U.S. Department of Energy (DOE)
Finding of No Significant Impact
Construction and Operation of the Linac Coherent Light Source (LCLS) at the Stanford Linear Accelerator Center (SLAC), California.

AGENCY: U.S. Department of Energy (DOE)

ACTION: Finding of No Significant Impact (FONSI)

SUMMARY: The U.S. Department of Energy (DOE) has prepared an Environmental Assessment (EA), DOE/EA-1426, evaluating the proposed action to construct and operate the Linac Coherent Light Source (LCLS) at the Stanford Linear Accelerator Center (SLAC).

Based upon the information and analyses in the EA, the DOE has determined that the proposed federal action does not significantly affect the quality of the human environment within the meaning of the National Environmental Policy Act of 1969.

Description of the Proposed Work:

The DOE proposes to construct and operate a new research facility at SLAC, the Linac Coherent Light Source (LCLS), as a collaborative effort with other DOE facilities. The purpose and need for the LCLS is the creation of a 4th generation X-ray light source from a single pass free electron laser (FEL). The FEL would have a peak brightness 10 orders of magnitude greater and with faster pulses (in the sub-picosecond range), than the most intense synchrotrons currently available. The higher peak brightness would allow examination of much smaller particles, and the faster pulses would allow scientists to evaluate changes within a very small timeframe. The FEL would not only reveal structures of the smallest molecules, but would also provide scientists with a tool to evaluate how interactions occur on an atomic level. Construction of the LCLS would further research in a broad range of fields, including physics, biology and chemistry. The LCLS would be the most powerful FEL in the world contemplated at this time.

The LCLS facility would take advantage of the existing infrastructure at SLAC resulting in significant cost savings. Proposed new construction would consist of two new buildings, called Experimental Halls (A and B), which would be connected by a new tunnel approximately 227 meters (745 feet) in length (Figure 2). The LCLS would use the last third of the three-kilometer (1.8-mile) Linac to accelerate the electrons to be used in the FEL. In addition, the LCLS would use the existing infrastructure above the Linear Accelerator (Klystron Gallery Building and existing utilities) to house an electron injector, electron beam transport system, and two electron beam pulse compressors for use in the FEL. A new undulator magnet to control electron direction to produce the x-ray beam would be housed in an extension of the existing Final Focus Test Beam (FFTB) facility. New X-ray optics are planned, as part of Hall A. Construction would be accomplished within SLAC's developed areas and within the land leased to SLAC. The current schedule for LCLS calls for a three-year construction schedule, beginning in October 2005.

Construction of the LCLS would involve:

1. Removal and disassembly of various accelerator and beamline components, such as vacuum chambers, magnets etc.
2. The refurbishment of reusable accelerator and beamline components.
3. The fabrication of new components at vendor facilities or SLAC.

4. Assembly of accelerator and beamline components into the existing housings and new support buildings.
5. The upgrade, modification, replacement or installation of hardware such as power supplies, control systems, personal protection system, beamline data acquisition instrumentation etc. that is needed to achieve LCLS operating criteria.
6. Construction of two experimental halls and a tunnel to connect the two.
7. Some minor re-routing of utilities to accommodate the new buildings.

Operation of the LCLS is expected to begin in 2008, with an estimated operational lifetime of 20 years. During operations a new injector consisting of a gun and a short linac is used to inject an electron beam into the last kilometer of the SLAC linac. With the addition of two stages of magnetic bunch compression, the beam at the entrance to the undulator has an energy of 14.3 GeV, a peak current of 3,400 A, and a normalized emittance of 1.2 mm-mrad. A transfer line takes the beam and matches it to the entrance of the undulator. The 121-m long undulator will be installed in the tunnel that presently houses the Final Focus Test Beam Facility. After exiting the undulator, the electron beam is deflected into a beam dump, while the x-ray beam enters the Experimental Halls.

Alternatives:

Three alternatives to the proposed action were considered: (1) No action. Under the no action alternative, the LCLS would not be built and existing SLAC facilities would continue to operate until the termination of their useful lifetime. (2) Siting the LCLS at an alternate SLAC location. Under this alternative, the LCLS would be sited at SLAC, but at another location using the existing Linac. This alternative is not viable because the LCLS layout must be aligned with the axis of the Linac to take advantage of its capabilities and that of other key existing structures. (3) Siting the LCLS at another DOE site. Under this alternative, the LCLS project would be built at a collaborator laboratory and not at SLAC. There is not a 1-km linear accelerator available to accelerate electrons for the FEL at any other DOE site. This alternative is not viable, as the cost to duplicate the LCLS Linac elsewhere would more than double the proposed LCLS budget.

