Engineering and Design Review

Version 1.0

Technical System: Main Linac Integration

Date:	27-28 September 2007
Location:	Fermilab
Host:	Chris Adolphsen; star@slac.stanford.edu
Secretary:	Tetsuo Shidara; tetsuo.shidara@kek.jp
Meeting:	Main Linac Integration Kick Off Meeting

Table of Contents

1 Goals

The goal of the Main Linac Integration (MLI) Kick Off meeting was to examine the MLI contributions to the RDR, collect missing or incomplete material and begin planning for the Engineering Design Phase.

Since this was the first MLI Kick Off meeting in the EDR phase, a secondary goal was to present and receive critical commentary on the EDR Plan.

2 Review Organization

2.1 Agenda

The agenda of the review is available from the InDiCo page together with the presentation material.

http://ilcagenda.linearcollider.org/conferenceDisplay.py?confId=1857

Thursday, September 27, 2007

09:00->12:00 Introduction, Test Facilities and ACD Time Lines

Introduction by A. Yamamoto; Discuss time line for delivering the EDR, cutoff dates for changes (including ACD), cost and schedule responsibilities and interactions among ML groups and with other high level groups.

Observations from the KOM Meetings So Far by N. Walker

What the ILCTA@NML and STF will NOT Tell Us for the EDR by 2011 by S. Nagaitsev

What XFEL Will Tell Us for the EDR by 2011 by H. Weise

ACD Down-Select Criteria and Time Scales for HLRF by S. Fukuda

ACD Down-Select Criteria and Time Scales for Cavity Shapes and Processing by L. Lilje

C; Again validation process, not enough time for change.

ACD Down-Select Criteria and Time Scales for Cavity Assembly and Peripherals by H. Hayano

ACD Down-Select Criteria and Time Scales for Cryomodules by H. Carter or N. Ohuchi

01:30->17:30 Beam Related Issues

Quad Package (Quad, Correctors, BPM, HOM Absorber) by N. Solyak, V. Kashikin, N. Eddy

Wakefields and Cavities by Z. Li; Simulation for multi-CM, elliptical, cross x-y,

Static and Dynamic Tuning by K. Kubo

Friday, September 28, 2007

09:00->12:00 Integration Issues

Wakes and Cavity Design by C. Adolphsen and L. Lilje; Includes proposal for reducing wake offsets due to asymmetric antennae penetrations.

Coupler Diameter, Multipacting and Tunability by C. Adolphsen; Surveys pros and cons of different coupler choices.

Waveguide Heat Loads by C. Nantista; Size and implications for CFS and LLRF

LLRF Requirements by B. Chase; Includes discussion of desired overhead and HLRF bandwidth

CFS Requirements by Vic Kuchler; Includes a discussion of how the linac alignment requirements (both spatial and temporal) should be specified for installation and site evaluation

Cryogenic Issues by T. Peterson; Includes discussion of layout and input required from other groups

Additional Cryo Cost vs Savings from Removing 5K Shield by Tom Peterson

Quad Field and Position Stablity by C. Adolphsen; Review of short and long term quad stability requirements and implications for the support system

13:30->17:30 Cost and Design Optimization

General Cost Model and Gradient and Gradient Spread Dependence by C. Adolphsen

Main Linac Cost Summary, Drivers and Technical and Cost Risks by T. Shidara

Close-out points by N. Walker

2.2 Host

Chris Adolphsen at SLAC.

2.3 Attendance

V. Kuchler, E. Huedem, B. Chase, T. Lakowski, R. Stanek, S. Nagaitsev, V. Kashikhin, C. Jansen, N. Solyak, J. Noonan, Z. Li, J. Cawardine, H. Hayano, N. Ohuchi, T. Peterson, R. Kephart, S. Mishra, H. Carter, C. Adolphsen, C. Ginsburg, A. Yamamoto, M. Ross, M. Champion, T. Shidara, L. Lilje, N. Walker, H. Weise, K. Kubo, Lebrun, Poirier, Fukuda, P. Pfund, K. Jobe, J. Leibfritz, E. Elsen, V. Yakovlev, K. Yokoya, D. Schulte, E. Paterson, R. Larsen, S. Michizono, N. Toge

2.4 Secretary

These notes were taken by T. Shidara

3 Review Documentation

The topics of the review are displayed below and followed by the conclusion or recommendation. The factual basis is given. The review material has been posted with the agenda on the web and will be complemented by this document.

