

Date: December 3, 2004

To: M. White, S. Milton

From: I. Churin, F. DePaola, J. Grimmer and S. Sharma (Chair) *SKS*

Subject: Final LLP Pre-Production Review of the APS-LCLS Undulator System

Attached is the review report for the final LLP pre-production review of the APS-LCLS undulator system held at APS on November 15, 2004. We appreciated the opportunity to participate in this project as review committee members.

cc:

M. Erdmann

J. Ingraffia

G. Lawrence

E. Moog

E. Trakhtenberg

I. Vasserman

D. Walters

Review Report

APS-LCLS Undulator System – Final LLP Pre-Production Review

A final Long Lead Procurement (LLP) Pre-production Review of the LCLS Undulator System was held on Tuesday, November 15, 2004 at the Argonne National Laboratory (ANL). The review committee members consisted of Igor Churin (Fermi National Accelerator Laboratory), Frank DePaola (Central Shops/ANL), John Grimmer (APS/ANL), and Sushil Sharma (APS/ANL) who chaired the review.

The review agenda with presentation topics is shown in Attachment-1 of this report. The committee appreciated excellent presentations by the LCLS team: Steve Milton, Marion White, Emil Trakhtenberg, Joseph Ingrassia, Glen Lawrence, Elizabeth Moog, Dean Walters, Mark Erdmann, and Issac Vasserman who gave a guided tour of the prototype undulator facility. Several presentations covered various technical design aspects of the LCLS Undulator System in so far as they could affect the long lead procurement. It was stated that the technical design of the undulator systems had already been reviewed in depth by several previous review committees. Also, for the purpose of this review the committee was advised to ignore design changes relate to gap and pole-spacing that are presently under consideration.

The following is the response to the four specific items in the Charge to the Committee.

(1) Are we ready to release long-lead procurements necessary to construct the specific undulator design that was presented to the Committee's? [SOW, drawings, QA, schedule].

The undulator system procurement, including design drawings, statements of work (SOWs), assembly procedures, and procurement support, has all been well planned and documented. The overall system design, procurement approach and QA plans are sound. There appears to be no show-stopper that could impact the long-lead procurements.

The following recommendations are presented by the Committee to strengthen the long-lead procurement.

1. The delivery schedule for the strongbacks (one unit every 2 weeks) seems aggressive. Having more than one vendor submit a first article is recommended. The delivery and performance of the first article should be an important consideration in the decision of how the total quantity would be split between the vendors. The SOW for the strongback should be modified to reflect this approach.
2. The outside-diameter machining of the strongback should be modified to: (a) add a machined flat surface to be used for support and clamping for the subsequent machining, (b) eliminate any provisions for attaching magnetic needles as was discussed during the review, and (c) allow attachment of the strongback to the support/mover system regardless of how the latter evolves in its design.

Additionally, the machining tolerances should be reviewed to ensure that the strongback is not over-toleranced.

3. It was mentioned in the review that the successful bidder for the magnet poles would be responsible to purchase a special machine that would be used to minimize the loss of material when cutting blanks from a forged bar. This should be mentioned in the poles' drawing and/or in the SOW for the poles.
4. A note should be added to the strongback's drawing that specifies where and how the strongback would be supported during inspection. These locations should be the same as those used in the final assembly to ensure that the tolerances are verified in the same functional position.

(2) Are we ready to proceed with the undulator assembly program and to successfully manage all vendors?

The undulator assembly procedure is well conceived and has been shown to work on the prototype LCLS undulator. There is nothing in the assembly procedure, or in the designs of magnet/pole structure base and assembly fixture, that would conflict with the long-lead procurement items (strongbacks, poles and permanent magnets).

The undulator assembly program itself needs to be further developed with design drawings, procedures, SOW and QA plan before this phase of the procurement (undulator assembly) can be initiated.

(3) Although some components are not yet designed [fixed supports, support/mover system, vacuum chamber..], are there any issues that would prevent us from proceeding to procure long lead items?

Fixed supports and vacuum chamber have no direct attachment to the strongbacks. The interface between the support/mover system and the strongback should be modified as mentioned above. There are no other issues that would impact on the procurement of long lead items.

There was some concern that the new design options for the vacuum chamber may not be consistent with the present undulator design, but this was considered to be outside the scope of this review.

(4) Are there any other issues of concern, or issues that would prevent us from proceeding as planned to construct the specific undulator as designed.

It was conveyed to the Committee that a decision to change undulator gap and pole spacing will be taken within the next couple of months. The Committee recommends that any changes (of the scope that are consideration) be first implemented in the prototype undulator for evaluation before initiating the long lead procurement.

A few other minor concerns and comments, which should have no impact on the long-lead procurement, are as follows:

1. A vendor-specific material, Neomax 335H (should be 35H), has been specified in the magnet drawing L143-110106. This would preclude other vendors.
2. In the SOWs the critical measurements are specified without units. Perhaps a note can be added that all dimensions are in millimeters.
3. In the pole drawing L143-110105, annealing is specified to be carried out in vacuum or in dry hydrogen atmosphere, whereas in the SOW an inert gas atmosphere is specified.
4. No time duration is specified for thermal stabilization of the magnets (SOW, page 6).
5. The critical dimensions are to be inspected as 20 °C. Is it consistent with the operating temperature in the LCLS tunnel?

Attachment - 1

Agenda:

Monday, November 15, 2004

- 09:00 - **Welcome and Introduction to LCLS** Stephen V. Milton,
09:30 ANL
- 09:30 - **Charge to the Committee, Undulator Magnet** Marion White, ANL
10:00 **Scope,**
Procurement plans, Integration with SLAC
- 10:00 - **Undulator Mechanical Design** Emil Trakhtenberg,
11:00 ANL
- Modifications since March 2004
 - Overview and recommendations from the internal design review (IDR)
 - Responses and measurements after the IDR
- 11:00 - *Break*
11:15
- 11:15 - **Tour of the Prototype Undulator** Isaac Vasserman,
12:00 ANL
- 12:00 - *Lunch*
13:00
- 13:00 - **ANL Procurement Preparations in Support of** Joseph A. Ingraffia,
13:30 **LCLS** ANL
- 13:30 - **Presentation of the LLP SOW's** Glen Lawrence, ANL
14:30
- Drawing Packages
 - QA
 - Vender Prequalification
- 14:30 - **Magnet Material Choice** Elizabeth Moog,
15:00 ANL
- 15:00 - **Support and Mover System** Emil Trakhtenberg,
15:30 ANL
- Design and Procurement Considerations for the Support and Mover System
 - Integration of the Support and Mover System with the Undulator Structure
 - Electromagnetic Quadrupoles and

- Fixed Supports

15:30 - *Break*

15:45

15:45 - **Integration of the Vacuum and Diagnostics into the** Dean Walters, ANL

16:15 **Undulator**

16:15 - **Undulator Assembly Plans and Procedure** Mark J. Erdmann,

17:00

ANL

17:00 - **Committee Closed Session**

Tuesday, November 16, 2004

09:00 - **Committee Deliberations**

12:00 LCLS personnel available to answer questions

12:00 - *Lunch*

14:00

14:00 - **Closeout**