SCRF Monthly WebEx Meeting Sept. 22, 2010

Agenda

1. Report from PMs (15 min.)
    1. BAW-1 report and proposal for TLCC
    2. Preparation for the industrialization
    3. Interim report
2. General Report from GLs (15 min.)
3. Special Discussions (30 min.)
    1. Comments from P. G
    2. ILC-CLIC Workshop Agenda

General Schedule related to SCRF

- Sept. 8-10: BAW-1 (completed)

- Oct. 18 – 22: IWLC-2010 at CERN
- Oct. 20: Next SCRF WebEx during IWLC
  - S1-Global Interim report and further plan
- Oct. 31: Due date for Interium Report Draft

- Nov. 11-12: ILC-PAC at Oregon

- Jan. 18 – 21: BAW-2, SLAC
- Jan. 31 - : (TTC)

ILC-BAW1
Summary and Recommendations

Akira Yamamoto, Marc Ross and
Nick Walker
GDE Project Managers

Reported at BAW1, held at KEK, Sept. 10, 2010

Baseline Assessment WorkShops

Baseline Assessment Workshops

- Face to face meetings
- Open to all stakeholders
- Plenary

	When	Where	What
WAB 1	Sept. 7-10, 2010	KEK	1. Accelerating Gradient 2. Single Tunnel (HLRF)
WAB 2	Jan 18-21, 2011	SLAC	3. Reduced RF power 4. e+ source location

Subjects discussed in Sessions

Date	Main Theme	Tasks
Sept. 7	Introduction HLRF-KCS: Design and R&D RDR-backup: Technical	Make the workshop tasks clear Process for the reality including cost Feasibility as a backup solution
Sept. 8	DRFS: Design and R&D LLRF/Control Discussions	Process for the reality including cost R&F operation margin for cavity/accelerator Recommendation
Sept. 9	Cavity Gradient: R&D Discussions	Strategy for cavity gradient improvement Short-term and long-term strategy to be clear
Sept. 10	ML Accelerator Gradient Discussions	Accelerator gradient including spread, Appropriate balance of gradient in cavity/cryomodule/accelerator, and Adequate margin in accelerator operation Recommendation

Summary and Proposal for Top Change Control Panel

- HLRF/LLRF design with Single Tunnel layout
- ML Accelerator Gradient

HLRF/LLRF Design with Single Tunnel

- The main proposal is to go to a single tunnel solution for the Main Linac technical systems remains essential that outlined in the SB2009 report, and is based on the adoption of two novel schemes, requiring RD, for the HLRF in the single tunnel:
  - KCS: preferred solutions for <u>‘flat land’ sites</u>
  - DRFS: preferred solutions <u>for mountainous region</u>

- Two backup scenarios are proposed for supporting <u>RDR-like HLRF solutions in a single-tunnel</u>
  1. 10MW MBK + (Marx) Modulator in the tunnel
  2. XFEL-like solution with modulators (low-voltage) accessible in cryo refrigeration builds/caverns, with long pulsed cables feeding 10MW MBKs, via a pulse transformer, in the tunnel.
- Both are considered technically feasible, and no R&D program is proposed.
- We propose to phase out one of these RDR-like options within the next six-months, in order to reduce the number of scenarios to be developed.

Accelerator Gradient

Common understanding and Recommendation

- Observation
  - Challenging operational margin in accelerator operation to be reliable enough for sufficient availability for physics run.

- Our Strategy Proposed
  - Provide two major guidelines
    - R&D milestone: 35 MV/m with 90 % yield (eq. > 38 MV/m on average) , including 2nd pass,
    - ILC ML Cavity specification: 35 MV/m on average with spread,
  - Make our best effort with forward looking position to realize the accelerator operational gradient to be 31.5 MV/m, on average with reasonable gradient spread (< ~ +/-20 %). We require an additional HLRF power of 10 %.
  - Keep cost containment concept, and prepare for the industrialization including cost and quality control.
  - Ask physics/detector groups to share our observation and forward looking strategy

ILC-ML SCRF Cavity Gradient Specifications
proposed, based on R&D Efforts and Goals

