



***External Independent Review (EIR),
Linac Coherent Light Source(LCLS)
Project Baseline***

**Preliminary Observations and
Recommendations**

**June 10, 2004 Outbrief
at the**

Stanford Linear Accelerator Site

Burns and Roe Enterprises, Inc.



Agenda

- **EIR -Purpose and Approach/ Methodology**
- **Resource Loaded Schedule- Selected Work Breakdown Structure Analyses**
- **Total Project Cost and Project Schedule**
- **Work Breakdown Structure**
- **Risk Management**
- **Preliminary Design and Design Review**
- **System Functions and Requirements**
- **Hazards Analysis**



Agenda (cont'd)

- **Value Management / Engineering**
- **Project Controls/ Earned Value Management System (EVMS)**
- **Project Execution Plan**
- **Start-up Test Plans**
- **Acquisition Strategy**
- **Integrated Project Team**
- **Summary Recommendations**
- **Path Forward**



EIR Purpose & Approach

- **EIR Purpose**
 - **Determine Reasonableness of Proposed Baseline Total Project Cost (\$315M through FY08) and Schedule (Start Operations October 2008)**
 - **Review Supports DOE CD-2 Decision and Baseline Validation Review**
- **Approach/ Methodology**
 - **DOE O 413.3, DOE OECM Procedure & Review Plan**
 - **Using: Proposed Baseline Package + Other Material Pre-Established Lines of Inquiry Site Staff Discussions**
 - **Review Material/ Discussion Results**
- **Determine Reasonableness of Baseline**
- **Provide Summary Recommendations**



Introduction

- ***Environment Is Exceptionally Cordial, Facilitating the EIR***
- ***LCLS Staff Was Well Prepared, Knowledgeable, Open and Forthcoming About Their Areas of Responsibility***



WBS Elements Examined

- **WBS 1.01, Project Mgt., Planning & Admin**
- **WBS 1.02.03, Injector Lasers**
- **WBS 1.03.02, Linac Controls**
- **WBS 1.04.03, Undulator Magnets**
- **WBS 1.05,04, Optical Subsystems**
- **WBS 1.06.05, X-Ray Detectors**
- **WBS 1.09.03, Undulator Hall, Near Experimental Hall, Far Experimental Hall & Caverns**



Resource Loaded Schedule

- **Schedule Is Resource Loaded As Required, ~14K Activities, Fully Integrated, Is Used As Project Controlling Document**
- **Resource Loading Is Exceptional And Fairly Represents the Overall Labor Requirements, Staff Very Knowledgeable In Use And Capabilities**
- **Major Challenge To Build Staff To Meet FY05 Needs**
 - ◆ **Project Developed Detailed Staffing Plan**
 - ◆ **Controls Staffing The Major Challenge**
- **Resource Levelization On A FY Basis Is Reasonable**
 - ◆ **Requires Further Refinement On A Month To Month Basis**
 - ◆ **“T&M Crafts” August 2007 Is 29.2 FTE, Staffing Plan Shows 5.8**



Resource Loaded Schedule (Cont'd)

- **Correct Miscellaneous Allocation Of Resources**
 - ◆ **Some Critical Activities Have Less Than 1 FTE Assigned**
 - ◆ XE_2602 “Design For Hall-Beamline Control”, 120 Days Resources Electrical & Controls, 120 Hours
- **For The Most Part, Schedule Durations Are Based On Experience On Similar Projects Or Prototype Development**
- **For WBS 1.03.02, Linac Controls; an Overall “Global” Schedule Or High-Level WBS That Ties-In and Coordinates All X.X.02 Control Subsystems Needs To Be Implemented**



