Engineering and Design
Kick Off Meeting Summary

Version 2.0

Technical system: CONTROLS

Date:	20 August 2007
Location:	Fermilab
Host:	John Carwardine; carwar@anl.gov
Secretary:	Marc Ross; mcrec@fnal.gov
Meeting:	Controls and LLRF Kick Off Meeting

Table of Contents

1 Goals

The goal of the Controls Kick Off meeting was to examine the Controls contributions to the RDR, collect missing or incomplete material and begin planning for the Engineering Design Phase. The agenda included presentations on the global Controls System, the Low Level RF, and the centralized business computing complex.

Since this was the first of the EDR Kick Off meetings, a secondary goal was to present and receive critical commentary on the EDR Plan.

2 Kick Off Meeting Organisation

2.1 Agenda

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

http://ilcagenda.linearcollider.org/conferenceDisplay.py?confId=1849

Controls & LLRF Kick-off Meeting - 20-22 August 2007, Fermilab.		
Daily Programme: Monday 20 August 2007		
Introduction	07:00-07:10	CARWARDINE, John
View from the Project Management Office	07:10-07:40	ROSS, Marc
EDR Work Packages MOU	07:40-07:55	MISHRA, Shekhar
Controls RDR Design walk-through	07:55-08:55	LACKEY, Sharon
Electronics Platform Reference Design	08:55-09:15	LARSEN, Raymond
Computing Infrastructure Reference Design	09:15-09:25	BANERJEE, Bakul
Timing/RF Phase Distribution Reference Design	09:25-09:40	LENKSZUS, Frank
break	09:40-09:55	
Discussion	09:55-10:25	
LLRF RDR Design Walk-Through	10:25-11:25	SIMROCK, Stefan; CHASE, Brian
Discussion	11:25-11:55	
lunch	11:55-13:00	
Q&A Discussion	13:00-14:30	
break	14:30-14:45	
Discussion as needed	14:45-16:15	
Controls & LLRF Kick-off Meeting - 20-22 August 2007, Fermilab.		
Daily Programme: Tuesday 21 August 2007		
LLRF and RDB S2 goals	07:00-07:15	

LLRf Planning for EDR Phase	07:15-08:15	SIMROCK, Stefan
Connecting EDR activities with Beam Test Facilities	08:15-08:55	
Discussion	08:55-09:15	
break	09:15-09:30	
Discussion	09:30-10:30	
lunch	11:30-13:00	
Availability Considerations	13:00-13:45	
Controls planning for Engineering Design Phase	13:45-14:45	
break	14:45-15:00	
Discussion	15:00-16:00	
Controls & LLRF Kick-off Meeting - 20-22 August 2007, Fermilab.		
Daily Programme: Wednesday 22 August 2007		
Controls RDR Costing walk-through	07:00-07:45	BANERJEE, Bakul
Discussion	07:45-08:15	
break	08:15-08:30	
LLRF RDR Costing walk-through	08:30-09:15	CHASE, Brian
Discussion	09:15-09:45	

2.2 Host

John Carwardine at ANL.

2.3 Attendance

Bakul Banerjee
Gustavo Cancelo
Ruben Carcagno
Brian Chase

Bob Downing
Eckhard Elsen
Kazuro Furukawa
Mike Haney
Paul Joire
Kevin Krause
Sharon Lackey
Ray Larsen
Frank Lenkzsus
Gang Li
Shin Michizono
Tony Pietryla
Vince Pavlicek
Ron Rechenmacher
Stefan Simrock
Nobu Toge
Margaret Votava
Steve Wolbers
Akira Yamamoto
Jijiu Zhao

2.4 Secretary

These notes were taken by Marc Ross and Eckhard Elsen

3 Documentation

The topics of the kick off meeting are displayed below and followed by the conclusion or recommendation. The factual basis is given. The 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 Topic 1: Review the requirements provided by Area Systems with a focus on missing or incomplete items

3.1.1 Low Level RF Vector Sum Specification

The most important incomplete specification concerns the Low Level RF control of cavity vector sum. Needed information includes the range of bunch and train intensities for which precision control is required, the definition of the beam – based calibration process and the range of allowable maximum cavity gradients within a given RF unit.

