LCLS X-Ray Endstation System Review

December 2, 2003

The Endstation Systems Review committee was asked to evaluate the program in six areas:

Does this Endstation work scope seem appropriate?

The work scope was defined to consist of 1) personnel protection systems, 2) machine protection systems, 3) network and computer support, 4) beamline controls, 5) basic experimental chambers, 6) synchronized laser system, and 7) prototype detectors. The committee felt that each of these was appropriate. Some concern was voiced regarding the communication between the beamline optics group and the endstation group, since there are many high-impact issues which span this boundary. Management should ensure that the needs and concerns of both groups are adequately communicated.

Detector procurement should be partitioned into basic, day-one systems purchases and longer term, more speculative systems development. A basic set of commercial detectors should be procured, including a good 2-D x-ray detector. These should be procured as late as consistent with on-time delivery to allow the best specifications to be obtained.

A longer-term investment is worthwhile in more speculative areas, specifically in areas for which a good commercial solution does not, and will not, exist. Some of this development should be coordinated with the optics and diagnostics group, since their instrumentation will presumably require detectors. Others should coordinate with the individual experiments when they are chosen. Large pixel detector arrays are still speculative, and some further review would be warranted to decide which of the various competing efforts should be supported.

The streak-camera collaboration currently underway at SPPS seems to be a good basis for further development for LCLS. Other high-speed detector systems may well have to wait until the LCLS beam is available to be tested, and should therefore not be part of this initial R&D effort.

Are there aspects that are irrelevant or missing?

All of the items described to the committee are important for the successful completion of high quality science at the LCLS.

However, since distribution of accurate, flexible triggering signals is crucial to the success of almost all the proposed science, development of a timing and beam parameter distribution system should be added to this list. In addition to distributing trigger signals, this system should provide a unified approach to time-stamping all data taken including electron and x-ray diagnostic data.

Is the proposed scope technically feasible? Is there a better way?

The work described in the presentation is clearly feasible. There was a significant discussion about the beamline control and network systems.

The LCLS experiments and machine require a high performance data and communications network that is tailored to:

a) real-time machine performance and experimental synchronization
b) data networks with sufficient bandwidth
c) experiments network that controls instrumentation and manipulates data
d) standard business network (might be same as experiments network)
e) user and visitor network to interact with the experiments

The communication and data requirements for the LCLS experiments will require then-state-of-the-art network, computing and data infrastructure. For the initial period (first 2 years), a network design should be established that is consistent with the schedule of the Controls development. In the last two years before commissioning, a significant increase in networks will be required.

Sufficient expertise to fulfill these requirements exists within the SSRL network group but would require fractional expansion in the beginning followed by a dedicated effort in the second phase.

A project plan must be developed rapidly that includes at least the following components:

a) requirement gathering from the initial (atomic physics) and subsequent 5 experiments must be conducted and should include information on similar experiments that are currently being conducted including the SPPS experiments
b) establish software process for the entire project
c) establish timelines, deliverables, and milestones; this is the most critical aspect since the long-lead time followed by short implementation time does not leave any time for re-designs at commissioning time
d) develop UML on the each of the experiments and establish common ground for all and for subsets of experiments

In order to accomplish the above, a development team needs to be established that includes the following members (by expertise):

a) Scientific software developer/staff scientist
b) Software engineer
c) Systems developer
d) Software programmer
e) Database developer
f) Systems administrator
g) Network administrator

While a certain degree of staging is possible, a core group (a-c) has to be established immediately, followed by the development group (d,e) after the first year and the administration group a year ahead of the commissioning. The different expertise areas and competencies envisioned above is a model that has been used successfully at SSRL, which could serve as a model for the approach.

The choice of EPICS for the instrument control seems appropriate. The requirements of all instrumentation being time-synchronized and/or time-stamped has been highlighted earlier and clearly a mission critical component to make the experiments successful. A design has to be developed that can deliver all relevant beam parameters (energy, intensity, time, profile) to the experiment on a shot-by-shot basis so that triggers can used and/or data be correlated in post-experimental processing.

Where are the high risk areas? Are there ways to mitigate the risks?

Development of suitable timing and synchronization systems is clearly difficult and crucial for the success of the project. The committee urges an early start at developing and testing those systems, possibly on the SPPS project which closely mimics many of the problems which will be faced by LCLS.

Large pixel detector arrays are still speculative, and some further review would be warranted to decide which of the various competing efforts should be supported.

Do the preliminary cost and schedule calculations seem reasonable?

The overall budget is reasonable. However, analysis of individual portions of the program is difficult because of the preliminary nature of the plan. It will be critical to rapidly establish milestones, deliverables, and actual engineering goals to establish if the prelim cost and schedules are realistic. A monitoring of these milestones over the initial year will provide the data to evaluate if it is realistic.

Is further review necessary?

While further review is not absolutely necessary, there are many details yet to be defined. As these are defined, further review may be desirable.