Environmental Impacts:

Construction: The EA analyzed the impacts of the LCLS at SLAC for effects from construction, normal operation, accidents, decontamination and decommissioning, and cumulative and long-term impacts. The EA considered impacts to air and water quality, land use, biological resources, noise, traffic, and hazardous material usage. As described in the EA,

there would be no significant environmental impacts from construction and operation of this facility.

Operations: The impacts of ionizing radiation produced during normal operation are anticipated to be negligible. The copper plated stainless steel vacuum chamber and surrounding concrete accelerator housing walls would absorb nearly all of the radiation. Induced radioactivity could occur in a small number of components or devices. The number of workers that would be exposed to measurable amounts of radiation from the LCLS in the course of normal operations would not exceed 50. Based on a lifetime (age 20 – 64 y) risk of 3.69×10^{-4} fatal cancers per rem for adult workers (NCRP, 1997), the maximally exposed worker would have an annual probability of fatal cancer induced by radiation of approximately 4×10^{-6}. The average exposed worker would have an estimated annual risk of approximately 5×10^{-7}.

Potential radiation sources associated with normal operations at the LCLS project are very small. Calculations for total potential radiation exposures to the closest hypothetical maximally exposed resident off the SLAC site, 487 meters (1640 feet) from the LCLS, show that the contribution from LCLS would be less than or equal to 0.2 mrem/year as compared to the DOE dose limit of 100 mrem/year.
Possible accidents involving radiation at LCLS include beam-loss events and release of induced radioactivity into the air from normally sealed spaces. The most serious radiation accident that could occur during LCLS operations would be the total loss of the injector beam at the maximum possible current and energy. Based on maximum credible beam power for the LCLS of 150 kilowatts and beam loss at a point where the shielding is least extensive, the calculated dose equivalent rate to the nearest member of the general public (a distance of 487 meters or 1640 feet) would be about 0.56 mrem/hour as compared to the DOE dose limit of 100 mrem/year. This rate would last for only a fraction of a second, thereby producing a negligible radiation dose. Impacts from radiological accidents would not significantly affect worker or public health and safety at SLAC.

Decontamination and Decommissioning (D&D): D&D activities relating to the LCLS facility and equipment are anticipated to have negligible impacts to worker and public health and safety. Once the decision to decommission LCLS is made, a plan will be written ensuring the best available technology is used and that all closure activities are in accordance with applicable laws and regulations, as reflected in established SLAC and DOE policies and procedures. Decommissioning would be expected to consist of the following two general stages: assessing the current conditions, and determining appropriate decommissioning procedures. Components would be placed into a state of protective custody, and could include

the following operations: initial decontamination, disconnection of some or all operating systems, drainage of liquid-filled systems, physical and administrative controls to limit access, characterization surveys, and surveillance and maintenance, as necessary. Appropriate decommissioning procedures would be developed, and could include removal and dismantling, cleaning of equipment, materials, and buildings, as appropriate. Items could be stored for future use, or packaged according to DOT specifications, and shipped to an appropriate disposal site. The NEPA process would be used as appropriate, to assist decision-making during the decommissioning process.

Cumulative Impacts: No cumulative or measurable long term environmental impacts are expected from the proposed construction and operation of the LCLS facility. The radiological dose attributable to LCLS operations would have negligible contributions to the cumulative impact of SLAC operations. The contributions of waste products from construction, operation, maintenance, and D & D activities would add to the waste accumulation and the environmental impacts associated with the disposal facilities. Their contribution to such impacts would be negligible. LCLS operations are not expected to cause soil or ground water activation.

Environmental Justice: Executive Order 12898 requires that all federal agencies evaluate whether proposed actions would cause disproportionate impacts on minority or low-income communities. Neither the construction or operation of the proposed action would affect low income or minority community or place it at a disproportionate risk, nor would it use criteria, methods or practices that would discriminate on the basis of race, color or national origin.

Determination:

Based on the information and analysis in the EA, the DOE has determined that the proposal to construct and operate the Linac Coherent Light Source (LCLS) at the Stanford Linear Accelerator Center (SLAC) does not constitute a federal action significantly affecting the quality of the human environment within the meaning of the National Environmental Policy Act of 1969. Therefore, a FONSI is made and an Environmental Impact Statement is not required.

Public Availability:

Copies of this EA are available from:

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On the LCLS web site at
http://www-ssrl.slac.stanford.edu/lcls/documents/Final-LCLS-EA-Report_2-6-03.pdf

or

For further information regarding the DOE National Environmental Policy Act (NEPA) process, contact:

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