Facility Advisory Committee (FAC) General Aspects Closeout

LCLS Facility Advisory Committee

16, 17 April 2007

General Observations

- *The Project, its position in SLAC and progress since last meeting is strong*
- *Significant progress in integration and installation preparedness is in evidence*
- *The integrating phase of the project is in full swing*
- *Many good things, but a few troubling things*

Continuing Resolution

- *Handled the uncertainty and accommodation about as well as could be expected*
- *Understand frustration as funding profiles disrupt project in significant manner*
- *The impacts are certainly far reaching and may not be entirely quantifiable*
- *The next Lehman/EIR will be "fun"*

Schedule

Everything we've said before and then some

October 2006

- *The schedule will only get tighter as time goes on*
- *Delays are a source of concern*
- *Installation schedule may not be under control*
- *A day of float should only grudgingly be surrendered*
- Just in time *items are disconcerting*

April 2007

- *The schedule has only gotten tighter*
- *Delays continue to accumulate*
- *Installation schedule still seems a major problem*
- *"Buoyancy" is decreasing*
- *Even more in evidence*

Installation schedule in particular is an area of major concern – especially the next shutdown

Shutdown & Installation Schedule

- *The detailed scheduling of the shutdown and installation is only starting*
  - *"First Cut" – mid May*
  - *"Bullet proof" – full deployment – by 1 August*
- *It is premature to consider slipping the shutdown timing*
  - *Need to establish date for gatepoint*
  - *Need to establish criteria for decision at gatepoint*
- *Linac access, tunnel access, tunnel locations, etc. need be viewed as explicit resources*

Project Organization

- *Baroque → Classic → Avant Garde → Post Modern?*
- *The organization is mature and the integrating aspects seem to be taking hold*
- *Staffing issues remain, but don't seem as central to issues*

LCLS & LUSI

- *The incorporation of LUSI (in a practical sense) is important for the operational facility*
- *The dilemma*
  - *The need to keep the projects separate*
  - *The need to get the projects together*
- *Need to resolve how the FAC is to address*