Cost-relevant design parameter(s) for TDR	ML cavity gradient Specification	Cavity R&D goal	Relevant R&D Programme
9-cell Cavity Gradient in vertical test	35 MV/m, average - Spread: 28 – 42 MV/m (+/- 20 % or less)	35 MV/m at 90 % yield including 2nd pass, (eq. $\geq$ 38 MV/m, average)	S0
Cryomodule Operational Gradient	34 MV/m, average	34 MV/m, average CM Obs. G. Limit = 3 % + **	S1
ML Operational Gradient	**31.5 MV/m avg** - Spread: 25 – 38 MV/m (+/- 20 % or less: TBD)	31.5 MV/m, average Op. G lim = 1.5 MV/m** Cntrl margin = 3 %**	S2 (S1*)
Required RF power overhead for control	10 % to be reserved in operation at 38 MV/m		S2 (S1*)

** as milestone for R&D

Proposal to adopt a single tunnel configuration for the ILC-ML

Proposal to adopt a single tunnel configuration for the ILC main linac

Introduction

The proposal to adopt a single tunnel solution for the Main Linac technical systems remains essentially that outlined in the SB2009 report. The primary motivation was and remains a reduction in project cost due to the removal of the support tunnel for the Main Linac. (The service tunnel for the BDS remains.)The original proposal was based on the utilization of two novel schemes for the HLRF:

- Klystron Cluster System (KCS). KCS has been identified as a preferred solution for 'flat land' sites where surface access (buildings) is not restricted
- Distributed RF System (DRFS). DRFS has been identified as being the preferred solution for mountainous region where surface access (buildings) is severely limited.

It is acknowledged that both these schemes require R&D (briefly described below). Having both R&D programmes in parallel can be considered as risk-mitigation against one or other of them failing.

At the beginning of the cost-reduction studies (2008), the two primary obstacles to adoption of a single tunnel were identified as:

- safety egress
- operations and availability.

Both these issues were subsequently addressed, and the successful results reported in the SB2009 proposal (submitted December 2009). The conclusions were later accepted by both AAP and PAC.

The remaining identified issues were the technical feasibility and cost of the HLRF solutions upon which the single-tunnel proposal was based. Two components to successful adoption were identified:

- Definition of acceptance criteria for TD Phase R&D for successful demonstration of one or more of the novel HLRF schemes.
- Inclusion in the designs of a risk-mitigation strategy, whereby a fall-back to the RDR HLRF Technology solution could be adopted, should the R&D on DRSF or KCS not be considered successful. In this context, RDR HLRF Technology is defined to mean the technology based on a 10 MW MB klystron and a local rectangular waveguide power distribution system directly feeding a few cryomodules.

Technical Issues with DRFS

Basic concept of the configuration (a feasibility demonstration) will be tested this year at S1-global. The DRFS klystron has been designed and two are on order. Preparation for this test has advanced the DRFS design in 2010, generating substantial progress since January. Technical issues that remain include an evaluation of cost effectiveness (a cost estimate is due in 2011), klystron MTBF (scaled from KEKB linac S-band klystron performance), and radiation sensitivity for tunnel hardware (to be updated based on both XFEL experience and further experimental studies). Significant progress on RF power overhead analysis has been made, which has impact on the number of klystrons and the AC power requirements. Additional power margin is required to accommodate the proposed *gradient spread*, which is reviewed in a separate recommendation. (See DRFS overview, slide 9; 800 KW is 14% more power than foreseen in RDR.)

Technical Issues with KCS

Full field tests of prototypes of all critical KCS components will be performed within the TD Phase. The stored energy in the test waveguide, which could be deposited during a breakdown test, is about 1/6[th] of that available in a full ILC system discharge. A ten-meter section of waveguide and Co-axial Tap Off (CTO) prototypes have been successfully built and cold-tested in 2010. In addition, there was significant progress in understanding operational aspects. (For new estimates of the required overhead, see KCS Overview, slide 46. Neglecting RF power devoted to availability, 14% more power is needed). As above, some of this is to accommodate the proposed *gradient spread*, which is reviewed in a separate recommendation. Technical issues that remain include better understanding of the extrapolation of proposed tests to full system, quantification of system tolerances and assumptions (combiner etc.), and the development of an improved, detailed failure mode analysis.

RDR HLRF Technology Solution (back-up)

Two scenarios have been briefly studied for support of an RDR-like HLRF solution in a single-tunnel:

1. 10MW MBK + (Marx) Modulator in the single tunnel
2. XFEL-like solution with modulators (low-voltage) accessible in cryo refrigeration buildings/caverns, with long pulsed-cables feeding 10MW MBKs (via a pulse transformer) in the single tunnel.

