# To:DistributionFrom:GDE Change Control BoardSubject:Response to the Change Request for the BCD Parameter section

#### Preamble

This is the CCB response to the proposed change on the Parameter section of the April 23, 2006 version of GDE ILC Baseline Configuration Document [1]. CCB received the change request from E.Paterson and N.Toge on April 21, 2006 [2], and CCB forwarded it to GDE the same day [3]. An important technical reference for this Change Request is a report written by H.Ehrlichmann et al in April, 2006 [4]. This change request was classified as Class-1. Initially, G. Blair and S.Mishra were assigned as the CCB reviewers. Due to an urgent non-CCB task, S.Mishra was replaced by K.Kubo on April 26.

#### Discussion

This change request consists of three points as follows:

- (1) Minor textual improvement of the Baseline Parameter descriptions.
- (2) Creation of a "Layout" subsection within the Parameter section.
- (3) Introduction of the "approximately 1.2km-long positron insert", which adjusts the path length of positron beams. It is needed for ensuring the collision of electron and positron beams under a variety of bunch patterns.

Discussions ensued among the members of CCB, GDE and GDE-related groups. Some of them are enumerated in the reference section of this report. W. Funk and G. Blair contributed improvements to the text. K. Kuriki [3] and H. Ehrlichmann [4] gave comments on the bunch-timing configuration. The leaders of the Positron Source, Damping Ring, Main Linac and BDS [6] Area Groups contributed their remarks at the request by CCB. In response, clarifications were made in the proposed text, and an amendment was submitted by the requesters on April 28.

CCB agrees with the proposed changes in (1) and (2), which improve the completeness of BCD.

Concerning (3), CCB agrees that the type of path length constraints discussed in [4] would be a logical consequence if we assume the following conditions:

- a) Undulator-based positron source is implemented, and
- b) Colliding beam in the electron linac is used for producing photons with these undulators, and
- c) Damping rings with circumferences ~6.5km are located near the upstream ends of the two main linacs, and
- d) Certain operational flexibility need to be ensured in terms of bunch fill patterns in the damping rings and bunch numbers in each machine pulse,

Given the conditions a) through d) and considering the need for expediting the ongoing efforts towards the ILC Reference Design (RDR), CCB concurs with the requester that the proposed insertion of the "1.2 km-long positron insert" is a reasonable, additional working assumption to introduce. Therefore, CCB accepts and approves the change request in the form amended by the requester. The updated files have been uploaded at [1].

CCB would like to take this opportunity to point out some outstanding issues stemming from this Configuration Change:

- It was pointed out by M.Kuriki that the positron transport energy in the new text of this section, 400 MeV, is not consistent with the description in the Positron Section, i.e. 250 MeV. In consultation with the Positron Source Area Group, CCB understands that 400 MeV is the presently preferred transport energy. CCB assumes that at some point in the near future the Positron Section of BCD be updated to incorporate this and other relevant revisions.
- The length of the "positron insert" is dependent on the design details of the undulator section, including the separation of photon and electron beams as well as provision for allowing production of polarized positrons in the future. The exact details of these issues are still under evaluation as of now (early May, 2006). Some aspects of it might be site-dependent.
- As stated earlier, CCB agrees with the need for complying with path length constraints and the need for path length adjustments as laid out in this Change Request. However, if any of the conditions a) through d) above are revised, the optimum layout design of ILC could turn out to be something other than inclusion of the "positron insert" as discussed in this Change Request. CCB notes that further optimization of the solution, in terms of overall machine performance and cost, needs to be left for post-RDR studies. This work can involve a major reevaluation of the positron production system and the overall machine layout.

#### References

[1] <u>http://www.linearcollider.org/wiki/doku.php?id=bcd:bcd\_home</u>

- [2] http://lcdev.kek.jp/ML/PubCCB/msg00049.html
- [3] http://lcdev.kek.jp/ML/PubCCB/msg00050.html
- [4]

http://www.linearcollider.org/wiki/lib/exe/fetch.php?cache&media=bcd:timingrecommendations -revapril17.pdf

[5] Appendix A

[6] Appendix B

## **Appendix A**

Subject: [CCB-337] AW: GDE Baseline Config Change with Bunch Timing Considerations

Date: Tue, 25 Apr 2006 16:58:48 +0200

From: Ehrlichmann, Heiko

To: N.Toge

CC: CCB, Paterson, Ewan

My comments to the proposed change of layout:

As mentioned in the change request text this solution is not the optimal solution, since it depends on several other parameters which have to be fixed in future; it's a good preliminary solution to allow further planning and costing based on a consistent layout (also with respect to the timing), even if the costs for this solution may be higher.