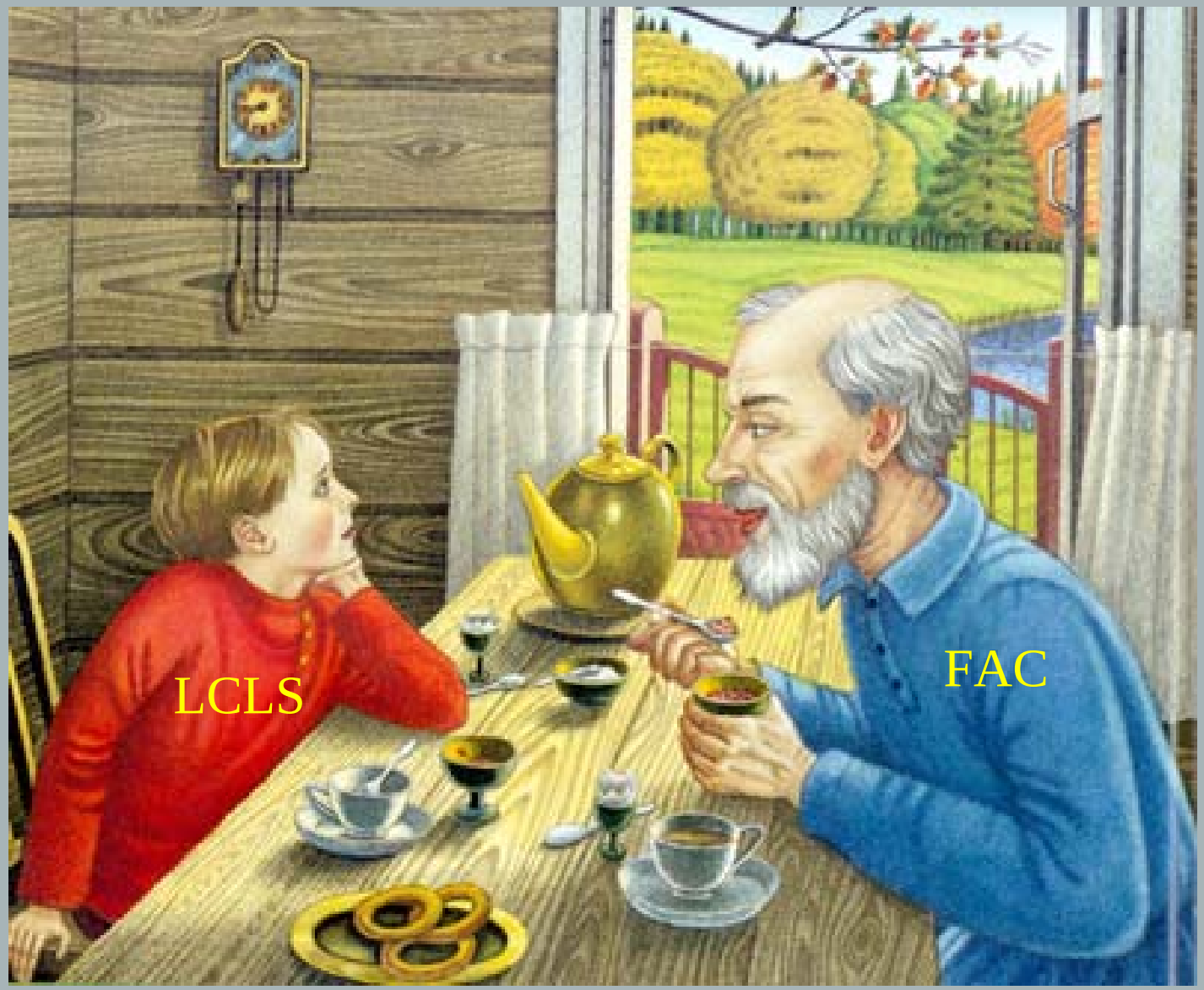
The LCLS operating model

- *Could likely be more as a high-energy physics experiment than a conventional synchrotron radiation experiment*
- *Data and experimental organization*
  - *Timing and deployment*
  - *Intimate knowledge of pulse by pulse parameters*
- *Experimental incorporation and integration with source operation*

Risk Registry

- *We simply can't leave this alone*
- *The active punch list is GREAT … and*
- *Need to have section of the registry that incorporates those risks that have a more passive response*
- *Mitigations*
  - *Active reduction*
  - *Insurance*
  - *Avoidance*
  - *Transference*
  - *Acceptance*

LCLS and the FAC?



The Interaction has Slipped

- *Our role for you needs a reminder*
- *Are we (the FAC) your*
  1. *Personal trainer?*
  2. *Old grandparents to be fed and ignored?*
  3. *Kindly, but slightly crazy uncle and aunt?*
- *Two days is just **too** short*
  - *Inability to delve into issues*
  - *Inability to reflect on potential counsel*
- *Don't "Lehmanize" the FAC Meeting *
  - *We're here because YOU asked us*
  - *Don't concentrate on your accomplishments*
- *Continued emphasis on I-5*
- *Timing and approach for next FAC meeting needs to be looked at*
  - *October 2007 is right in the middle of the shutdown*
  - *Perhaps distributed or …?*

From a Complete Facility Standpoint:

- *Schedule*
  - *Resource constraints and moving LEFT*
- *Scope*
  - *Beat on the details that could quickly become critical*
  - *Integration, interfaces and installation*
- *Cost*
  - *Make certain that the CR impact for rebaseline is adequate*
  - *Frugality is important, but estimates to complete (ETCs) must be carefully examined for completeness*
- *Make certain that Safety continues to be given the attention necessary in all technical systems as well as CF*

Parting Points

Thanks for all of the work for the Meeting, especially Helen

Thanks for letting us observe an exciting project evolve

Accelerator Systems Group

Max Cornacchia
Wim Leemans
John Lewellen
John Corlett

Start of LCLS Beam Commissioning

- A major milestone
- **Congratulations to the LCLS team for producing electron beam!**
- 10 Hz
- ~300 pC
- 250 MeV
- Through BC1
- Some evidence of bunch compression observed
  - Half commissioning goals achieved
- **Testifies to the high quality of the design and fabrication**

