# Facility Advisory Committee (FAC) Closeout - General Aspects

LCLS Facility Advisory Committee

31 October 2007

# General Observations

- Progress continues strong
- Installations and integrations have gone well – so far
- Interface/ integration with SLAC Operations appears very strong
- Many, Many good things and strong progress – but …

# Baseline Change Request

- Appears adequate
- Some aspects may not fully mesh
  - If all additional $\Delta t$ taken does it fit within the **$**?
- Project momentum is a non-linear, non-conserved quantity
  - *CR-jitters* can over spook a project
  - Slowing down too much to save $ can actually cost $

# Some Points to Ponder

"This tendency to *oversteer* is characteristic of human interaction with dynamic systems. We let ourselves be guided not by development within the system, that is, by time differentials between sequential stages, but by the situation at each stage. We regulate the situation and not the process, with the result that the inherent behavior of the system and our attempts at steering it combine to carry it beyond the desired mark."

– David Dorner, *The Logic of Failure*,

# More from *The Logic of Failure*

*When we are working on a problem we focus on that problem alone and not on problems that don't exist yet. It is less a problem of not knowing than one of not wanting to know. And not wanting to know is a result of not ill will or egoism, but of thinking on an immediately acute problem.*

**INTEGRATION**

# Schedule – Vigilance unfailing

- The *imposed* schedule slip from the CR is *dangerous*
- The project can in no way tolerate slippage of anything as it will cost dearly
- Some items have now slipped into *crash* mode where overtime and other more costly measures are needed to make *Just-in-time*

# Installation and Integration

- Progress continues strong
- Well integrated with SLAC
- Next installation push may be psychologically harder
  - No longer the external forcing of a linac/PEP-II shutdown
- Co-occupancy may not be very *beneficial* occupancy

# *The Face of Co-Occupancy?*

# Safety – a scary concern

- Construction rates
- Co-occupancy
- Installation sub-contractors
- …

# Project Organization

- Adding of depth to project office continues
- The transition to Operations is starting
- LUSI integration appears more seamless

# FAC Meeting

- 2 ½ days probably optimum
- May need to have a subgroup specifically looking at integration
- Need to have a *zoom* aspect

# From a Complete Facility Standpoint:

- **Schedule**
  - CR imposed slip is dangerous to entire project
- **Scope**
  - Details are already critical
    - Items that no-one would have thought driving schedule are now close to impacting
  - Integration, interfaces and installation
  - Integration, interfaces and installation
- **Cost**
  - The BCR is the last and only *trip to the well*
- **Safety**
- **Transition to operational facility**

# Parting Points

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

*Tremendous accomplishments*

*Thanks for letting us observe an exciting project evolve*

# Electron Systems Subgroup

John Corlett
Max Cornacchia
Wim Leemans
Jorg Rossbach

# Commissioning

Excellent results

congratulations on meeting injector commissioning goals!

reflects excellent planning and execution

# Laser systems

Beam quality and reliability very good
- recent improvements not tested with beam
    - temporal and spatial profiles improved
- needs continued attention to optimize performance

Interaction between laser and physics groups is productive

The committee encourages early tests at 120 Hz

We are pleased to see that the group has grown
    - now 4

# Gun

Excellent performance

- anticipation of detailed design issues is paying off

- encourage continued performance improvements
  - cathode QE non-uniformity needs to be understood
  - thermal emittance contribution needs to be studied

- will replace field probes early 2008

We encourage early tests at 120 Hz

The committee encourages continued attention to build-up of 2nd gun

- e.g. explore inclusion of load-lock to facilitate analysis of operating cathodes, cathode cleaning techniques, etc

The committee recommends building of a gun test facility

# Emittance

Measured projected emittance @ 1 nC after BC1 - 1.7 μm-rad
Causes presented:

- BC1 dipole field inhomogeneity
- Exacerbated by bunch lengthening (space charge, small laser spot size)
- Transverse wake of x-band linearizer cavity

Encourage plans to address these in next commissioning phase

- also investigate ballistic compression using phase ramp in LOA

# BC1 dipole magnet

Field quality is poor
Support plans to improve performance of existing dipole

# Coherent OTR

Clear signature of micro-structure in the beam
Not fully understood
Needs continued attention
*evidence of beam dynamics that may affect lasing*

