: Miss-steered electron beam during commissioning, bremsstrahlung on residual gas etc.

Has to be observed carefully lifetime estimation should be made.

**X-Ray Subgroup Summary
Facilities Advisory Committee
April 8, 2005**

**Roger Falcone
Josef Feldhaus
Paul Fuoss
Tom Rabedeau
Pete Siddons
Thomas Tschentscher**

Major Subsystems

- **Front End**
- **Near Experimental Hall**
 - hutch layout
 - diagnostics
 - experiments
- **Far Experimental Hall**
 - Hutch layout
 - Beam distribution system
 - Conventional infrastructure
- **Experimental Support**
 - Detectors
 - Computer infrastructure

Discussions

- **XTOD Layout and Diagnostic Systems - Rich Bionta**
 - Work on the project restarted after the continuing resolution ended. Roughly 22 staff are now working on the project (6.8 FTE)
 - Plans for damage testing at VUVFEL
 - Preliminary design sketch for a bolometer array
- **X-Ray Low-Pass Mirror System - John Arthur**
 - A SiC mirror pair has been proposed to offset the beam by 25 mm to avoid high energy background radiation
 - No provision for straight-through beam but could be added
 - Fuoss proposes a different scheme which uses fewer total mirrors
- **Revised Endstation Systems Scope - S. Moeller**
 - Focus on the AMO experiment design
- **The PIXEL Project - John Arthur**
 - Phase 1: Finished 2009
 - Single Particle Scattering and Time Dependent Scattering
 - Phase 2: Finished 2012
 - XPCS and Magnetic Imaging
 - HED not included
 - Fund Pixel detector

Discussions (Continued)

- **Far Hall Hutch Layout and Design - John Arthur**
 - Three competing designs
 - Marginal support infrastructure near the experimental area
- **X-Ray Detector Efforts - John Arthur**
 - LCLS Detector Advisory Committee met in February
 - LDAC recommended
 - BNL 2D Detector (MOU being negotiated) (PIXEL funded)
 - Cornell Pixel Detector (MOU) (LCLS funded)
 - LBNL Streak Camera (being initiated) (LCLS funded)

Concerns

- **Per shot beam characterization.**
 - Each pulse needs to be characterized nondestructively if single shot experiments are being performed.
 - May cause large computational and/or network demands
- **Diagnostics to detect low-gain FEL beam**
- **Mirror optics**
 - Coherence preservation
 - **Angular stability**
 - Degradation from high energy photons and particles
 - Degradation from high peak fluxes
 - Overall layout
- **Layout of optics and experiments in FEE and NEH**
 - Is space being used efficiently
 - Experiment in NEHH#1 pressures FEE
 - Poor coordination between affected parties
- **Design of FEH hutch**
 - Straight through beam capability
- **Concepts rapidly changing**

Prior Recommendations

- **Efforts of the x-ray group should focus on problems which are unique to LCLS**
 - Shot by shot non-destructive diagnostics
 - Data flow issues
 - Synchronization and merging of data streams
 - Development (and avoidance) of feedback systems appropriate for low rep rate operation
 - Coherence preservation and measurement
- **DAC should oversee detector development for both LCLS and MIE programs and ensure coordination between both efforts.**
- **Identification and communication of critical issues to the MIE teams should be a priority**

Recommendations

- **Efforts of the x-ray group should focus on problems which are unique to LCLS**
- **Hutch layout**
 - All hutch and assembly areas should have same height
 - Favor “Stephenson” staggered hutch arrangement
 - Ensure that on-axis hutch has provision for “white” beam
- **Optics (mirror) design**
 - Preserve option for straight through beam operation
 - Deal with personnel protection issues now, don’t assume they will become easier later
 - Investigate long-term damage to mirror and impact on coherence preservation
 - Include stability and alignment issues in design
 - Generate holistic design that preserves future flexibility
- **DESIGN a revised beam transport, optics and hutch layout**
 - publicize it
 - get buy-in from experimental groups
 - make decision

Endorsements

- **Staffing progress**
- **Good plan for detectors**
- **PIXEL/Science User communications are improving**
- **With PIXEL and XES, staff efforts are being aligned with the necessary work**
- **Enthusiastic grappling with really hard problems**

April 8th, 2005
Conventional Facilities Subcommittee
H. Carter, A. Chargin, G. Kugler, K. Schuh

AREAS REQUIRING PRIORITY

Undulator Tunnel

It appears that the Conventional Facilities team (CF) by itself has no workable solution to meet the undulator tunnel physics criteria. We expect that part of the solution may be in an active alignment system for the machine. There is no calculation prediction of the foundation system deflection for near term or long term creep.

Construction Management

A construction safety program specific to the LCLS project is needed and an approach similar to successful programs implemented on other DOE construction projects is recommended.

The award of a CM/GC contract is time critical because the Project needs the experienced resources of a CM for design reviews, management of construction safety programs, site management, procurement support, and for project continuity.