Gun

- Gun initial performance very good
  - Excellent agreement between design and measured RF parameters
- RF power testing revealed overheating of cavity probes
  - Limits operation to 30 Hz and 115 MVm^{-1}
    - Gun 2 fixes this
      - Recommend Gun 1 is retrofitted with modified probes at an appropriate time
      - Existing gun appears to be adequate for commissioning
- Quantum efficiency appears to be lower than expected
  - Early days
    - Recommend:
      - Confirm diagnostics calibrations
      - Clean and map QE of cathode
- Dark current very low - very good

Photocathode Laser -1

- Oscillator
  - Maintenance - contamination of crystal surfaces is a concern
  - Ability to maintain lock - new mirror mounts are to be installed
  - Ability to reset - need remote control
    - We support the plan to buy new oscillator
- Transverse pulse shaping
  - Aspheric optics - stringent requirements on steering & input pulse shape
  - Currently using imaged aperture
    - Impact on emittance being studied
      - We support plans to explore other options including deformable mirror

Photocathode Laser - 2

- Longitudinal pulse shaping
  - Harmonic content makes Dazzler operation difficult
    - Thales to return & fix in September
    - Other options including pulse-stacking being explored
- Recommend continued beam dynamics modeling with realistic pulses
- Spares
  - Two Jedi pump lasers on order
    - Recommend continued attention to building up of a duplicate system
- Position stabilization on cathode is operational

Diagnostics

- Some diagnostics not fully installed, or faulty
  - High priority to enable full suite of diagnostics up to the end of BC1

- Removal of wire scanners in L2
  - Introduces risk in characterizing beam in critical region before BC2
    - Committee concerned but cannot make any recommendations based on information received

RF systems

- New LCLS LLRF network being implemented
- Switchover to be gradual
  - Good work

Schedule

- Concerns that the 2007 installation is highly constrained and on critical path
  - Result likely to be lack of diagnostics & controls installation and checks
    - Impacts commissioning schedule
- Applaud plans to develop an integrated installation schedule
- (Kem Robinson comments)

Undulators Subgroup Summary

FAC

16, 17 April 2007

K. Robinson, (J. Pflüger)

Good Work Overall

- Switch to Geoff Pile from Steve Milton
- Focus at ANL on deliverables and QA
- 3 Undulator magnetic structures completely tuned – *finished*
  - 1 additional in rough tuning
  - 1 additional in fine tuning
- Final deliveries of magnetic structures by June 2007
- ASK and time tracking/planning system

Continuing Resolution Woes

- CR impacted Undulator in both cash flow and resource matrix situation
- Most of the issues have been addressed
- Progress back on track
  - Unrecoverable schedule losses must be fully appreciated
  - Unrecoverable costs must be fully appreciated

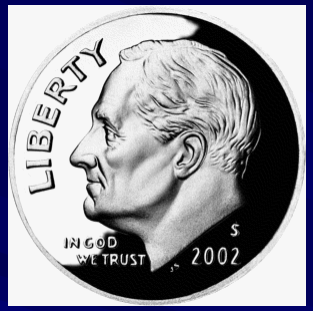
Undulating Excitement

- MMF is fully operational
  - Test plan and fiducialization plans in place
- Chasing down a lot of *features*
  - Hall probe noise
  - Magnetic measurement bench electrical noise
  - Planar / tensor Hall-effect issues
  - Hall probe calibration problems
- A number of *start up* issues over last 6 months
  - Air conditioner / air compressor failures
  - Ran out of magnetic shims
- Resource issue: lost mechanical designer
- QA issues also slowing progress
  - Oversize Strongbacks
    - Accepted at ANL not communicated to SLAC
    - Mu-metal shield doesn't fit
    - Kinematic mount feet don't fit
  - Unknown control issues associated with SN06 end fields

Magnetic Measurements Schedule

- Because of *features* and *issues* many weeks of original schedule have been lost
  - 3 months behind schedule presented in October 2006
- Tuning approaches for end-fields not yet developed
- Full production processing not fully integrated or streamlined
- Determine the sensitivity to magnetic centerline on the planar/tensor Hall effect
- Unlikely to frequency up shift throughput of 1.65 μHz (1/week)

The Undulator Vacuum Chamber



The best dime I ever invested

- The decision to go with stainless chamber
- Chamber prototypes demonstrate needed technologies and specifications
- Unrecoverable schedule slip puts vacuum chamber on or near critical path

