December 1, 2006

To: Distribution
From: GDE Change Control Board
Subject: Response to the Change Request (November 16, 2006) for the BCD Polarized Electron Source – CCR#22

Preamble

This is the CCB response to the proposed changes to apply to the Polarized Electron Source (PES) section of the November 5, 2006 version of GDE ILC Baseline Configuration Document [1]. CCB received the change configuration request (CCR) from A. Brachmann on November 16, 2006 and CCB forwarded it to GDE the next day [2]. Request was treated as Class-1. N.Toge and M. Kuriki were assigned as the CCB reviewers. The initial CCR did not include the proposed replacement text for the PES section, but it was later submitted by the requester on Nov. 28, 2006. The cost impact assessment which was provided by the requester was confirmed by GDE Cost Engineers on Nov.30, 2006 (Appendix A).

Summary

Requester proposed:

CCR#22a: Eliminate second (backup/redundant) normal conducting beam line.
CCR#22b: Eliminate cavern for laser system; locate laser system in above ground building and addition of a small diameter shaft (d = 1.5 m) for laser beam transport.
CCR#22c: Modification of 'dogleg' section of beamline - Replace with vertical chicane.
CCR#22d: Replace 2 L-band bunchers and NC pre-accelerator with combined TW tapered L-band bunching and pre-acceleration section.

The main motivation for this CCR to the electron source baseline design is to reduce the overall cost of this area. CCR#22a and #22b will significantly reduce the cost of the injector, mainly through reduction of the lengths of beam and service tunnels and through elimination of a large cavernous space that would have been used to house the laser system. A second set of cost savings results from elimination of beam line components. The new beam line layout allows the modification of the 'dogleg' section of the beam line into a vertically oriented chicane, which is advantageous from an operational point of view. In addition, recent (but still preliminary) simulations of the L-band bunching section show significant improvements of injector efficiency if a tapered (beta-match) TW bunching section is used, instead of two L-band buncher sections of the baseline design. The last two subjects (#22c and #22d) are not expected to have a significant impact on the cost of the injector.

CCB response:

1. **CCB agrees that the cost change (in this case, reduction) expected from this change request is substantial, such that it qualifies as Class-1.**
2. **CCB finds that the revisions to the baseline configuration of the PES system reasonable and acceptable and accepts this change request as is.**

Discussion:

Availability issue:

1. CCB concurs with the requester that impact to the availability by eliminating the second normal conducting beam line is not significant, since the CCR proposes to retain spares of the critical components in ways integrated into the remaining beamline: drive laser, polarized gun and buncher klystron.
2. CCB foresees that relocating the laser system from the cavern to a surface building will improve the system availability through better accessibility for maintenance. The existence of an accessible spare will be of particular advantage, because it will allow laser development and improvement programs to proceed in parallel with accelerator operations. CCB notes that this comment is based partially on PES experience at JLab, where the spare laser system is installed in the accelerator enclosure and is not accessible during accelerator operations, necessitating investment in a third, off-line source for testing and development.

Beam performance:

1. CCR notes that a long transportation of laser light from surface to underground (CCR#22b) will bring about an increased amount of pointing jitter of the laser spot on the cathode, unless adequate stabilization measures (either passive or active) are taken.
2. According to recent simulation quoted in the CCR, CCR#22d (2 L-band bunchers and NC pre-accelerator replaced by a combined TW tapered L-band bunching and pre-accelerator section) improves the bunching performance. Bunch length defined by FWHM after this section is unchanged, but FW is reduced by half. FW energy spread is also improved from 1.5 MeV to 0.6 MeV. Transmission can be almost 95% (6.1nC/6.4nC) at 40 MeV. CCB consider that CCR#22d is reasonable from a beam-performance point of view.

Cost issue:

1. Magnitude of the cost reduction expected with this CCR, as provided by the requester and the GDE cost engineers, is summarized in Appendix A.
2. CCB finds that cost reduction is dominated by elimination of the large cavern for an additional beam line and many components.
3. CCR#22b requires an additional surface structure and a 1.5 m shaft for the laser transportation, but the laser cavern and the 9m access shaft, provided in the BCD, can be eliminated. The laser system requires only a conventional building, where air is well conditioned and controlled. This cost is likely much less than an equivalent space under ground, the laser cavern. The cost reduction by changing the shaft diameter from 9 to 1.5 m is obvious.

Overall CCB Assessment:

1. CCB finds that this CCR brings in a substantial cost reduction while maintaining a good likelihood of achieving a workable ILC design.
2. CCB notes that a careful consideration is critically required for the pointing jitter issues of the laser spot on the cathode. Some ways (optical fibers within a temperature-controlled conduit with possibly some active feedback elements, etc) to control the disturbance along the laser beam transport should be provided and be made part of the BC description of PES in a near future.

Additional Notes:

None

E N D

References

[1] http://www.linearcollider.org/wiki/doku.php?id=bcd:bcd_home .
[2] http://lcdev.kek.jp/ML/PubCCB/msg00110.html

Appendix A: Cost impact summary of CCR#22

Subject: RE: CCR#22 (PES) Cost Impacts
From: T.Shidara
To: N.Toge
Cc: A.Brachmann, P.Garbincius, W.Bialowons
Date: Thu, 30 Nov 2006 14:37:59 +0900

Dear Toge-san,

Your interpretation for the cost impacts of CCR#22 is correct.

Here is our confirmation for the cost impacts of CCR#22.

Cost saving: Cost difference BEFORE and AFTER the change is approximately 16.8 %, normalized to the total electron source cost.

CCR Class: This cost saving corresponds to Class 1.

Note 1: Due to our ILC-GDE confidentiality protocols, actual cost numbers are not shown here. With your knowledge you have gained in the past, this form of fractional cost difference might be sufficient for CCB.

Note 2: Assessment is partly based on the file “e-cost_summary_11_02_06(Valencia Ver.1)” prepared by the electron source AS leaders. Main contribution comes from CF&S part.

	Contributions to the total e- source cost as of Vancouver	*Cost reduction factors expected from CCR#22*	*Expected contributions to the total e- source cost after CCR#22*
e- source management	4.8%	16.8%	4.0%
e- source specific items	4.9%	20.6%	3.9%
cryogenics	3.7%	0.0%	3.7%
CF/S	45.8%	28.0%	33.0%
installation	5.6%	8.3%	5.1%
instrumentation	2.2%	8.3%	2.0%
cavities	0.0%	0.0%	0.0%
cryomodules	17.2%	0.0%	17.2%
LLRF	1.6%	6.0%	1.5%
HLRF	8.0%	7.7%	7.4%
magnets	5.7%	10.0%	5.1%
dumps and collimators	0.5%	35.7%	0.3%
vacuum system	0.3%	15.8%	0.2%
sum	100.0%		83.2%

Net cost reduction of e- source system with CCR#22 **16.8%**