Unfortunately there is the risk that this layout will be taken as the final one; future changes could become difficult.

(In my opinion it's not unlikely that the layout will change to a solution with a central DR and injector complex; in this case the proposed linac tunnel extension could be reduced significantly.) Maybe the capability of path length changes of the "trombone" should be specified better: first of all it's an addition transport line, second it allows an adjustment for the second IP (DC switch between two different path lengths) and third it allows the injection phase adjustment for the e+ DR  $\rightarrow$  continuous and remote controlled path length changes within at least one RF bucket. Since the timing problem with two longitudinal spaced IP's (and full bunch timing flexibility for operation of both IP's) is solved by the trombone, the DR circumference can be fixed (to 6614m).

### Appendix B

- Subject: [CCB-368] RE: We Need Your Input on the Params Change Request Apr.21, 2006
- From: Andrei Seryi
- To: Nobu Toge
- Date: Sun, 30 Apr 2006 15:31:31 -0700

Dear Nobu,

Thank you again for sending us a request to study this issue.

In summary, I think that this issue merits further discussion, and that configuration of the insert and of the trombone could be made more optimal. I will explain below in details.

I) Let me summarize the sequence of events, as I understand it, to make sure I did not miss anything:

- 1) During Snowmass 2005 time, the ILC parameter sets have several FIXED values for linac bunch separation: 200, 400, 600 linac rf buckets (154ns, 308ns, 461ns).
- 2) Taking the above into account, BDS was designed to allow collisions in any of these cases, with path difference for two IPs =138m (600 linac rf buckets). In all parameter cases the bunches collide at the IP (several first bunches may "collide" with empty buckets, but this was considered OK).
- 3) Then at some point parameter group considered that the linac bunch separation can have many different values between min 200 linac buckets and max 600 buckets, as shown in Table1.1 in the BCD.
- 4) The DR group and Timing taskforce found (FOR GIVEN DR RADIUS AND RF FREQUENCY) the optimal fill patterns and possible optimal linac bunch separation, such as 134, 177, 237, 224, 256, 268, etc., linac buckets. None of those were same as 200, 400, 600, considered earlier. The optimal IP separation was suggested as, e.g. 61, 123, 185m, all different from 138m that BDS assumed.
- 5) A change request was suggested that introduced an insert into low energy positron beamline for correction of path length (by 1.2km) and also included a trombone which would correct for IP path length difference. The trombone has two 180deg turns and e+ go through the trombone if either of IPs is used.
- II) Questions on the proposed trombone configuration:

- The positrons in this region have energy spread of about 10% (the energy of positrons in trombone is not specified in the text). There could be increased losses of e+ in the trombone. Does it affect ILC performance? Perhaps it does.
- 2) The trombones have also possibilities for small adjustment of path length. How big is this change and can it be done in other places, so that the beam would not have to go through trombone for this reason of fine adjustment? Since I haven't seen a proof, for the discussion below, I assume the answer is yes.
- III) Possible optimizations of the configuration:
  - Assume that we will build BDS so that the IP path difference will be optimal for one of most favorite configurations, e.g. 123.61m where the IP path length compensation is not needed
  - 2) Modify the trombone in such a way that it would have a straight-trough option, without the need to go around two 180deg turns.

With these modifications, there will be a set of time parameters which would not require use of trombone. The trombone will be needed only if some other linac bunch spacing will be used.

- IV) Questions for further study
  - 1) Design trombone in details and study beam losses
  - Study consequences that linac bunch spacing can have many different values and not only multiple of 200 rf buckets. This could be various electronics, diagnostics and maybe detector data acquisition.
  - 3) Now: study the range of IP path separation which BDS is comfortable with. In TDR time: chose the optimal separation and make another optics, when other layout and DR parameter will settle.

Best regards Andrei