Will impact diagnostics capabilities
- use of OTR screens for emittance measurements

The committee considers this an important issue and encourages further investigations including
- high-resolution diagnostics
- theoretical studies
- use of laser heater

# Installation

Excellent progress in 2007

Co-occupancy important for the next stage

- Need careful attention to ensure viability

# Commissioning to BC2

Larger accelerator physics group for the next stage
Resources seem reasonable (14 physicists available)
Planning for 2 physicists/shift for 10 shifts/week

# FEL commissioning

Plans are at an early stage and need to be developed with focus on

- instrumentation
- detailed simulations and modeling of commissioning procedures
- techniques to identify the FEL signal at as low level as possible
    - e.g. the proposed modulation of laser heater

We encourage continued participation of photon scientists in instrumentation for, preparations for, and execution of, commissioning

The committee would like to hear a presentation jointly to e-beam, photon beam, and undulator groups, of photon beam diagnostics and plans for FEL commissioning

# Undulator Subsystems

***K. Robinson, J. Pflüger***

- General
- Magnetic Measurements
- Vacuum Chamber
- System Integration
- Beam Loss Monitor System
- Girder setup and testing
- Vacuum system
- SLAC / ANL coordination

# General

- Production situation is much relaxed: Undulator Magnetic Structure moved from the critical path
- Although somewhat behind schedule, the risk of additional schedule delay is now very small (The details can kill the schedule – more on this).
- MMF has reached its design capacity of ~1 Undulator / 6 days
- Vacuum system: Impressive effort

# Magnetic Measurements

- All (39) undulators in house, 15 finally tuned, more are in the pipe line
- Response to last FAC
- Measurements approaching design speed of 1 undulator/week
- Risk of additional delays is small
- Plans for fixing “bad undulators”

# Vacuum Chamber

- Congratulations! Tough and impressive effort! ….after many critical FAC comments. Now moving forward in a good manner.
- Convincing, very economic solution, fulfilling requirements and specs: Roughness 150μm, slope error 15-20mrad slope error, good vacuum performance
- Production is in preparation, time schedule looks plausible, Schedule is tight but not undoable

# Quadrupoles

- 1. Articles insufficient field, will be improved
- But showed good field data:
  - Less than 2 μm center shift when corrector power supplies are applied.
  - Splitting Tests: By opening magnets the magnetic center moves less than 1 μm

# Beam Loss Monitor System

- BLM have now appropriate importance
- Protection of the Undulator is topmost priority
- Must be available for commissioning !
- System shown may fulfill these requirements
- Dosimetry using TLDs are planned.  Data can be used for calibration of BLM
- FLASH experience may give a good guidance:
  Doses damaging the undulator are in the range $10^5$-$10^6$ Gray
- Long term monitoring will be very important for commissioning and operation
- Schedule is **very** tight – the project will have to accept whatever performance is first achieved as schedule cannot tolerate iteration on design.
- The integrating aspect of BLM may be a bit much to ask
- Consider deploying multiple technologies (BLM, TLD, fibers …)

# Girder Setup and Testing

- Solid plan, but unstarted / unfinished details may cause trouble
  - Quadrupoles
  - Corrosion
  - Fasteners
  - Transportation and handling

# Vacuum System

- Complete Vacuum integration may be troublesome, but tractable
  - Just in time aspects of BLM and BPMs
  - Vacuum flanges require training and care, but should be OK
  - Enough flexibility appears incorporated in design

# SLAC / ANL Coordination

- Seems good in general, but anisotropic
  - Details and assumptions are problematic
    - BLM / Magnetics
    - QA and subcontracts
    - ...
- Strong teams on both sides
- During the *heat of battle* take care to ensure that *everyone* understands that *all* are allies

# Cavity BPMs

- Technical performance demonstrated
- Seem to be on track, but schedule very tight – *just in time*
- Problems now may be non-technical
  - Placing / managing contracts
  - Addressing issues as they arise