Recommendation for topic 3.1.1

> *Since the LLRF system carries substantial technical risk, a carefully determined set of specifications is required. This must be done together with the RTML, Main Linac, BDS and Damping Ring Accelerator Systems Groups. This will require that the LLRF team determine the engineering parameters they need to have defined that will then be provided directly by the accelerator leaders or derived from requirements provided by the accelerator leaders.*

3.1.2 Cables – Specification (may want to include utilization of rack space)- perhaps equipment layout is a cost driver. Installation was estimated by the installation group.

The RDR Global Controls RDR cost estimate included procurement of cables and relay racks. Similarly, These costs were moderate ‘cost-drivers’ in the Controls estimate, and yet cable lengths and relay rack utilizations are inherently dependent on the physical layout of technical equipment in the accelerator tunnels. For much of the ILC, these were developed in a crude fashion, without the benefit of well-developed equipment layout details.

There is a related issue associated with bringing cables to the front-end electronics crates. For reliability reasons, it is preferable to bring cables to the back of the electronics crates, which in turn requires rear access to relay racks. If layouts dictate no rear access to relay racks, then alternative cable entry solutions would need to be considered.

Recommendation for topic 3.1.2

> *The initial phase of the EDR will include a comprehensive evaluation of underground space usage. The evaluation will focus on the distribution of electrical equipment and cable routing. The Controls Global must participate in the CFS value engineering process.*

3.1.3 Specification budget

RDR Area systems specifications are determined based on performance criteria. For a practical engineering approach, subsystem performance requirements must be apportioned out of these. Two such examples are the: 1) BDS inter-crab cavity phase 'jitter' and 2) the controls subsystem availability. In these two cases, the performance 'budget' allocation part of the value engineering process and will be managed differently – in the former case, several Technical Area Groups are involved (BDS, HLRF, Controls/LLRF, Cryogenics and Cryomodules) so the apportionment must be defined by the Project Management Office. In the latter case, only the Controls Global Technical Area Group is involved, so the process of evaluation (and possible re-allocation) can be done internal to that group, with only sign – off required by the Project Management Office.

Recommendation for topic 3.1.3

> *The initial phase of the EDR will include a value engineering process which will include an assessment of how to distribute performance 'budgets' that indicate sub-system performance requirements. The EDR Project Organization must devise criteria for optimizing system design such that sub-system performance requirements are understood and documented. In the latter example given above, the controls system component availability performance budget distribution can be managed entirely within the Area Technical Group.*

3.1.4 Complexity of specialized sub-systems

The RDR Controls Global Systems group had insufficient information to analyze and provide a cost estimate for creating the interface to specialized sub-systems, such as instrumentation or special power supplies. Often, a single network connection was assigned. In such cases, the RDR value estimate may have 'gaps' where the local controls needed for specialized sub-systems are not accounted properly.

Recommendation for topic 3.1.4

> *In some cases this information is available, but not documented or properly transmitted to the supporting Technical Systems Groups. The EDR Project Organization must collect and document, as part of the Baseline Configuration, design information for these systems such that interface requirements can be developed.*

3.1.5 Systems aspects

The RDR has focussed on ATCA as model standard for the controls. The first ILC-specific ATCA boards are currently being manufactured in various labs. At this time it is not known how well the standard performs in an accelerator controls environment with a mix of analogue and digital signals and sometimes very high bandwidth requirements.

Recommendation for topic 3.1.5

> *System acceptance tests should be specified for the chosen standard(s). Once available field tests using real applications should be performed to exercise the*

chosen model. Early contacts to industrial crate/board vendors should be sought to prove that the chosen path is viable.

3.2 Topic 2: Examine plans to initiate the cost reduction and value engineering process

3.2.1 Change Control

The ED Activity will include the exploration of cost-saving alternate designs and development of the baseline. An appropriate level of effort is required for each of these somewhat conflicting tasks. In the RDR, technical groups including Controls and LLRF spend a lot of effort redoing the same work in response to frequent changes (or proposed changes) to the accelerator configurations. Often times, information relevant to Controls and LLRF did not reach the groups until much later.