This represents a strong motivated effort on the part of the project engineering team

Undulator Systems Diagnostics

- Undulator Cavity RF-BPM
  - 3 BPM test at LEUTL in May
    - Make certain that configuration matches layouts (waveguide connections etc.)
  - Final production delivery in January 2008
- Beam Loss Monitors
  - Only in a conceptual level
  - To undefined for this stage of the project
  - Unlikely to survive: schedule / cost
    - Define a minimal protection system rather than abandon everything

The Details WILL Kill You

- End-field tuning approaches
- Reducing tuning to technician levels
- Quality assurance
- Completeness of documentation
- ASK Deployment
- Controls portion of the Undulator Systems a concern
- Placing procurements, travelers, consistent drawings, …
- Integration and installation details

Majority of non-central magnetic structure doesn't start to deliver until after September 2007

Almost anything can quickly become a pacing item

X-Ray Subgroup Summary
Facilities Advisory Committee
April 17, 2007

Paul Fuoss
Tom Rabedeau
Thomas Tschentscher

Discussions

- **LCLS**
  - **XTOD update (Bionta)**
  - **Mirrors (Stefans)**
    - **Vendor samples**
    - **Coating**
    - **Mirror supports and benders**
  - **XES update (Moeller)**
- **LUSI**
  - **Project Overview (Hastings)**
  - **Pump-Probe Experiments (Fritz)**
  - **Coherent X-Ray Imaging (Hastings)**
  - **No discussion of x-ray photon correlation spectroscopy**
- **Controls and data acquisition (Feng and Sass)**
- **Relationship between LCLS and LUSI**

Positive Developments

- **A great deal of progress has been made on design of experiments**
- **Specification process proceeding more rapidly**
- **Baseline components and systems are steadily moving through the approval and acquisition process**
- **Progress on real time monitors**
- **Controls and data acquisition are receiving much needed attention**
- **Excellent coordination between LUSI and LCLS**

Concerns

- **Mirrors remain a concern**
  - The hard x-ray mirrors may delay commissioning
- **Shielding requirements still aren't finished**
- **Don't make data acquisition overly complicated.**
  - Short term needs are much less demanding than long term possibilities
- **While straightforward, slow controls will still be time consuming**
- **Alignment of x-ray components**
- **Experiments need to develop metrics that can guide machine operations**

Current Recommendations

- **Mirrors are crucial in the current concept**
  - Mechanical and optical design concepts efforts should move ahead semi-independently
  - Purchase a commissioning set of hard x-ray mirrors even if they don't meet the ultimate performance specs by the end of May
- **Obtain expert advice on design and fabrication of thin monochromator crystals**
- **Define critical paths for commissioning and for the experimental program**
- **Develop a "minimum equipment list" for each experiment to guide control and data acquisition development**
- **Don't let the "best be the enemy of the good", use phased improvement**

Controls

Tom Himel
Karen White
4/17/06

Controls Progress

Great progress has been made since the last FAC

- Have beam with working control system and diagnostics.
- Users are only bitching a little bit. Amazingly good considering the amount of new stuff.
- PLC based PPS system is approved and in use. A milestone for SLAC.
- BCS got done in time for ARR approval

Old Comments

- Schedule still very tight for some systems for January test run Schedule was adjusted. OK now
- New LCLS MPS design still in early phase; need to evaluate if hardware will be fast enough – a lot of work remains to complete this system in ~1 year - Continue with MPS 1553 to give extra year to implement newest MPS.
- Initially, emittance and bunch length measurements done in MATLAB – not available to Correlation Plots (SLC) – is this a problem? - no
- Should plan for revision control for MATLAB applications written by physicists – in progress

New Comments

- The newest MPS system now has a viable design. It still needs some time to complete, so it is good that controls is planning to use the 1553 MPS system as a temporary expedient in the linac.
- It is more than a 1 person job as there is more than the central backbone.
- Care must be taken in software interface to protect against unwanted logic changes and bypassing of inputs.
- It needs a good name. “newest MPS” is clearly inadequate. We suggest **MPS 2006**. This follows the Microsoft naming convention of naming something for the year is was supposed to be released. Much as we love to hate Bill Gates, in this case he has a good system.
- The “new MPS system” can be retroactively named MPS 199?