# X-Ray Subgroup Summary
# Facilities Advisory Committee

# Halloween

Josef Feldhaus
Paul Fuoss
Tom Rabedeau
*Thomas Tschentscher*

# Discussions

- **Breakout Talks**
  - **XTOD Status (Bionta)**
    - **Indirect Imager design not done**
    - **K spectrometer design not done**
    - **Technical problems with Total Energy Sensor**
    - **Collimators on the critical path**
  - **Mirrors (McCarville)**
    - **Error budgets**
    - **Finite element analysis and verification**
    - **Pointing resolution and stability (requires temperature stabilization)**
    - **Coating stress and morphology relationship not discussed**

# Discussions (continued)

- **AMO Instrument (Bozek)**
  - **Project is in good shape**
- **XPP Instrument (Fritz)**
  - **Better definition of experiments - prioritize applications**
  - **Need rudimentary monochromator**
  - **Retain space for  a single bounce, fixed energy instrument**
  - **Examine using anti-parallel crystals to get shorter monochromator**
- **CXI Instrument (Boutet)**
  - **Mirror damage testing should be a priority at LCLS startup**
  - **Examine mechanism of final aperture failure and examine other materials**
- **XCS Instrument (Robert)**
  - **Builds on common infrastructure and is last to be completed**
  - **Retain flexibility to change as opportunities and problems are discovered**

# Discussions (continued)

- **Data Acquisition (Haller)**
  - **Fine low level concept**
  - **Concerns about interface between system level and user level code**
  - **Support of user supplied computers and analysis packages**
  - **Standards for electronic logbooks**
  - **Budget and scope need to be clearly defined**
- **X-Ray Commissioning (Tompkins)**
  - **Preliminary plan is suitable**
  - **Continual refinement is required**
  - **Plan should provide for early x-ray testing of components**

# Concerns

- **Funding impacts on instrument development and science output**
- **Don’t make data acquisition overly complicated for the user.**
  - **Need to hide complexity**
  - **Flexibility (can I add a motor this morning?)**
- **Experiments need to develop metrics that can guide machine operations**

# 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**
- **LUSI should make sure that at least one instrument is completed**

# New Recommendations

# Controls

Tom Himel
Karen White
10/31/07

# Controls Progress

Great progress has been made since the last FAC

- Very successful use of SLC and MATLAB applications for BC1 commissioning
- Met tight schedules
- Controls and DAQ for experiments now assigned to G. Haller and plans are well developed

# Old Comments

- Schedule continues to be very tight for some systems. Improved schedule coordination seems to be helping.

# Old Comments

- Multiple concerns remain about the MPS2007. There has been major progress.
  - More resources added to project
  - Viable hardware designs with active prototypes
  - PDR and FDR have not yet occurred. Should proceed as soon as possible in case changes are indicated
  - Slow start leaves schedule concerns, in particular the development of the user interface software is not yet assigned

# Old 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.
- This work has now been assigned to G. Haller's group and a list of needed components was presented
- Next time, please show plans to provide unique devices such as the wavefront sensor, diffractometer, etc.

# Old 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.
- This work is now assigned to G. Haller's group
- Detailed architecture presented for DAQ and storage. Prototype hardware exists along with test setups
- This work has taken a giant step forward

# Old Comments

- Hamid badly needs a deputy.  We know they have been looking.  Keep looking. We can always hope.
- Should take advantage in more places of EPICS security features. Some security was in place for the last commissioning run and more is planned.

# New Comments

- Addition of E. Williams, who is now in charge of controls software, is working well.
- Plans are in place to isolate the controls network from the office network before the next commissioning run.
- Off-line storage and processing needs for experiments are quite unknown and assumed to funded by operations. Be sure this is included in ops planning.