Jacobs Design Management

The turnover in staff at Jacobs since Title I design places the Title II design at increased risk. With start of Title II design scheduled this week, the Project needs to assure that Jacobs is assigning their best qualified personnel to the Title II design.

Interaction with DOE/EPA

The CF design has changed from that which is the basis for the original LCLS Finding Of No Significant Impact (FONSI). While no problems are anticipated with the evolved design, the project office should obtain DOE/EPA agreement that the initial FONSI is still in effect.

Along the same lines, at the last review we were informed that the design basis is UBC1997. We comment again that this should be checked with DOE. By the completion of the project this design basis will be over 10 years old. If nothing else, the earthquake design requirements seem to change every several years and DOE may require retroactive application of the newest design criteria. It would be prudent to seek DOE agreement

with the design basis code because DOE does require retrofit to existing laboratory buildings.

GENERAL COMMENTS

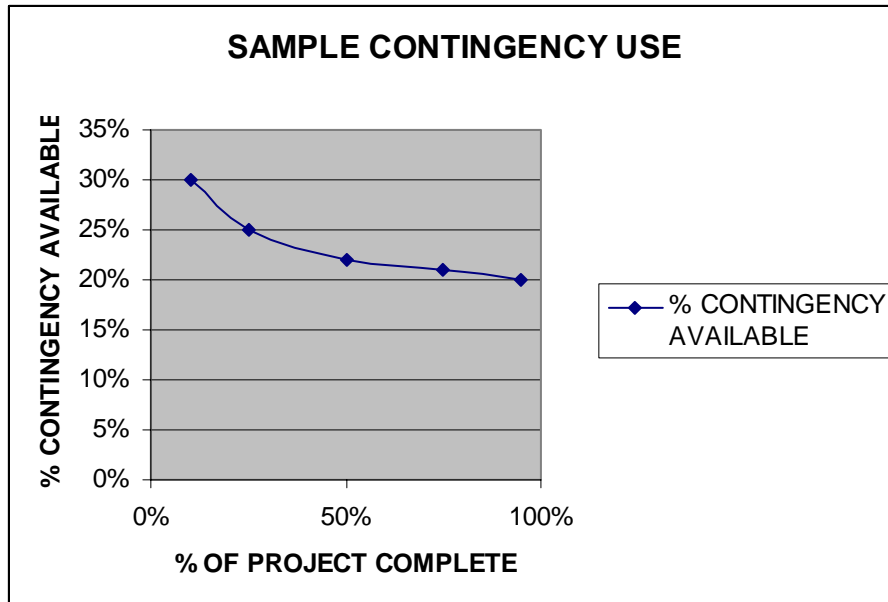
Contingency and Schedule

The Conventional Facilities schedule durations and contingency have been increased since our last review in response to comments from several independent reviews including this FAC Subcommittee. Though no detail assessment was performed by the FAC Subcommittee, the conventional facility schedule and budget with contingency now appear to be reasonable.

BCWS planning plots don't show contingency use. For planning purposes, a useful approach would be to plan all the activities for early starts up to the point where all of the BA in each fiscal year would be used. Exceeding this optimistic BA plan by 5 to 10% would also be helpful. This approach assures that there are "swing items" available to accomplish timely work when some activities naturally slip due to typical project management experiences. If the project doesn't have swing items to fill in the available time and uses the entire available BA, the project will accumulate all the slips at the end of the project and the CD-4 may be in jeopardy.

In addition, a plan that uses up all of the BA in each year provides for a complete FTE plan as opposed to having an FTE plan based on BA minus any contingency in the respective fiscal year. Such contingency use plan would not have a corresponding FTE plan to go with the contingency funding amount. So to repeat in different words, one need not develop a contingency use plan, just an early use of the entire BA in each fiscal year. Then, as such a plan in execution fails, due to unpredictable problems, some of the BA would be converted to the contingency rubric. The contingency would end up being used productively and somewhat in proportion to time and BA expenditure.

A useful plot that illustrates this phenomenon is contingency remaining as % of remaining budget versus % of project complete. Asymptotically speaking, it should be roughly a horizontal line above 20%. Early in the project life it will start out at a higher number.



HVAC

The approach to cooling temperature sensitive components has been defined and, though expensive, appears to be feasible. Detailed calculations on mixing zones and air flow velocities are required and will be performed in Title II design to verify the concepts proposed in Title I.

Vibration

A combination of approaches that includes both local isolators and proximity to sensitive components has been defined in Title I design. Detailed calculations against vibration budgets will be required in Title II design to demonstrate compliance to limits.

Access to LCLS Website

It would be useful to the FAC to have access to the LCLS internal website in order to be able to view other reviews and important work that can have an impact on the scope and details of future reviews.

DETAILED COMMENTS/DISCUSSION

Undulator tunnel

The undulator floor/tunnel design remains as a critical issue that needs to be addressed as soon as possible so that Title II work can proceed in this area of the project. The CF subcommittee suggests that a cost/benefit analysis be conducted utilizing the following specifications for floor settlement:

- 0.04 mm RMS/year/10m separations
- 0.2 mm RMS/year/10m separations
- 1.0 mm RMS/year/10m separations

Once this analysis has been conducted, a determination can be made regarding how much of the problem should be solved with civil construction and how much should be resolved using BBA and other alignment techniques, and beam steering.