TPC and Project Schedule

- **Schedule Development is Comprehensive**
- **4 1/2 Year Completion Appears to be Comfortably Achievable**
 - ◆ **Opportunities Exist To Complete Even Earlier (on Going)**
 - ◆ **Completion Of Main Control Ctr Could Be Much Earlier**
 - ◆ **Parallel Undulator Installation Shortens Duration**
 - ◆ **Linac Design Phase Acceleration Adds Float**
 - ◆ **New Tunneling Options Improve Baseline Finish Dates**
 - ◆ **Resequence Using Float And Funding As A Guide**
- **TPC Is Reasonable and Appears Achievable**
 - ◆ **FY05, Expected (Political Season) Continuing Resolution, If Prolonged, Could Affect Schedule**
 - ◆ **Contingency Comfortably Accounts For Cost Risks**



TPC and Project Schedule (cont'd)

- **Minor Adjustments Could Be Made to the Baseline Schedule**
 - ◆ **Determine Primary Project Critical Path(s) Schedule**
 - ◆ **Correct CD-4 Start Of Operations To 9-30-2008 (now 10-30-08)**
 - ◆ **Incorporate Known Adjustments To Duration**
 - ◆ **E.g. Central Lab. X-ray End Station and Others**
 - ◆ **Commissioning Integration Will Require Improvement**
 - ◆ **Injector Design/Procurement Completion April 2006**
 - ◆ **Injector Start Commissioning May 2006**
 - ◆ **Injector Controls Installation Starts March 2008**
 - ◆ **Review All Controls Integration And Validate Logic**
 - ◆ **Refine Logic: MMF 30% Review & Approval Ties Into MMF 60% Review & Approval, But No Work Is Shown Between Them**



TPC and Project Schedule (cont'd)

- **Primavera Needs Some Minor Corrections**
 - ◆ **Correct Coding For Some Level 3 Milestones**
 - ◆ **Tie Remaining Few Open Ends (Good Effort So Far)**
- **WBS Costs Are Based On Vendor Quotes, Catalog “Cuts”, Or Engineering Judgment**
- **For WBS 1.02.03, Injector Lasers: To Preclude The Laser From Becoming A Critical Path Item, the Proposed Design Change (Diode-Pumped Laser) Should Be Approved**
 - Recommendation**
A Preliminary Design Review Should Be Performed ASAP to Support RFP Release
- **For WBS 1.05.04, Optical Systems; Some Cost Build-Ups Have A High Degree Of Uncertainty, Are Based On Expert Opinion (No.6) and Appropriately Have Been Given A High Contingency**



TPC and Project Schedule (cont'd)

- **For WBS 1.06.05, X-Ray Detectors:**
Recommendation
 - * **Move the 2-D Integrating X-ray Detector And The “Enhanced” Steak Camera to OPC (These Are R&D Efforts).**
 - * **Leave the Beam Cameras As Procurements In 1.06.05**

- **WBS 1.09.03, Conventional Facilities:**
 - ◆ **Baseline Cost And Schedule Based On All Concrete Being “Trucked” In**
Recommendation: It Appears That A Batching Plant On Site Would Yield Benefits Considering Economics, Scheduling and the Community



Work Breakdown Structure

- **WBS Is Representative of Project Scope**
- **Some WBS Dictionary Elements Lack Sufficient Detail**
- **Some Minor Inconsistencies**
 - ◆ **WBS That Are Now “Reserve” Have Activities Associated**
 - ◆ **WBS 1.02.02.03.01, 1.02.02.04.01, 1.02.05.04**
 - ◆ **WBS 1.02.08.05, 1.02.10.07, 1.02.17.02**



Risk Management

- **LCLS Risk Management Plan meets the intent of DOE Order 413.3 and DOE M 413.3-1**
 - **Process Is Ongoing**
 - **Process Involves the Entire Project Team**
 - **Risks Are Quantified**
- **Contingency**
 - **Contingency Applied To Lowest WBS Level**
 - **Contingency Methodology Should Be Made Part Of Risk Management Plan**



Risk Management (cont'd)