# New Comments

- Data visualization and analysis software remain the great unknown. Not clear who will do this and what needs to be done.
- Electronics in tunnel
  - Radiation – possibility of single event upsets
  - Temperature – calculations look good and load estimates will be confirmed

# New Comments

- High level applications
  - Infrastructure is planned
  - Improved Save/Restore application (Phase I) to be delivered in soon
  - XAL (from SNS) modified for modeling applications
  - The selection of the high level applications infrastructure and plans for specific applications is significant. Developing the applications will involve many man years of effort. This should be reviewed by external software experts and internal customers (e.g. Physicists and Operations representatives)

# Linac Coherent Light Source Facility Advisory Committee Conventional Facilities Subgroup

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

# Outline

- CF General
- CF Design
- CF Construction
- CF Installation and Commissioning
- CF Safety

# CF General

- April 2007 Recommendations & LCLS Responses
  - **Eight recommendations resulted from the April 2007 review. Seven of the eight have been satisfactorily addressed. The outstanding recommendation is that dealing with the issue of "red lined" drawings, namely:**
  - **Recommendation #7:** Develop and implement the plan for dealing with "red lined" drawings
    - **Response #7**: A Project Management Document (PMD) will be prepared and made a part of the project record.
  - **October 2007 FAC:** The record is not the concern, it's interface coordination with design not performed in conventional facilities. If there are no "red lined" changes and/or there is an alternate method of design interface, no action is required.
- Charge to Conventional Facilities Subgroup for this Review
  - Conditions at early occupancy
  - Safety on the construction site
  - Contingency burn rate
    - SLAC, Turner Const. Co roles/responsibilities

# CF Design

- Mostly done
- Hutches and office refurbishment delayed

**Recommendation #1: Invest in hutch design to add to "swing" procurement list**

- Change order rate is quite low, shows design is good
- Title III support from Jacobs is very good

**Recommendation #2: Title III support should be extended as necessary**

# CF Construction

- Status
  - 5 months ahead of contract schedule. However, due to 3 months late start, the construction is actually 2 months ahead of schedule.
- Contingency
  - Change order rate is quite low at 4% with > 50% construction complete
  - Less than 10% contingency may be set aside ← Charge to panel response
  - Change order system is in place and working satisfactorily
  - Construction change orders in the amount of $326K are outstanding
  - Sizable Turner claim is in negotiation
- CPR Baseline for Turner construction
  - Turner reports a 50% completion based on progress payments
  - Construction quantities based on joint CF staff and Turner walk downs indicate construction completion approaching 68%
  - This inconsistency understates actual construction progress

**Recommendation #3:** Apply accural accounting methodology as in other LCLS subsystems to accurately reflect the state of construction completion based on construction quantities.

# CF Installation and Commissioning

- There is not consistent understanding of the conditions for co-occupancy
- CF staff is in the process of writing a Memo of Understanding (MOU)
- Turner in charge of co-occupancy introduces additional risk due to their poor safety performance to date
- A risk benefit analysis should be done to determine whether there is sufficient basis for co-occupancy
- The projected co-occupancy period is only three months
- If co-occupancy were eliminated, there is a potential for schedule recovery
- Risk of Turner claims for delay will be reduced without a co-occupancy period

**Recommendation #4: Consider the elimination of the co-occupancy period**

# CF Safety

- Construction Safety
  - Turner's safety performance should not be accepted
  - A corrective action plan has been implemented
    - Management Safety Walks
    - Look-Ahead Schedule
    - Job Safety Analysis – QA
  - This action plan has not produced positive results
  - The risk of problems in this area requires immediate action