To improve the design criteria one can engage soil modeling experts. The existing empirical data from the SLAC tunnel and the geotechnical data can be used to make a reliable model of the expected performance of the soil foundation. These experts can be hired by the AE if the AE does not possess the inhouse capability.

Given the above calculation, one can design the optimum structural configuration to minimize long term creep. The proposed separation of the floor from the tunnel structure may be an expensive complication not necessarily contributing to the needed solution. There has been no evaluation of the “moment-free” tunnel shape, which is not a circle but rather resembling a flattened pear shape as one sees in metal culvert shape. This shape may provide for additional space in the horizontal direction where the air handling ducts. The floor would be a bit flatter too and any additional concrete placed to build up the floor would be wider for shorter maximum depth providing for more efficient use of material. The flattened pear shape is not presented here as an obviously better answer, but it needs a quick quantitative look to demonstrate that the circular shape is chosen on a sound basis.

The SLAC linac tunnel performance, in its average creep and deflection, would be acceptable if it were replicated in the undulator tunnel. While the linac tunnel is rectangular, it should be trivial to replicate its stiffness in either circular or squashed pear shape. The only issue would be whether the soil mechanics behavior under the undulator tunnel would be as in the better areas of the soil under the SLAC linac.

LCLS Construction Safety Program

The importance of safety in the conduct of work is accepted by the LCLS group. Continuous improvement is, of course, a core function of the Integrated Safety Management System and needs to be pursued. To this end, the LCLS FAC Committee suggests several actions for consideration and approval by the Director for response.

The LCLS project is waiting direction from ES&H management regarding subcontractor safety program implementation. New construction designs are currently at the Title II level and cost and scheduling need to be developed that will include ES&H overhead. The schedule has Title II being complete by November, 2005. Outside firms that are at times unfamiliar with SLAC practices, requirements and infrastructure will need to have a clear understanding as to exactly what their ES&H responsibilities will be. The LCLS project has indicated that these SLAC ES&H requirements are in the process of being revised at this time and the program is in a state of frequent change. It will be difficult for subcontractors to provide accurate cost and scheduling estimates if they do not have a full understanding of their responsibilities. Deficiencies in subcontractor work control planning and implementation and not having subcontractor acceptance of the safety program would exacerbating already strained safety culture. The Committee deems it essential that the safety expectations and requirements be clearly presented to subcontractors.

The LCLS has taken very proactive steps to improve the level of safety on the project. This has been achieved by adding a full time ES&H person and they are in the process of developing a construction safety program for the project. The model that they are using to develop their program has been proven to work at other sites and meets industry standards including DOE expectations. The LCLS advisory committee fully supports and encourages continued work on this.

Nonetheless, this Committee sees an opportunity to enhance the performance of safety as discussed. SLAC can better and more efficiently execute modifications to its safety program by working with LCLS and creating a program that embodies an appropriate level of safety. LCLS should be encouraged implement its construction safety program during the work at Sector 20.

Far Hall Layout

The Far Hall Layout needs to be finalized. If the hutch size in the original design is inadequate, the alternate plan should be adopted as the baseline design for Title II.



Controls

Tom Himel
Karen White



Controls

- ✚ A lot of good progress has been made since the last meeting

Controls – Previous Items

- ✖ WBS structure - Done
- ✖ Need global standards – Lots of progress, x-ray beamline more integrated with addition of S. Lewis
- ✖ Need central database – hire in progress
- ✖ SLC-aware IOC – infrastructure good progress, applications now even more critical
- ✖ X-ray beamline controls not defined – In progress
- ✖ Location of BPM relative to quad – now BPM locked to quad – very good



Controls – Previous Items

- ✚ Engineering process – proceeding w/o requirements/reviews) – improving
- ✚ Can you get x-band, klystron and waveguides free from NLCTA? - some
- ✚ Injection laser controls interface needs close communication between vendor, laser people and controls people – still a concern



Controls – Previous Items

- ✚ Unclear how to design feedback to control x-band phase – explore dithering – complete
- ✚ Great that each previous concern was specifically addressed



Controls - New

- ✚ Ensure PPS PLCs are "safety" certified
- ✚ Consider redundant readbacks on magnet power supplies
- ✚ Need to start on Machine Protection System
- ✚ Good use of commercial hardware solutions – helps keep engineering costs down
- ✚ Good that planned AC distribution system has room to accommodate future linac upgrade

Controls - New

- ✚ Need to adopt common version control procedures and repository
- ✚ Need a way to version control PLC code
- ✚ Coding standards written and adopted – very good
- ✚ Consider single motor with chain or air cylinders to slide undulator in and out versus two motor solution



Controls - New

- ✚ Is there an integrated plan for mitigating the temperature tolerance in undulator? (+/- .2 C)
This constraint has implications for controls
- ✚ Fiber solution for RF distribution seems promising – should actively pursue R&D