- **For WBSs Assessed, Risks Are Generally Well Understood And Mitigation Plans Defined**
- **In General, “Continuing Resolution” Could Affect The Project Negatively, Especially FY2005**
- **Undulator Hall Environmental Control is a Potential Significant Contributor To Project Risks and Availability**
Recommendation: Perform HVAC System Evaluations For Meeting Spatial Temperature Distributions
- **95% LCLS Availability Goal Needs to be Examined**
Recommendation: Perform RAMI Analysis
- **DOE Has Considered Its Risks and Exposures For the Project, But Has Not Documented Them or the Potential Mitigation/Avoidance Plans**

Preliminary Design and Design Review

- **Design Reviews Have Taken Place And Are Continuing Or Are Planned**
- **Resulting Actions Are Being Addressed**
- **For WBS 1.02.03, Injector Lasers; a Laser Review Committee Has Been Established That Is Planned To Convene In The Near Future**

Recommendation: Since A PDR Is Still Required, Committee Should Perform This Function ASAP To Prevent the Delay Of Procurement Of the Injector Laser

Preliminary Design and Design Review

- **Undulator HVAC Systems Are Comprised Of Once Through Systems Without Filtration**
Recommendations:
 - ◆ **Evaluate Activation Of Particulates**
 - ◆ **Re-Evaluate HVAC Design and Provide Filtration If Required**
- **Large Diameter Tunnel Construction is Beyond SLAC Experience**
Recommendation: Seek An Independent Constructability Review
- **Formal System Design Descriptions Are Not Being Developed On The Project**
Recommendation: List Of Systems Needs To Be Developed and Documentation Defined

Preliminary Design and Design Review

- **Undulator Hall Temperature Tolerances Are Very Tight, Failure Of Equipment/Components to Maintain Will Result In Deterioration of System Performance**

Recommendation: Perform RAMI Analysis to Optimize System to Maintain 95% Operability

- **Undulator Hall Ventilation System Includes Fans That Are Inaccessible For Maintenance During Operation**

Recommendation: Analyze Consequences of Failure Of These Fans



System Functions and Requirements

- **Project Requirements Are Well Defined**
 - **Based On Physics Requirements Documents (PRD) That Generate the Engineering Specification Documents (ESD); Many PRDs Have Been Completed Or Are In-work; ESDs Are Being Developed**
- **Interfaces Must be Coordinated and Should Define Technical Data, Schedule Information and Responsibilities**
- **Interfaces Defined and Controlled By Interface Control Documents (ICD) That Are Under Configuration Control**
 - **Some ICDs Have Not Yet Been Written**
- **The Undulator Project Appears To Be Especially Well Managed; Prospects For The Successful Delivery Of the System On Schedule Are Good**



Hazards/Safety Analysis

- **Safety Analysis (SA) Documentation Is Well Written; However Improvements Are Necessary**

Recommendations:

- **Develop Logical Progression Of Hazard Evaluation and Mitigating Features Considered In the SA to Lead to Selection (and Documentation) Of Systems Important To Worker Safety, Systems (e.g., MPS) For Defense In Depth And Systems Important To Protection Of Plant Investment**
- **Include Analysis Of Enveloping Unmitigated Events (Such As A Runaway Beam)**



Hazards/Safety Analysis (cont'd)

- **LCLS SA Does Not Consider Hazards Associated With Accidental Release Of Large Stored Quantities Of Chemicals/Cryogenes At The SLAC Site (E.G. Plating Shop)**

Recommendations:

- **Perform Unmitigated Release Analyses To Determine Effect On Worker Safety**
- **If Worker Safety Is Affected, Enhance Chemical Containment to the Current Required High Standards For Natural Phenomena And Postulated Initiating Events**
- **Loss Of Electron Beam Dump Cooling System Is Not Evaluated**

Recommendations: Evaluate Consequences Of Loss Of Cooling and Consider Passive Cooling Systems



Hazards/Safety Analysis (cont'd)

- **Awareness Of Graded Classification Of Systems, Structures And Components And Corresponding Graded Application Of Design, QA, Operation And Maintenance Is Generally Lacking Amongst Design Groups**

Recommendation: Ensure That There is a Common Understanding Of Graded Requirements At All Levels And Is Reflected In Project Plans And Procedures