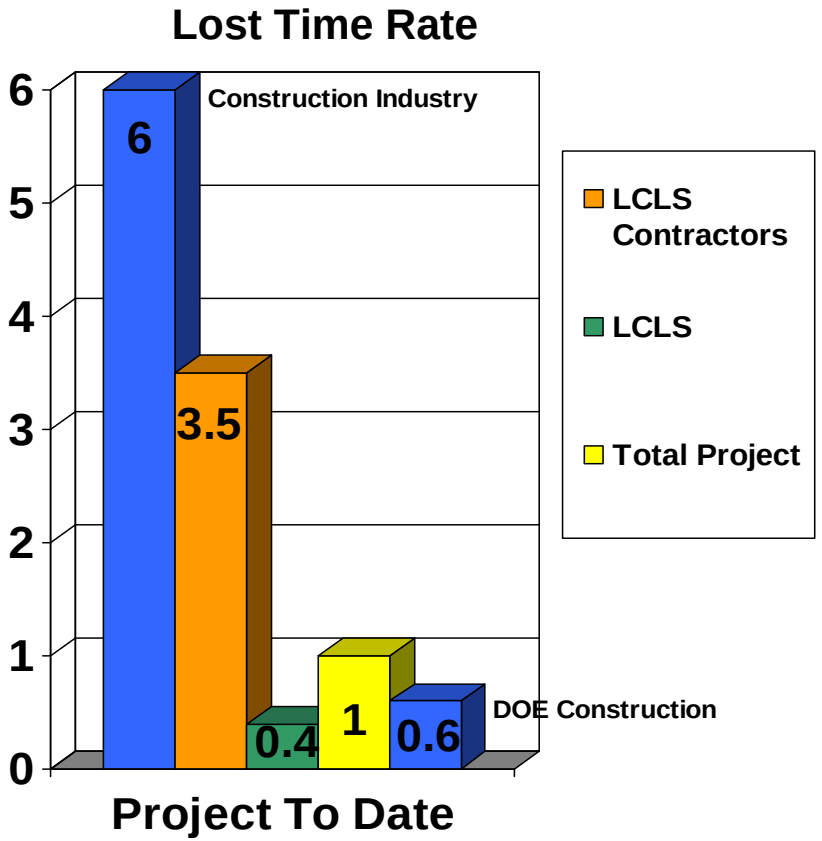
**Recommendation #5:** Reassign the best available CF staff to support Turner line managers in the field in directing safety activities

- The CF Review Panel will provide detailed suggestions for Integrated Safety Management in the final writeup
- After beneficial occupancy and commencement of operations, LCLS and SLAC safety responsibilities will require close co-ordination

# End of Presentation

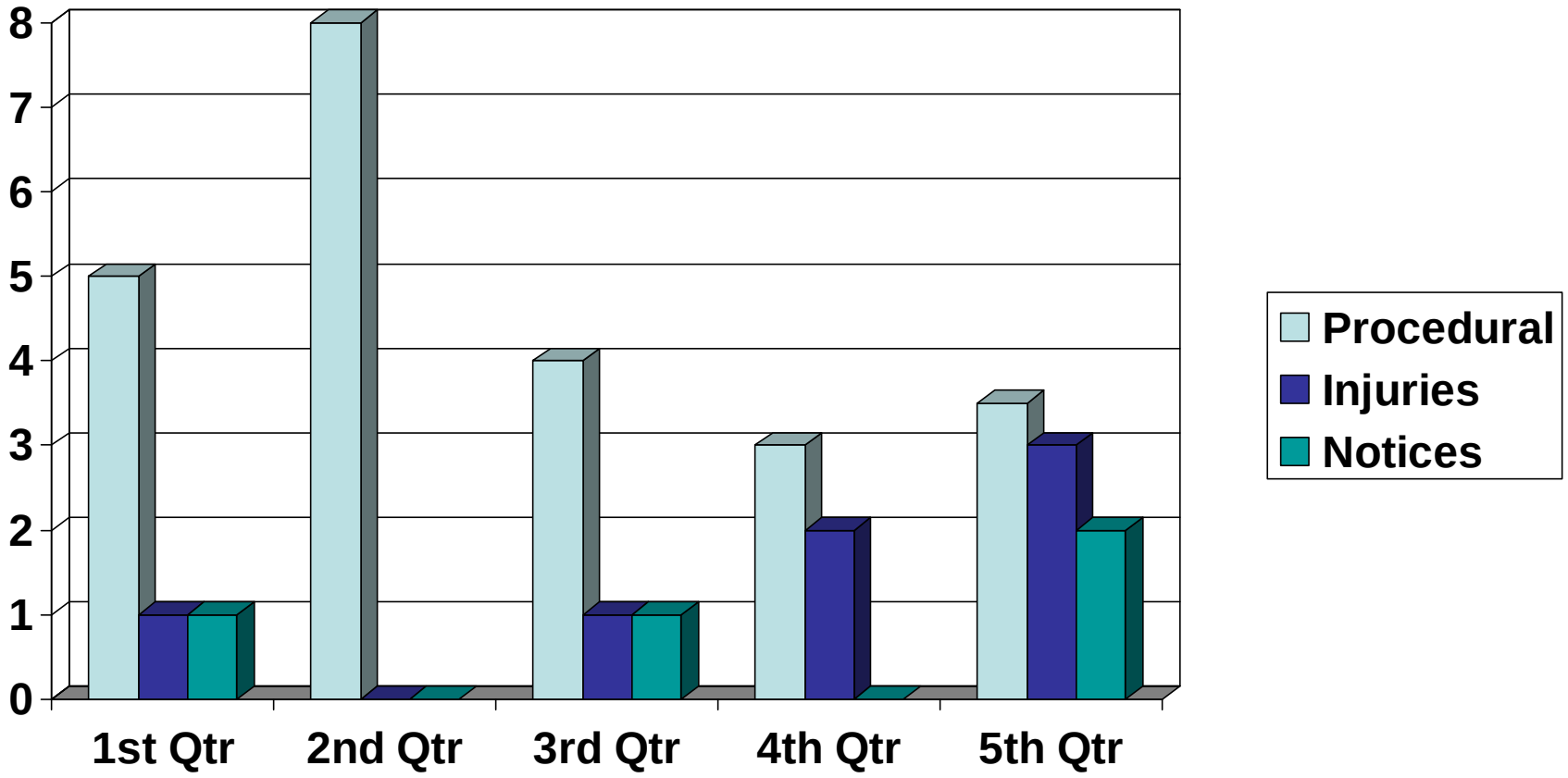
# PROJECT SAFETY EXPERIENCE
# 30 September 2007