Both are considered technically feasible. (The latter is currently being constructed and will be operated at the European XFEL in 2014.)

For 1: Early investigations show the tunnel diameter would need to increase to 6.5m. This represents an estimated 10% increase in cost/unit tunnel length compared with the proposed DRFS tunnel unit cost (~0.5% TPC) and is considered acceptable. Current availability simulations (see below and SB2009 proposal) suggest an additional ~5% linac overhead (~2.5% TPC) is needed.

ML Accelerator Gradient Summary of Discussions and Proposal

Summary

We discussed the optimum Main Linac (ML) operational field gradient based on the current status of the global R&D effort and the evaluation of achieving the milestone cavity performance of 35 MV/m, with $Q_0 \geq$ 8E9, and a second pass production yield of 56% in the middle of TDP.

As a result of the workshop discussions, we propose keeping our best effort to realize a ML accelerator operational gradient of $\geq$ 31.5 MV/m with $Q_0 \geq$ 1E10, on average, with a gradient spread of not larger than ±20%.

To accommodate the operation of cavities with the proposed range of gradients, additional RF power of 10-15% (for 31.5 MV/m ±20%) is required over that stated in the RDR. (The additional overhead will be smaller if, after further R&D, the gradient spread can be reduced.) It is assumed that this additional cost is more than offset by the cost-effectiveness of accepting a gradient spread (in terms of mass-production yield and its impact on cavity costs).

Preparation for IWLC at CERN

- Discussions on
  - Cavity Industrialization

Global Plan for SCRF R&D

Year	07	2008	2009	2010	2011	2012
Phase	TDP-1			TDP-2		
Cavity Gradient in v. test to reach 35 MV/m	→ Yield 50%			→ Yield 90%		
Cavity-string to reach 31.5 MV/m, with one-cryomodule		**Global effort for string assembly and test** (DESY, FNAL, INFN, KEK)				
System Test with beam acceleration		**FLASH (DESY) , NML (FNAL)** **STF2 (KEK, test start in 2013)**				
Preparation for Industrialization			**Production Technology R&D**			
Communication with industry:	2009: 1st step: Visit Venders (2009) 2010: 2nd step: Organize Workshop (2010) ~ 2011: (Plan) 3rd step: Issue specification & receive response					

Two approaches proposed for communication with Industry

- A standard approach
  - Prepare for preliminary specifications including
    - design parameters, plug-compatible interfaces, process of the fabrication : (process specification: not built-print, and not functional specification).
  - Send the specification to possible vender and
    - Receive their response without commercial contract
      - Within standard process for call-for-tenders
- Alternate approach
  - Prepare for specific specification for the industrial models in details
  - Make contract to study the models to
    - receive best cost effective way of manufacturing including factory layout and working models ,
  –

Plan to prepare for Further Communications/Interactions with Industry, under discussion

Period	Action Items	purpose
Oct. 20 or 21	Discuss 'cavity and CM specification' during the CERN meeting (IWLC-2010)	Prepare for specification and industrialization model
Oct. 25-26(am)	Learn E-XFEL cavity specification with visiting DESY	Prepare for specification and industrialization model
TBD	Learn E-XFEL cryomodule assembly specification in communication with CEA-Saclay (/DESY/INFN)	Prepare for specification and industrialization model
Nov. 11-12	Present our preparation plan for industrialization	Get a review by PAC.
Jan.	Distribute 'specification' to possible venders	Explain common specification
April/May	Receive 1st responses from venders	(no contract)
June ?	Receive	(with contract with limited companies)
~ Dec.	Prepare for cost-estimate update for TDR	

Interim Report

- First meeting editing team today
  - Tech. Editor Board (TEB) + communicators
  - TEB: Elsen, Harrison, Ross, Walker, Yamamoto, Yokoya
- Outline agreed upon
  - approximate page counts
  - principle authors
- Principle TEB contacts for sections identified
- Workflow discussed (needs refinement)
- Milestones agreed-upon (next slide)
- Next steps
  - Iterate authoring guidelines with communicators
  - send email to principle authors
  - Set-up ILC-EMS workspace

Schedule

- 5.11.10 First drafts from authors

6 weeks

- 17.12.10 Editing cycle complete

4 working weeks

- 28.01.11 FINAL DRAFT Available

4 weeks

- 25.02.11 FINAL REPORT finished

EC sign-off; send to printer

3 weeks

- 19.03.11 ALCPG – PUBLISH!