New Comments

- There are many new types of diagnostics in the X-ray beam line that are not just repeats of what has been done for the e-beam line.
- They weren’t covered in this review.
- Please tell us the plans for implementing these at the next FAC meeting.

New Comments

- The DAQ for the X-ray experiments is a **BIG** deal and is very different than the types of things an accelerator controls group normally works on.
- 60 TB/day of data is scary.
- We did not look at the budget and schedule, but they should be checked after this project is scoped out more.
- It sounds like the first phase of AMOS is planned for except for the analysis piece. But:
- Recruit people with DAQ and analysis experience from large HEP detectors. (this has started)
- Get X-ray users to consider how data can be triggered and/or compressed.

New Comments

- Hamid badly needs a deputy. We know they have been looking. Keep looking.
- Good that have someone on board (Ernest Williams) to manage the growing EPICS infrastructure.
- Should take advantage in more places of EPICS security features.

Linac Coherent Light Source Facility Advisory Committee Conventional Facilities Subgroup

H. Carter, T. Chargin, A. Kugler, K. Schuh

Outline

- Findings
- Comments
- October 2006 Recommendations & LCLS Responses
- April 2007 FAC-CF Recommendations

Conventional Facility Subgroup Findings

- General
  - Overall, we are pleased to see that good progress has been made in preparation for CF construction ramp up
  - CF contracts at 98% of the total are awarded
  - CF percent complete is 31% vs. 46% for the total project
  - CF change order rate is 6.5% to date for total work completed vs. 14% contingency held by the project office
  - The CLOC elimination has been implemented in the project plan but as yet not approved by DOE
  - There is a pending claim from the CM/GC in the amount of $4.5M. The realistic project exposure is ~$1.1M. The final number is under negotiation.

Conventional Facility Subgroup Findings

- Organization
  - CF staff additions within the past year are making a positive difference to subsystem progress
  - Management of the CM/GC contact continues to be a challenge, but the LCLS staff is handling it.
  - CF staff continues to perform special inspections on construction and has an inspection agency under contract to supplement their staff
  - Five new CF personnel are in the process of being requested to support the construction ramp up. This appears appropriate.

Conventional Facility Subgroup Findings

- CF Documentation and Tracking
  - The CF staff has implemented a formal tracking process of Requests For Information (RFIs). Approximately 10% of the RFIs end up as Field Change Orders (FCOs)
  - An FCO system is in place. 40 FCOs have been written and 28 have been approved and fully released
  - The risk registry is improved and supports the contingency analysis
  - The “red lined” drawing issue from the October 2006 review still needs to be addressed. A defined process is required.

Conventional Facility Subgroup Findings

- Schedule
  - CF Schedule is very aggressive with inherent risk
  - The project plans to use co-occupancy as a means of saving schedule

Conventional Facility Subgroup Findings

- Safety
  - Turner has effective control of the work process and safety planning at the job site
  - LCLS safety personnel are effectively providing safety oversight of the construction site
  - LCLS safety personnel have developed an electronic tracking system for identifying and documenting safety deficiencies

Conventional Facility Comments:

- Organization
  - The CF has continued to develop and strengthen staff.
  - The cohesiveness of the CF staff is an excellent reflection on management.
  - The CF is well positioned for successful outcomes with experienced field contractors performing well in the field, a clean, organized, and structured construction site.
- Management of Turner
  - The local Turner Office needs to learn to work with this National Laboratory as a service contractor.
  - The project office and the CF staff are taking reasonable approaches in managing Turner (including personnel changes where necessary, partnering sessions, etc.)
  - One initiative taken is to meet with Turner Corporate to obtain Corporate Office support in the best interest of Turner and SLAC. Turner needs a successful outcome on LCLS for their future with Stanford University, as well as SLAC.

Conventional Facility Comments:

- Quality
  - There is evidence of good quality in field construction, and we see no reason this cannot be positively stated in status presentations. If there is something we are missing, please say so.
  - The current field change order rate of 6% implies a good quality design. When the interfaces between mechanical, electrical, and civil design are tested by field construction, the project will know more about the quality of the Jacob's design issued for bid.
  - The need to jack hammer out ten yards of concrete because the wrong mix design was accepted from the batch plant, is a significant quality finding that should be brought to the attention of the project office. If the contractor paid for the rework, then the contractor got the right message. We expect the corrective action included checking the batching slip in the future before unloading the truck.