- Total Project Hours
  - 1.37 M Hours worked
- SubContractors
  - 285 K Hours worked
  - 5 Lost Time Injuries
  - 1 Recordable Injury
- LCLS Collaboration
  - 1.08 M Hours worked
  - 2 Lost Time Injuries
- 7 Days Without Lost Time

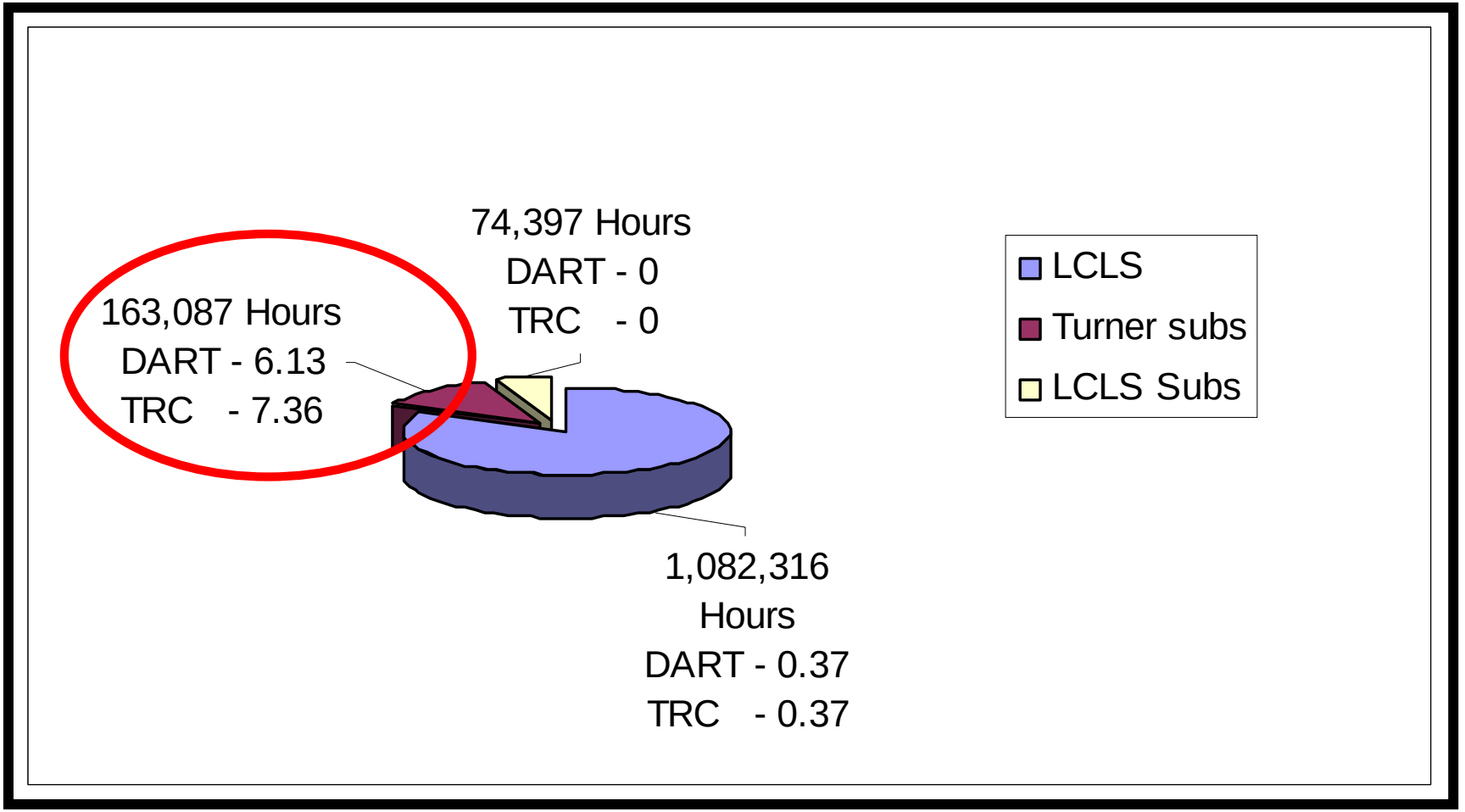



**Note:** Injury rates based on 200 K hours (100 man years) of effort.

# Incident Distribution



# Injury Experience



# Supporting Slides

# April 2007 Recommendations & LCLS Responses:

- **Recommendation #1:** LCLS Project Management should continue in its efforts to improve the interface with Turner
  - **Response #1:** Efforts to enhance the interface with Turner includes:
    - Team Building meetings
    - Modified Integrated Project Teams
    - Coordinated Meetings for Change Orders
    - Assigned CF staff for timely processing of Changes
- **Recommendation #2:** Project performance on field construction quality should be a part of status presentations
  - **Response #2**: The quality achieved in the field results from the efforts of the various trade subcontractors and the Quality Plan. The LCLS project retained an independent testing laboratory for acceptance testing. The Deficiency Notices issued to date include 2 for quality related reasons with minimal re-work being required.
- **Recommendation #3:** Schedule Reliance on Co-Occupancy has inherent risks that need to be assessed and managed.
  - **Response #3**: The risk associated with the co-occupancy of the LCLS facilities will be managed by incorporating a jointly-developed access plan based on the following:
    - Priority assigned to Civil construction
    - Co-occupancy dates proposed by Turner and accepted by LCLS