All RDR cost numbers, except those which were at a level high enough to be included in the RDR itself, must be password protected (or have an equivalent access restriction).

3.1 Specification tables for performance and envelope

Specification tables for performance, envelope and interface are needed to formally establish EDR baseline. These are inevitable for plug compatibility design.

Recommendation for topic 3.1

> *Specify performance, envelope and interface parameters which enable plug compatibility designs in the EDR phase.*

3.2 EDR time-scale and validation process for design change

EDR time schedule is an important issue for design change validation process. If 2010 is really the target, no demonstrations of ILC-like RF unit will be available at FNAL and KEK.

Only XFEL mass-production of 5-10 XFEL cryomodules might be produced and 5 will be high-power tested. Consensus for design change validation process is necessary, since we expect not enough time for down-select validation.

Recommendation for topic 3.2

> *Clarify the EDR time schedule and achieve consensus for design change validation process.*

3.3 Plug-compatibility concept

Plug-compatibility concept endorses baseline design evolution as well as ACD exploitation. It might be useful for future in-kind contribution in international collaboration, but needs refinement.

Recommendation for topic 3.3

> *Develop and refine the plug compatible concept.*

3.4 What to put into the EDR?

What should we put into the EDR? We want to construct a machine with best (cost effective) and mature state-of-art technology, but it must be a construction-ready or near construction-ready technology. Although we have no time for long term certification in the EDR phase, we also need to consider situations beyond EDR carefully.

Recommendation for topic 3.4

> *Put a construction-ready or near construction-ready technology into the EDR, but consider beyond EDR as well.*

3.5 WP preparation

WP definitions must be documented and available by the GDE meeting. FNAL meeting will have parallel sessions for refining WP definitions and continued discussions on critical technical issues. WP preparation will finish at the GDE meeting + 2-3 weeks. Need prioritization and openness is inevitable in international collaboration. All international

interest and available resources must be considered. We should also devise WPs covering possible experiments to do at TTF (for example).

Recommendation for topic 3.5

Prepare WPs with clear definition and open allocation process.

3.6 Cavity gradient

Cavity gradient is still an issue independent of CM design/DFM. 31.5 MV/m is not easily achievable, therefore S0 task force remains in GDE highest-priority.

Recommendation for topic 3.6

Pay attention to cavity gradient issue.

3.7 SC magnet and cryomodule

Review of short and long term quad stability requirements and implications for the support system were presented. Design efforts were FNAL centric, and known resources from Europe and Asia have to be included. Not enough specifications for adjustment tolerance and field failure. Magnet location was discussed. Cryomodule cost savings were discussed by removing 5K shield. Thermal loss calculations both static and dynamic are necessary.

Recommendation for topic 3.7

Collaborate with Cryomodule and Beam Dynamics groups and specify the adjustment tolerance and field failure as well as its location. Think the possibility of cryomodule cost savings by removing 5K shield.

3.8 Beam dynamics

HP/HOM coupler wake effect, due to asymmetric antennae penetrations, was considered. Cancellation scheme, for example feeding RF alternately, was proposed in order to reduce wake kicks. Since this effect clearly mandates some modifications to CM/Cavity and HLRF power distribution system, cross check by other simulation program, like MAFIA, will be needed.

Wake effect by elliptical deformation of the cavity was also simulated. Measurements might be necessary, but what kind of and till when are not clear.

Static and dynamic tuning was simulated for SB and MB emittance growth. It will be necessary to check assumptions, energy spread input and DC offset calculation. It is helpful to component specifications and feed-back is necessary.

Recommendation for topic 3.8

Organize a working group to check the HP/HOM coupler wake effect due to asymmetric antennae penetrations and, if necessary, find out the appropriate cancellation scheme.

3.9 Waveguide heat loss

Waveguide heat loss is still an issue and done by calculation. Since WG loss affects LLRF margin, actual measurements are mandate.

Recommendation for topic 3.9

Measure the waveguide heat loss for actual design.

3.10 LLRF

LLRF required overhead for operation taking into account gradient spread and HLRF band width. If 10% gradient spread and 33 MV/m is assumed, Gain/Power relation will require negotiation with HLRF group.

Recommendation for topic 3.10

Coordinate a group to develop a practical and optimized performance of LLRF.

3.11 Coupler design

There are many ‘variants’ in coupler designs. Relationship with EDR needs to be understood and quantified. Since coupler decision might be complicated, survey pros and cons of different coupler choices such as tunability, heat load, and reliability. But only issue might be a possibility of cost reduction for mass-production. Need plan and definition of success.

