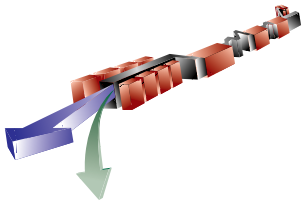
# 15 Work Breakdown Structure



***TECHNICAL SYNOPSIS***

*The Work Breakdown Structure (WBS) is used for defining work packages and developing and tracking the cost and schedule for the project. The work is broken down into tasks, each of which has a manager, a responsible institution, costs and schedule, technical scope, and, to the extent possible, a specific geographic piece of the machine.*

*Each level 3 element has a Task Manager who is responsible for the execution of the project plans for that element. The Task Manager is responsible for translating system performance requirements into design choices for the LCLS technical systems. He/she is also responsible for control of cost and schedule, quality and safety, and documentation. Performance requirements for systems at level 3 and below will be established and advocated by a System Manager. The System Manager advises the Task Manager and LCLS Project Management as to whether the LCLS systems will meet specifications necessary for the success of the Project. The Systems Manager is primarily an advocate of the performance of each system, with no responsibility for cost and schedule. Line responsibility for design choices and execution flows through LCLS Management and the Task Managers.*

*The responsibility for each level 3 element lies with one of the collaborating institutions. Other institutions may be involved in the execution but a lead institution is defined for each element. Also, to the extent possible, each level 3 element covers a specific piece of geography, which minimizes the complexity of the interface between elements.*

*The WBS is used to specify change control. The Project Management Plan specifies the levels of approval required for changes in cost and/or schedule at each level of the WBS.*

*The WBS is used for cost reporting. The project will report costs and progress to the DOE monthly at level 2 of the WBS. The project management will review costs and progress monthly at level 3. The System Managers will review costs and progress monthly at the lower levels of the WBS.*

## 15.1 Level 3 Work Breakdown Structure

The following describes the scope of work for each of the level 3 elements of the WBS. Each element includes design, simulations, documentation, fabrication, testing, installation, and commissioning of the equipment.

# 1. LCLS Construction Project (TEC)

**1.1. Project Planning, Management and Administration.** This element includes the general management of the project, establishment and operation of the cost and schedule tracking systems, generation of financial and technical reports, organizing technical and project reviews, and the accelerator and FEL physics activities not covered by the individual systems. Costs related to management of project-wide ES&H issues will be captured in this WBS element.

**1.1.1 ES&H.** This element will capture effort and other costs associated with management of safety issues in the design and construction phases of the Project.

**1.1.2 Project Supervision and Coordination.** This element will include the costs of oversight such as Project Director Reviews and other reviews. It will provide budget for Project Earned Value System.

**1.2. Electron Beam Handling Systems.** This element includes the technical equipment required to generate the electron beam, to accelerate and transport the electron beam, through the undulator, and to dump the electron beam.

**1.2.1 Injector.** The injector generates the electron beam and accelerates it to 150 MeV. This element includes the laser, optical transport, the electron gun, the accelerator sections, the solenoids and other magnets, the diagnostics including a diagnostic section at the end of the injector, the LCLS timing system, and the laser room. The interface to the Linac is at the downstream end of Dog Leg 1 (DL1).

**1.2.2 Accelerator.** The linac accelerates the electron beam while preserving the transverse emittance and compressing the longitudinal size. This element includes modifications to the last third of the existing SLAC linac, Bunch Compressor 1 (BC1), Bunch Compressor 2 (BC2), beam transport to the undulator, beam transport after the undulator, bend magnets and beam dump, the bypass system for transporting test beams to end station A, and diagnostics including characterizing both the electron and x-ray beams as they pass through the undulator.

The interface with the undulator is a vacuum flange at each end of the undulator. This element includes the common beam line beyond the undulator for the electrons and x-rays until the electrons are deflected enough

for an interface to the x-ray beam line.

**1.2.3 Undulator.** The undulator system provides the magnetic environment for interaction between the electron beam and an exponentially growing, coherent x-ray beam. This element includes undulator magnet, vacuum system, supports, beam diagnostics for the electron and x-ray beams in the undulator, ancillary magnets, magnetic measurements and fiducializing the undulator. Computer controls for hardware in the undulator path will be included in this element.

**1.2.4 Installation and Alignment.** This element is responsible for installation of the technical components and their alignment. This element includes the removal of existing components from the FFTB, installation of the undulator and dump magnets in the FFTB, the installation of new linac components, the installation of the injector components (not including the FEL x-ray optics).

**1.3. Photon Beam Handling and Systems.** This element includes all equipment required for manipulation and characterization of the x-ray beam downstream of the undulator. "Manipulation" includes collimation, attenuation, focusing, splitting/delaying, slicing/compressing, and monochromatizing. "Characterization" includes measurement of x-ray beam properties as necessary for commissioning and operation of the LCLS.

**1.3.1 X-Ray Transport and Diagnostics.** This element includes mechanical and vacuum systems for the x-ray beam path, shutters, attenuators, x-ray optics and x-ray diagnostics.

**1.3.2 X-Ray Endstation Systems.** This element includes the systems necessary to verify the performance of the x-ray optics and diagnostics and their suitability for LCLS scientific research. It will include laser systems to which the LCLS x-ray pulse must be synchronized in order to carry out many of the experiments envisioned for this facility. It will also include computer systems and detectors necessary to collect and analyze data necessary to verify the performance of the LCLS.

**1.3.3 Installation and Alignment** of Photon Beam Handling Systems.

**1.4. Conventional Construction.** This element provides the buildings and utilities to house and support the technical components from the Injector to the Endstation Systems.

**1.4.1 Injector Facilities.** The LCLS uses an existing tunnel at Sector 20 for the injector and an existing surface building for the gun laser. This element involves modifications to those facilities to accommodate the LCLS injector requirements including: clean room for the laser, personnel exclusion barriers for the PPS, and water and power distribution.

**1.4.2 Linac Facilities.** The linac housing will not be modified. This element includes modification to the existing utilities to provide power and cooling for the two chicanes and the new X band system.

**1.4.3 Undulator Facilities.** The existing Final Focus Test Beam tunnel will be modified to accommodate LCLS. This includes extending the tunnel approximately 64 meters to the east to meet the near hall, precision temperature control of the tunnel, relocation of the personnel access, and reconfiguring the utilities to match the new arrangement of components in the tunnel.

**1.4.4 Near Hall.** The LCLS Near Hall is a new building that will be constructed in the Research Yard. This element includes construction of this building and installing the utilities required by the x-ray diagnostics and the LCLS experiments.

**1.4.5 Tunnel and Far Hall.** The LCLS Far Hall will be constructed east of the Ring Road. The floor will be approximately 10 meters below grade to match the elevation of the x-ray beam. A laboratory and office complex will be included at grade, on top of the hall. This element includes installing the utilities required for the laboratories, offices, and the experiments. This hall is connected to the Near Hall by a tunnel through the existing hill between the halls. The construction of this tunnel is included in this element. The tunnel will be approximately 3 m by 3 m in cross section and will house an x-ray beam line (not included here) and cable trays for utilities and control cables.