February 3, 2006

To: **Distribution**
From: **GDE Change Control Board**
Subject: **Response to the Change Request for the BCD RTML section**

Preamble

This is the CCB response to the proposed change on the Ring-To-Main-Linacs sections of the Dec. 2005 version of GDE ILC Baseline Configuration Document [1]. CCB received the change request from P.Tenenbaum on January 27, 2006 (Appendices 1 and 2, and [2]; (Email copies are attached) and CCB forwarded it to GDE the same day. This Change Request was treated as Class-1. K.Kubo and D.Schulte were assigned as the CCB reviewer. Comments on this Change Request were received from L.Lilje [4], C.Adolphsen [5], W.Bialowons [6], W.Funk [7] and A.Wolski [8].

Summary

Overall, CCB finds that this Change Request constitutes a significant improvement of the RTML section along the lines of the discussion made at the Area System Leaders Meeting at KEK in January, 2006 [3], and that it merits positive considerations. CCB considers that most of the change requests should be approved. However, CCB assesses that it is not completely acceptable as a new RTML BC “as is”. CCB responses to specific change requests are listed below. CCB encourages the RTML area leaders to consult relevant parties within GDE, such as TS/Global groups, and hopes that they produce a revised Change Request soon.

Specifics

1. The damping ring extraction section is moved to the damping ring area.

Requester proposed: In Overview: eliminate “Completing the achromatic extraction of the beam from the damping ring" and "Moving the beam from the axis of the damping ring to the axis of the main linac (geometry match)”
In Baseline Description: Eliminate section on “Extraction Geometry and Betatron Match”.

CCB accepts these, as proposed. This change is consistent with the working agreement reached at the Area System Leaders Meeting at KEK in January, 2006 [3]. CCB approves this change with the provision that beamline descriptions are also updated for the Damping Ring and Main Linac sections accordingly.

2. The RTML-ML boundary lies between the diagnostic region at the end of the RTML and the upstream face of the first cryomodule in the ML.

Requester proposed: Delete the description of the diagnostic region at the beginning of the ML, which is redundant with the one at the end of the RTML.

CCB accepts this, as proposed. (This change should be in ML section, not in RTML section.) This change is consistent with the working agreement reached at the Area System Leaders Meeting at KEK in January, 2006 [3]. CCB approves this change with the provision that beamline descriptions are also updated for the Damping Ring and Main Linac sections accordingly

3. *The multi-wire emittance station immediately downstream of DR extraction is deleted and replaced with a single profile measurement device, technology to be determined.*

Requester proposed: Section on "Emittance and Trajectory Measurement", replace existing text with: This beamline uses a set of four orthonormal skew quadrupole magnets to couple all four xy coupling terms in the beam matrix; this allows coupling introduced by the process of beam extraction from the damping ring to be corrected globally. The coupling correction section is followed by a single transverse profile measuring device (exact technology yet to be decided), which permits emittance measurements to be made via quad scans. At the end of this beamline there is an insertable stopper which can be used to stop the beam from passing into the collimation section http://www.linearcollider.org/wiki/doku.php?id=bcd:ring_to_main_linac:ring_to_main_linac_home#transverse_collimation and other downstream areas. This stopper can probably only handle a fraction of the nominal beam power, and so can only be used for very short trains, very low repetition rates, or some combination of the two.

CCB suggests to perform further study whether reliable tuning of the damping ring extraction would benefit from a full emittance measurement (solving *x-y* coupling) immediately downstream of the damping ring.

CCB suggests to state "The exact specifications for the beam-handling capability of the RTML beam stops are pending further discussion among the GDE." CCB suggests to eliminate the sentence "This stopper can probably only handle a fraction of the nominal beam power, and so can only be used for very short trains, very low repetition rates, or some combination of the two." (Since this sentence is in December version BCD, this could be treated as change request by CCB itself. But CCB decides it is practically better to include here.)

4. *A DR stretch region of approximately 610 m length is inserted to adjust the location of the DRs within the site footprint.*

Requester proposed: In-between sections on "Transverse Collimation" and "Turnaround", insert the following section: Damping Ring Stretch - This beamline is a simple coasting beamline of 610 m approximate length. Its purpose is to allow the arc of the damping ring to fall entirely within the ILC site boundary (currently set by the arcs of the Turnaround, see next section). Without this section, the arc of the damping ring would extend some 610 meters past the arc of the turnaround, creating an undesirable extension of

the total site length required for 500 GeV CM. The Damping Ring Stretch also contains several BPMs which are used to measure the bunch-by-bunch position of each bunch within a train, which can be corrected (in a feed-forward sense) by correctors in the trajectory correction section.