Conventional Facility Comments:

- Safety
  - From the FAC CF Subcommittee, thank you for the CF safety performance on field construction.
  - Recent changes in Turner on-site personnel has improved the working relationship with LCLS project safety personnel
- Continuing Resolution
  - The project office placed the correct priority on CF construction. CF has an aggressive schedule that cannot be delayed further.
  - Bundling the CLOC descope with the baseline change due to continuing resolution could delay the descope approval significantly. LCLS Management is exposed to the risk of executing a project scope that is not DOE approved.

Conventional Facility Comments:

- Learning Curves
  - The project office and CF staff demonstrate a healthy respect for the impacts of the often overlooked project learning curve.
  - Recognition that each new contractor to the LLLS requires particular attention will pay dividends on safety, quality, cost, and schedule.
  - CF management, further, is keenly aware of the impacts of learning curves in evaluation and assessment of construction acceleration and work arounds. Less experienced construction managers frequently fail to consider the risks and inefficiencies inherent in staffing and destaffing versus seeking increases in productivity using proven resources already on the project.

Conventional Facility Comments:

- Schedule Reliance on Co-Occupancy
  - The project has committed and relies upon schedules that are contingent upon productive use of co-occupancy well before Beneficial Occupancy.
  - This work around has inherent risks: environmental conditions may be more difficult than envisioned, and the working space limitations may delay CF contractors. These risks need to be mitigated and managed.

October 2006 Recommendations & LCLS Responses:

- **Recommendation #1:** Consider adding cost schedule incentives to the CM/GC contract, either by an explicit formula or indirect means (such as scheduling early completion in 24 months).
  - **Response #1:** Cost incentives were explored in some detail with Turner on two separate occasions, but a mutually agreeable cost number could not be found. It appears that the remaining incentive for the CM/GC is early project completion. The LCLS CF staff is taking a very direct role in construction cost changes and construction quality control.
- **Recommendation #2:** Reestablish top level management meetings between the CM and SLAC.
  - **Response #2:** Monthly meetings have been reestablished and the APD for CF position strengthens senior level management participation on the Turner interface with newly assigned on-site Turner Project Executive.
- **Recommendation #3:** Continue strengthening the CF staff.
  - **Response #3**: CF management has made good progress in this area. The addition of an APD for CF to the team is an excellent move and care is being taken to not confuse accountabilities. Since this and other organizational changes have been implemented recently, it is imperative that roles and responsibilities are clearly defined and understood by everyone.

October 2006 Recommendations & LCLS Responses:

- **Recommendation #4:** Ensure that CF is involved in the safety documentation approval process
  - **Response #4:** CF management is included in the approval process and required to sign off on those items both directly and indirectly affecting CF planning and execution.
- **Recommendation #5:** Periodically present field changes above a certain value threshold to representatives of other LCLS systems.
  - **Response #5:** This item will be addressed by the newly formed Integration Management Team (IMT).
- **Recommendation #6:** CF Group staff additions and functional organization is a step in the right direction.
  - **Response #6:** See Response #4 above.
- **Recommendation #7**: In order to handle the anticipated "paper workload" staff specialists will need to be added.
  - **Response #7**: Part time help has been applied to this problem.
- **Recommendation #8:** Little evidence has been presented that the environmental issues have been fully addressed in the LCLS PSAD or the planned SAD.
  - **Response #8:** The project will include additional items in the Operational Safety Program.

April 2007 FAC-CF Recommendations

- **Recommendation #1:** LCLS Project Management should continue in its efforts to improve the interface with Turner
- **Recommendation #2:** Project performance on field construction quality should be a part of status presentations
- **Recommendation #3:** Schedule Reliance on Co-Occupancy has inherent risks that need to be assessed and managed.

April 2007 FAC-CF Recommendations

- **Recommendation #4:** CF is implementing an impressive list of DOE safety standards. These should be included in safety status presentations.
- **Recommendation #5:** Implement the proposed tunnel boring schedule as soon as possible
- **Recommendation #6:** Consider adding temporary safety person during the next shutdown