- **Fire Hazard Analysis (FHA) Has Not Been Performed**
Recommendation: FHA Should Be Completed In The Near Future



Value Management / Engineering

- **VE Studies Have Been Performed to Select Reference LCLS Concepts**
 - **Alternatives Were Evaluated During Conceptual Design**
 - **VE Program Has /Will Yield Cost Benefits**
 - ◆ **E.g. Cut & Fill Vs Tunneling and Tunnel Boring Strategies**
- **Technical Design Reviews Conducted or Planned in All Areas**
 - **Process Involves Appropriate Expertise and Decision Making Process (Mission Need, Constructability, Cost)**
- **Committees of Experts Review**
 - **Facilities Advisory Committee**
 - **Scientific Advisory Committee**
 - **Global Controls and Injector/Linac VE Review**
 - **Workshops**



Project Controls/ EVMS

- **EVMS: Conceptually Sound But Needs Further Development And Better Implementation**
 - **Establish Earning Rules And Develop A BCWS; Provide For A AWCP Collection That Is Consistent With All Three EV Elements**
 - **As An Example, The Title I Contractor:**
 - ◆ **BCWS -Uses Milestone % As Time Phased Distribution**
 - ◆ **BCWP -Uses Milestone % Complete To Earn**
 - ◆ **ACWP- Uses Incremental Progress To Authorize Billing Invoice**
 - Also Uses Accounting Process To Report Paid Amounts**
 - ◆ **Based On Current Data (As Of April 2004)**
 - ◆ **BCWS = \$ 535K**
 - ◆ **BCWP = \$ 536K**
 - ◆ **ACWP = Zero**
 - ◆ **Invoiced For Services Rented Through 3/11/2004 And Paid \$ 617K**
 - ◆ **SPI And CPI Variances Are Not Useful At This Point**
 - ◆ **Due To The Lack Of An Accrual System Cost Is Not Timely Accounted**
 - ◆ **Real Potential Problem Based On Data Provided:**
 - ◆ **Payment Of 617K For Work Up To 3/11/04**
 - ◆ **EV Shows Only \$ 536K Through End Of April 2004.**



Project Controls/ EVMS (cont'd)

- **BCWS**
 - ◆ Procurement- establish Distribution Guidelines.
- **BCWP**
 - Establish Earning Rules consistent to BCWS and ACWP
 - ◆ Introduce as much quantitative based % complete to Status Discrete Tasks
 - ◆ Contractors / Procurement: Reconcile Consistency of Earning Rules
- **ACWP**
 - ◆ Complete Transition of Collecting (Old) to New Cost Accounts
 - ◆ Develop and implement an “accrual” system
 - ◆ Establish Consistency in Capturing Expenditures
 - ◆ Three organizations three challenging ways of collection



Project Controls/ EVMS (cont'd)

Recommendations:

- **Perform a Detailed Review and Improve on Quality of All Three Elements of Earned Value**
 - ◆ **Align Earning Rules with BCWS/BCWP/ACWP**
 - ◆ **Establish with Procurement for Performance/ Payment Methods**
 - ◆ **Procurement/Contractor Accrual System**
- **Create Graphs That Report at Level 2 WBS and Consider Issuing CPI and SPI Graphs for Non LOE Tasks As Well**
- **Establish Internal Thresholds To Report On**
 - ◆ **Consider Lowering Current Reporting Thresholds**
- **Introduce Exception Reports To Help Manage Variances**
- **Conduct Review of Project Controls Processes and EVMS 60 to 90 Days After CD-2 to Verify Implementation**



Project Execution Plan

- **Project Execution Plan Good, Generally Contains the Required Material**

Recommendation: Minor Changes for Clarification

- Clarify Contingency Disbursements
- Augment Configuration Control Document List
- Show ANL and LLNL are IPT Members
- Make PEP and PMP Consistent
- Etc.

- **QA Manager Reports to Project Manager, Potential Lack of Independence**

Recommendation: QA Manager report to Non- Project Manager (SLAC QA Manager?)