CCB agrees to insert the "Stretch" but rejects to specify its length as proposed, on the following ground. The Area System Leaders meeting at KEK (January, 2006) has come to an agreement on placing electron and positron DRs at upstream ends of the two linacs in BC. However, while the participants there acknowledged the proposal by the RTML representative, it is the CCB's assessment that the meeting has stopped short of explicitly determining and agreeing on whether the Baseline DR should stay within or outside the ILC site footprint. The proposed choice of 610m-long stretch is not supported by a strong-enough justification at this moment. The stretch length also needs to be looked at from the beam controls standpoint in ensuring the IP beam collisions under various bunch fill patterns in the DRs. For now, it would be of GDE's interest for BCD to first (1) specify the required beamline characteristics (optics, tunability, instrumentation) of the stretches, (2) specify the minimum stretch length (could be near zero for BC), (3) explicitly state that the stretch length is considered site-dependent yet subject to constraints due to beam collision controls, and (4) leave the choice of its exact lengths for further studies with possible timeline goals.

Requester proposed: Trajectory Correction section: replace "emittance measurement" with "Damping Ring stretch".

CCB accepts this.

5. The skew correction section is removed from the emittance station which follows the spin rotator.

Requester proposed: Emittance Measurement and Coupling Correction section: rename "Emittance Measurement" and replace text with the following: This beamline uses a set of 6 laser wire profile monitors to make sure that the emittance correction is properly performed. The current baseline calls for a system which can measure full beam matrix and extract the normal mode emittances and the coupling terms. The emittance measurement station must be capable of measuring emittances during multibunch operation, using many bunches to measure the emittance within 1 train, and must also be capable of measuring emittances during single-bunch operation, using many pulses (at 5 Hz) to complete one measurement.

CCB partially accepts this, with the following provisional remark: CCB requests to insert a line which reads to the effect of "Studies of the performance of such a system show that it performs comparable to the two corrector-monitor sets," with additional pointers to adequate references.

6. The linac launch and diagnostic section at the end of the RTML is extended from 30 m to 60 m.

CCB accepts this.

7. Tables.

Requester proposed to apply the following edits:
- Magnet Counts table: replace with table on Slide 6 of my recent KEK talk.
- Instrument Counts table: replace with table on Slide 7 of my KEK talk.
- System Lengths table: replace with table on Slide 5 of my KEK talk.

CCB accepts them all except for entries pertaining to the DR stretches.

8. Justification:

Requester proposed to apply the following text revisions: Remove first sentence (which ends with "...is self-evident.").Second paragraph, first sentence: replace "emittance measurement station" with "profile monitor". Sixth paragraph: replace "lattice" with "lattices".
CCB approves them all.

References

[1] http://www.linearcollider.org/wiki/doku.php?id=bcd:dec2005version .
[2] http://www.linearcollider.org/wiki/doku.php?id=bcd:bcd_history .
[3] Materials from the Area System Leaders Meeting, January 19-20, 2006, KEK
Meeting information: http://lcdev.kek.jp/GDE/ASL2006KEK/ .
RTML presentation: http://lcdev.kek.jp/GDE/ASL2006KEK/RTML_Status_2006January.ppt .
Layout discussion: http://lcdev.kek.jp/GDE/ASL2006KEK/Yokoya-LayoutSummary.pdf .
Meeting minutes: http://lcdev.kek.jp/GDE/ASL2006KEK/Memo.ASL2006KEKv0.6.doc .
Follow-up memo: http://lcdev.kek.jp/GDE/ASL2006KEK/FollowupTor.21JAN2006.pdf .
[4] http://lcdev.kek.jp/ML/PubCCB/msg00011.html .
[5] http://lcdev.kek.jp/ML/PubCCB/msg00013.html .
[6] http://lcdev.kek.jp/ML/PubCCB/msg00014.html .
[7] http://lcdev.kek.jp/ML/PubCCB/msg00015.html .
[8] http://lcdev.kek.jp/ML/PubCCB/msg00016.html .