Recommendation for topic 3.2.1

The EDR Organization includes a Configuration Management and Change Control Group and associated procedures. The Change Control Process must provide stability such that value-engineering related development work can proceed in parallel with baseline development work.

3.2.2 Alternative design for precision local RF phase distribution system

The RDR Controls Global System baseline design for the local RF phase distribution uses a large and high-cost rigid coaxial cable to achieve the phase stability. This was the design used at SNS. An alternate design has been proposed that uses active compensation based on reflected / forward & reflected signals transmitted via lower-cost coaxial cable. This should be pursued as part of the value engineering efforts during the EDR.

Recommendation for topic 3.2.2

This is an important technical development and may provide an auto-stabilization process. A design, test and development plan should be developed. It is important that this plan take account of the effort underway at the XFEL project.

3.2.3 Rack Cabling

The EDR value engineering process will focus on the use of underground space. It may be suggested that special ‘single-sided’ racks are advantageous for single tunnel sections of the ILC, such as the Beam Delivery and Damping Ring. Also, the ATCA standard under evaluation is somewhat difficult to connect, especially through the rear panel. Both of these must be considered in developing cost – effective equipment layouts.

Recommendation for topic 3.2.3

The XFEL mock-up tunnel will provide some real size test options. The demands for access should be carefully specified.

3.3 Topic 3: Examine proposed Work Packages and comment on how they support the EDR goals

3.3.1 Prioritisation of Controls Global Group Work Packages

A fundamental management principle of the ED phase is the use of the RDR risk register and value estimate to prioritise design and R & D efforts. While it is clear that the LLRF system is a relatively small part of the ILC RDR cost estimate, a disproportionately large fraction of the R & D effort is (will be) applied to design, test and demonstration of the LLRF because of the perceived technical risk v/v the state of the art for this technology. An example technical risk / cost trade-off is the risk failing to provide stable, flat gradient in each cryomodule at a given power overhead. In this case, added LLRF development and testing may be useful in defining the level of required power overhead.

Recommendation for topic 3.3.1

> *The ED Plan must describe a prioritisation process that includes comparative ranking of technical risk reduction, cost risk reduction and cost reduction efforts in order to achieve a coherent project prioritization. Since, in this case, the technical risks are understood, the LLRF group should develop this comparison using a cost / risk model that attempts to show how a ranking process might work.*

3.3.2 Developing and Imposing Controls Standards

An important EDR deliverable is the production of an ILC Project Plan. In order to best include in-kind contributed hardware and software for all regions, standards must be defined and imposed on technical systems that interface with the control system.

Recommendation for topic 3.3.2

> *A Controls Group Work Package is required to develop models for technical interface standardization and enforcement processes.*

3.3.3 Assumed existing framework

The RDR value estimate assumes and existing controls system framework, with ILC-specific applications developed and integrated into the framework. Since there are several established control system frameworks already available, it is unlikely that no suitable starting point exists for an ILC control system. Down-selection to a particular control system framework will be left for a later phase, and will not be part of the scope of the EDR. However, the EDR should include a plan of how such a down-selection would be made.

Recommendation for topic 3.3.3

> *The possibility that a suitable framework would not exist is relatively small, yet the impact is large enough to warrant further analysis.*

3.3.4 Development of an LLRF performance metric and Demonstration of LLRF System Performance

LLRF performance can be characterized 1) electronically, using laboratory instrumentation, 2) using the beam in a test facility, 3) in terms of operability, using ease-of-use in a set of specific procedures and 4) in terms of availability, using estimates and observations of maintainability and reliability. These four system qualities, and perhaps others, can be unified in a performance metric assessment. Since the assessment will necessarily include Operations-related criteria, a set of use-cases will be required. As with many ILC systems, it will not be possible to definitively demonstrate performance with the planned small scale test systems.