SCRF Technology: Anticipated Subsection Authors/Contributors

2. SCRF Technology (total 35 pages)

- 2.1 Primary challenges for the SCRF Technology (4 pages, Akira Yamamoto, Jim Kerby, and Marc Ross)
- 2.2 Development of World-Wide infrastructure (5 pages, Mark Champion, Hitoshi Hayano, and Detlef Reschke)
- 2.3 Progress towards reproducible manufacture of high-gradient cavities (8 pages – Rongli Geng, Camille Ginsburg/Jim Kerby. ..)
- 2.4 Cryomodule design and development (5 pages, Norihito Ohuchi, Paolo Pierini, Tom Peterson)
- 2.5 High-Level RF development (8 pages, Shigeki Fukuda and Chris Nantista)
- 2.6 System integrations tests (5 pages, Hitoshi Hayano (STF) , Serge Nagaitsev (NML), John Carwardine/Nick Walker (FLASH)

- Individual communication is to be made soon

TDP: Interim Report

Reports from Group Leaders

- Cavity R&D : R. Geng
- Cavity Integration: H. Hayano
- Cryomodule: N. Ohuchi
- Cryogenics: T. Peterson
- HLRF: S. Fukuda and C. Nantista
- ML Integration: C. Adolphsen

Special Discussions

- Update cost estimating information
  - P. Garbincius
- International Workshop on Linear Collider (IWLC-2010), SCRF Parallel Session Agenda
  - H. Hayano, C. Pagani, and C. Adolphsen

cost info needed for BAW-1 proposals & BAW-2 please give complete info, not just incremental bits!

- CFS: specify diameter of tunnel KCS and for XFEL-like => klystron in tunnel w/ modulator in accessible location
- PMs: 1% or 10% RF overheads for cavity gradient spread? includes both HLRF & LLRF. Energy margin for reliability?
- Shigeki: latest estimate of unit costs (& quantities) for DRFS – scaling of cost of klystron & modulator w Power? P^{α}
- Chris & Chris: latest estimate of unit costs (& quantities) for Klystron Cluster pipe & CTOs. Cost of wave-guide valves. How does cost of klystron scale with power? P^{α}
- Carwardine: how does cost of LLRF scale with power? P^{α}
- Susanna: complete tech spreadsheets for 3.2 km DR for full power, low power, 10 Hz (twice duty factor – RF impact)
- PHG: do 10 MW modulators work for e- Source at 10 Hz?

IWLC-2010 General Plan and Subjects to be discussed

	Oct. 18	19	20-SCRF	21-SCRF	22
8:30 – 10:00		Plenary	Industrialization (specification)	Long-term R&D	Acc. Plenary WG summary
10:30 – 12:30		Plenary	Industrialization (process/model)	Long-term R&D	Acc. Plenary WG Summary
14:00 – 15:30	Plenary	Acc. Plenary	S1-Global (interim rep.)	Cavity fundamental (breakdown, radiation …)	Plenary
16:00 – 18:00	Plenary	Acc. Plenary	S1-Global or Joint session w/ CFS	Linac instr. or Joint session w/ NC Linac tech.	Plenary

Main Issues:
1) SB2009 to Top Level Change Control: Single tunneling
2) S1-Global: Interim review and further plan
3) Preparation for PAC, November: preparation for industrialization

Seek for a joint session with CFS

Wednesday **October 20**

0830 – 1000

CLIC Detector Experience - A. Herve (30 mins)

ILC IR Conventional Facilities Overview – T. Lackowski (30 mins)

General Discussion for Detector Movement - (30 mins)

1030 – 1230

Cryogenic Caverns for Asian Sites – K. Hosoyama (30 mins)

Design Progress for Asian Single Tunnel Configuration – M. Miyahara (30 mins)

Review of Main Linac Tunnel Dimensioning – A. Enomoto (30 mins)

General Discussion to Establish Main Linac Tunnel Dimensioning – (30 mins)

1400 – 1600

Lessons Learned for the LHC Helium Release – S. Weisz (45 mins)

CLIC CES Chapter for CDR – J. Osborne (30 mins)

General Discussion of ILC Cryogenic System Criteria – (45 mins)

1630 – 1800

CLIC Project Schedule Status – K. Foras (30 mins)

ILC Project Schedule – M. Gastel (30 mins)

General Discussion of ILC Schedule – (30 mins)

- Discussion required: ML tunneling dimensioning