Appendix 1

- *Subject*: [CCB-92] Change request for BCD
- *From*: Peter Tenenbaum <quarkpt@xxxxxxxxxxxxxxxxx>
- *Date*: Thu, 26 Jan 2006 10:06:58 -0800

I am writing today to formally request approval of the changes to the RTML section of the BCD which were presented and discussed at the recent ILC ASL meeting in KEK. Specifically:

1. The damping ring extraction section is moved to the damping ring area.
2. The RTML-ML boundary lies between the diagnostic region at the end of the RTML and the upstream face of the first cryomodule in the ML. The diagnostic region at the beginning of the ML is redundant with the one at the end of the RTML and should be deleted.
3. The multi-wire emittance station immediately downstream of DR extraction is deleted and replaced with a single profile measurement device, technology to be determined. The combined result of items (1) and (3) is that the RTML now begins with a Skew Correction Section, not a Damping Ring Extraction section or an Emittance Measurement section.
4. A DR stretch region of approximately 610 m length is inserted to adjust the location of the DRs within the site footprint.
5. The skew correction section is removed from the emittance station which follows the spin rotator. 6. The linac launch and diagnostic section at the end of the RTML is extended from 30 m to 60 m.

Considered as a whole, my judgement is that this is a Category 1 change to the BCD, with a total cost impact of under $100 million.

I look forward to hearing from you on this matter.

-PT

Appendix 2

- *Subject*: Re: [CCB-92] Change request for BCD
- *From*: Peter Tenenbaum <quarkpt@xxxxxxxxxxxxxxxxx>
- *Date*: Thu, 26 Jan 2006 17:37:13 -0800

Text changes:

Overview:

eliminate "Completing the achromatic extraction of the beam from the damping ring" and "Moving the beam from the axis of the damping ring to the axis of the main linac (geometry match)".

Description:

Eliminate section on "Extraction Geometry and Betatron Match"

Section on "Emittance and Trajectory Measurement", replace existing text with:

This beamline uses a set of four orthonormal skew quadrupole magnets to couple all four xy coupling terms in the beam matrix; this allows coupling introduced by the process of beam extraction from the damping ring to be corrected globally. The coupling correction section is followed by a single transverse profile measuring device (exact technology yet to be decided), which permits emittance measurements to be made via quad scans. At the end of this beamline there is an insertable stopper which can be used to stop the beam from passing into the collimation section <http://www.linearcollider.org/wiki/doku.php?id=bcd:ring_to_main_linac:ring_to_main_linac_home#transverse_collimation> and other downstream areas. This stopper can probably only handle a fraction of the nominal beam power, and so can only be used for very short trains, very low repetition rates, or some combination of the two.

In-between sections on "Transverse Collimation" and "Turnaround", insert the following section:

Damping Ring Stretch

This beamline is a simple coasting beamline of 610 m approximate length. Its purpose is to allow the arc of the damping ring to fall entirely within the ILC site boundary (currently set by the arcs of the Turnaround, see next section). Without this section, the arc of the damping ring would extend some 610 meters past the arc of the turnaround, creating an undesirable extension of the total site length required for 500 GeV CM. The Damping Ring Stretch also contains several BPMs which are used to measure the bunch-by-bunch position of each bunch within a train, which can be corrected (in a feed-forward sense) by correctors in the trajectory correction section.

Trajectory Correction section: replace "emittance measurement" with "Damping Ring stretch".

Emittance Measurement and Coupling Correction section: rename "Emittance Measurement" and replace text with the following:

This beamline uses a set of 6 laser wire profile monitors to make sure that the emittance correction is properly performed. The current baseline calls for a system which can measure full beam matrix and extract the normal mode emittances and the coupling terms. The emittance measurement station must be capable of measuring emittances during multibunch operation, using many bunches to measure the emittance within 1 train, and must also be capable of measuring emittances during single-bunch operation, using many pulses (at 5 Hz) to complete one measurement.

Magnet Counts table: replace with table on Slide 6 of my recent KEK talk.

Instrument Counts table: replace with table on Slide 7 of my KEK talk.

System Lengths table: replace with table on Slide 5 of my KEK talk.

Justifications:

Remove first sentence (which ends with "...is self-evident.").

Second paragraph, first sentence: replace "emittance measurement station" with "profile monitor"

Sixth paragraph: replace "lattice" with "lattices".

-PT