DESY has no serious problems at 250 kW operation. DESY changed the coupler design slightly. DESY is waiting for proposal from industry at fabrication phase.

Recommendation for topic 3.11

Make plan and definition of success for coupler choice. Survey pros and cons of different coupler designs.

3.12 CFS

CFS requirements, interfaces, derivatives (performance/cost) are not well defined in the RDR, since we had not enough time to optimize these and iterate between related system group leaders in the RDR phase. The linac alignment requirements (both spatial and temporal) should be specified for installation and site evaluation and needs WP.

Recommendation for topic 3.12

Make a strong liaison to CFS and iterate with them in order to optimize the CFS related designs. Specify the alignment requirements (both spatial and temporal) for installation and site evaluation.

3.13 Cost

The current RDR VALUE estimate is linked with the baseline definition, and is put under change control. Changes to the VALUE estimate will be reviewed as part of a technical change request to the baseline or as an update VALUE estimate for the existing baseline.

VALUE estimate will evolve continuously as EDR progresses, and we should consider scheduled reviews/re-estimates for key systems in order to avoid last minute panic at end of EDR phase. We are looking for actions that reduce the cost with better performance and optimization of the complete system. New VALUE estimate must reflect most mature designs with minimum risk

Recommendation for topic 3.13

Review the VALUE estimate for technical changes in addition to update VALUE estimate for the existing baseline. Look for cost reduction actions and optimize the complete system.

4 Action List

Action list as derived from the recommendations

Reference	Responsible	Identifier	Action
Topic 3.1 (Specification tables)	MLI Leader	ILC-ED-MLI-01	Specify performance, envelope and interface parameters which enable plug compatibility designs in the EDR phase.
Topic 3.2 (EDR time schedule)	Director + PM, and MLI Leader	ILC-ED-MLI-02	Clarify the EDR time schedule and achieve consensus for design change validation process.
Topic 3.3 (Plug-compatibility)	MLI Leader + PM	ILC-ED-MLI-03	Develop and refine the plug compatible concept.
Topic 3.4 (What to put into the EDR)	MLI Leader	ILC-ED-MLI-04	Put a construction-ready or near construction-ready technology into the EDR, but consider beyond EDR as well.
Topic 3.5 (WP preparation)	MLI Leader	ILC-ED-MLI-05	Prepare WPs with clear definition and open allocation process.
Topic 3.6 (Cavity gradient)	MLI Leader	ILC-ED-MLI-06	Pay attention to cavity gradient issue.
Topic 3.7 (SC magnet and Cryomodule)	MLI + Cryomodule + Beam Dynamics Leaders	ILC-ED-MLI-07	Collaborate with Cryomodule and Beam Dynamics groups and specify the adjustment tolerance and field failure as well as its location. Think the possibility of cryomodule cost savings by removing 5K shield.
Topic 3.8 (Beam dynamics)	MLI + Beam Dynamics + Cavity Leaders	ILC-ED-MLI-08	Organize a working group to check the HP/HOM coupler wake effect due to asymmetric antennae penetrations and, if necessary, find out the appropriate cancellation scheme.
Topic 3.9 (Waveguide heat loss)	HLRF Leader	ILC-ED-MLI-09	Measure the waveguide heat loss for actual design.
Topic 3.10 (LLRF)	MLI + HLRF + LLRF Leaders	ILC-ED-MLI-10	Coordinate a group to develop a practical and optimized performance of LLRF.

Topic 3.11 (Coupler design)	Cavity Leader	ILC-ED-MLI-11	Make plan and definition of success for coupler choice. Survey pros and cons of different coupler designs.
Topic 3.12 (CFS)	MLI + CFS + Beam Dynamics Leaders	ILC-ED-MLI-12	Make a strong liaison to CFS and iterate with them in order to optimize the CFS related designs. Specify the alignment requirements (both spatial and temporal) for installation and site evaluation.
Topic 3.13 (Cost)	MLI Leader + Cost Engineers	ILC-ED-MLI-13	Review the VALUE estimate for technical changes in addition to update VALUE estimate for the existing baseline. Look for cost reduction actions and optimize the complete system.

5 Summary of Meeting

[The Action List above does not specify individual's names. There are many 'Responsible Parties' listed, the MLI Leader, PM and other system leaders. For the purpose of this report, the MLI leader and PM are Chris Adolphsen and Akira Yamamoto, respectively).]