    - Technical Installation work categorized and scheduled to minimize potential interferences.

# April 2007 Recommendations & LCLS Responses:

- **Recommendation #4:** CF is implementing an impressive list of DOE safety standards. These should be included in safety status presentations.
  - **Response #4:** Safety performance is paramount. However, frequency of minor events continues to alarm. Stern consequences applied.
- **Recommendation #5:** Implement the proposed tunnel boring schedule as soon as possible
  - **Response #5**:
    - Recovery schedule was implemented.
    - Undulator Hall Tunnel excavation complete. Concrete subcontractor preparing to place the finished invert slab.
    - Far Hall excavation proceeding well.
    - X-ray tunnel excavation well-advanced (additional construction access)
- **Recommendation #6:** Consider adding temporary safety person during the next shutdown
  - **Response #6**: Shutdown work is independent of CF work. Non-Turner work is supervised by UTR (safety trained).

# April 2007 Recommendations & LCLS Responses:

- **Recommendation #7:** Develop and implement the plan for dealing with "red lined" drawings
  - **Response #7**: A Project Management Document (PMD) will be prepared and made a part of the project record.

Yet to be implemented

- **Recommendation #8:** Schedule the next CF subcommittee review of construction before completion of the next critical activities required from CF in the next four months, assuming that FAC advice could be relevant in those areas.
  - **Response #4:**
    - CF-managed work made good progress since last meeting.
    - Project would like to reserve the offer for future