Recommendation for topic 3.3.4

> *Using experience with working systems, the LLRF group should develop a practical performance metric for use in the LLRF design and value engineering process. Plans for demonstrating performance using test facilities, including a prioritized set of beam – based tests, should be drawn up for review.*

3.3.5 The LLRF system platform

The LLRF system platform, (VXI, ATCA, PCI or other) is presently not defined and development is anticipated using at least these three. LLRF system overall performance will be different, in general, for each of these and a comparative assessment may be difficult and time-consuming.

Recommendation for topic 3.3.5

> *To develop the process for choosing between viable alternates, the EDR plan requires that the technical experts devise both draft criteria and a model proposal, including a timeline, for a suitable selection process. In cases where the outcome has impact beyond the Technical Area Group itself, the alternate selection process must include the Project Management Office.*

3.3.6 Business and Central Computing Services

The RDR estimate for Business and Central Computing Services was compiled and analyzed by the Controls Global Group. It is largely based on the present Fermilab Computing Center operational cost.

Recommendation for topic 3.3.6

> *The estimated cost of the Business and Central Computing Services infrastructure and operation is important enough to warrant further study and modelling.*

4 Action List

Action list as derived from the recommendations

Reference	Responsible	Identifier	Action
Topic 3.1.1 (LLRF specs)	LLRF Team Leader	ILC-ED-CT-01	Prepare a presentation for the ML integration Kick-Off meeting (Sept 27-28), notify Chris A. and Akira Yamamoto
Topic 3.1.1 (cable / equipment layout)	Controls Group Leader	ILC-ED-CT-02	Prepare a set of questions to be asked at each Accelerator Area Kick Off meeting that obligate that group to provide needed equipment layout information.
Topic 3.1.1 (sub-system performance)	Project Management Office	ILC-ED-CT-03	Describe, in the ED Project Plan, the performance specification ‘apportionment’ aspect of the system engineering process.
Topic 3.1.1 (specialized sub-systems)	Controls Group Leader	ILC-ED-CT-04	Review the RDR to understand the impact that the simple model has on the value estimate. Require updates from the Accelerator Area Systems as appropriate.
Topic 3.1.1 (system tests – ATCA)	Controls Group Leader	ILC-ED-CT-05	Present a schedule for development and implementation of system tests.
Topic 3.2.1 (baseline vs. alternate)	Project Management Office	ILC-ED-CT-06	Describe in the EDR Project Plan, simple rules for comparative ranking of baseline and alternate development efforts
Topic 3.2.1 (alt. phase dist. system)	Controls Group Leader	ILC-ED-CT-07	Present an R & D Work Package supporting this novel approach
Topic 3.2.1 (rack cabling)	Controls Group Leader	ILC-ED-CT-08	Present a design Work Package that involves the Accelerator Area Systems (and the CFS group) for optimising the rack placement in each area.
Topic 3.3.1 (comparison tech risk/cost reduction)	LLRF Team Leader	ILC-ED-CT-09	Present a model for a technical risk / cost risk / cost reduction comparative assessment for LLRF
Topic 3.3.1 (controls	Controls Group Leader	ILC-ED-CT-010	Present a management Work Package for evaluating policy aimed at optimal standards

standards)			development and promulgation
Topic 3.3.1 (existing framework)	Controls Group Leader	ILC-ED-CT-011	Present an evaluation of the involved risk
Topic 3.3.1 (performance metric)	LLRF Team Leader	ILC-ED-CT-012	Present a work package aimed at developing and implementing a performance metric – based assessment and prioritization of LLRF design / R &D
Topic 3.3.1 (platform selection process)	LLRF Team Leader	ILC-ED-CT-013	Present technical criteria and a timeline for an appropriate selection process.
Topic 3.3.4 (business / central computing	Controls Group Leader	ILC-ED-CT-014	Present a Work Package that shows the effort needed to further model this cost.

5 Summary of Meeting

[The Action List above does not specify individual's names. Further, there are only three 'Responsible Parties' listed, the Controls Group Leader, the LLRF Team Leader and the Project Management Office. For the purpose of this report, these are John Carwardine (until Margaret Votava assumes this role, Brian Chase, and Marc Ross, respectively).]