Project Execution Plan (cont'd)

- **CD-4 “Success” Inconsistent With CD-0 Mission**
 - **CD-4 Measures Success as X-Rays Reaching the Far Hall**
 - **CD-0 Lists Specific Mission Goals**
 - ◆ **Photon and Beam Energy**
 - ◆ **Peak Power and Brightness**
 - ◆ **Pulse Duration and Repetition Rate**

Recommendation: Clarify PEP Defining CD-4 Consistent With CD-0 Mission



Project Management

- **Modify Project Management Plan**
 - Include Project Critical Path Schedule
 - Expand Configuration Management Controls
 - Discuss Tracking Systems
 - Make Change Approval Authorities Same as PEP
- **Large Funding Increase FY04 to FY05**
 - Continuing Resolution Could Have Significant Impact
- **Address Staffing Issues**
 - Significant Increase FY04 to FY05
 - Project Director Span of Control
 - Project Controls Staffing



Project Management (cont'd)

- **LCLS Stand-Alone**
 - Document All Bases Including SLAC Experience
 - Consider Systems Engineering Approach
- **Many Processes to be Implemented in Short Time Period**
- **SLAC Support Required for Success**
 - Support Needs to be Formalized Early
 - ◆ LCLS Director Interface With SLAC Peers
 - Procurement
 - Technical Support
- **DOE**
 - Project Staff Is Minimal
 - Too Dependent on LCLS



Start-Up Test Plans

- **Start-Up Plans Are Appropriately Developed for this Stage of the Project**
 - **Section 11 of the PEP Identifies Items That LCLS Must Complete As They Relate to Commissioning**
 - **LCLS Start-up Test Plan Defines Major System/Components That Must Be Tested and Their Goals**
 - **Detailed Test Procedures Will Be Developed at a Later Date As the System Equipment Is Purchased**
- **LCLS Has Addressed the Issue Of Spare Parts and Has Provided for Them in the Baseline**



Acquisition Strategy

- **Acquisition Strategy Is In-Place (AEP) and Consistent with Project Execution**
- **Acquisition Strategy Was Used as the Basis of Establishing the Procurement Strategy**



Integrated Project Team

- **Project Established an Integrated Project Team (DOE/LCLS Project) With Appropriate Expertise/ Disciplines**
 - **SLAC/ANL/LLNL Active Participants in IPT**
 - **WBS/Physicist Management Team**
- **Continue Development of IPT Relationship/ Interactions/ Coordination Necessary to Achieve Objectives**



Summary

- **Overall LCLS Cost and Schedule Baseline to Achieve Project Scope is Reasonable**
- **SLAC Experience Provides Confidence That LCLS Will Be Successfully Completed But Not Without Challenges Meeting the Mission Capabilities**
- **Baseline Cost Estimate Is Adequate**
- **Critical Path Schedule Needs to Be Finalized, But There Is High Confidence That the Overall Schedule is Achievable**
- **Risk Management Process Has Identified Risks and Potential Mitigation**
- **Planned EV Performance Measurement Process Has Appropriate Attributes, But Needs an Accrual System and Consistency in Its Application**
- **Safety Analysis Documentation Needs to Be Enhanced for This Stage of the Project**



Summary

- **Significant Challenges Include**
 - **Staffing Ramp-Up FY04 to FY05**
 - **Timely FY05 Appropriation**
 - **Keeping Scientific Staff Focused on This “Engineer/ Procure/ Construct” Project**
 - **Obtaining Required SLAC Support**
 - **Ensuring Timely Identification of Issues/ Problems**
 - **Early Implementation of Project Management and Controls Processes**



Path Forward

- **Today: Outbrief of Review of Reasonableness of Proposed Baseline Cost and Schedule to Implement Baseline Scope**
- **June 25: Issue Draft Report to OECM With Detailed Supporting Observations**
- **July 2: DOE Provide Factual Accuracy Comments**
- **July 12: BREI Issue Final Report to OECM**