GDE Baseline Workshop #2 - Overview

Marc Ross, (Fermilab)
Nick Walker, (DESY)
and Akira Yamamoto (KEK)

Motivation and Background behind the proposals to revise the RDR baseline

Workshop Program – BAW-2

1. **Reduced Beam Parameter set**
   – *n_b* reduced 2x from 2625 to 1312 ('low beam power')
2. **Positron Source Relocation**
   – Source moved from the 2/3 point to the end of the linac

Objectives of the Workshop:

- **Assess technical implication**
- **Including impact across system interfaces**
- **Discuss with community**
- **Prepare recommendations for 'Top-Level' Change Control (TLCC)**

Workshop Scheme:

- **Open meeting**
- **Presenters:**
  - GDE PMs (Chair)
  - GDE ADI team / TAG leaders
  - Physics/Detector Representatives
- **Registered: 68**
  - (22 Asia, 17 EU, 29 Americas)
- **Workshop Dinner Wednesday**
- ***Thank you very much to SLAC for hosting***

Overview

- **<u>Changing the ILC Baseline – TLCC / BAW Process</u>**
- **Background: Motivation for Cost Containment**
  - TDR will have updated cost estimates for SRF and CFS

1. **Reduced Beam Parameter Set**
2. **Positron Source Relocation**
   - →(Ewan Paterson, Thursday Jan 20)

- **Summary**

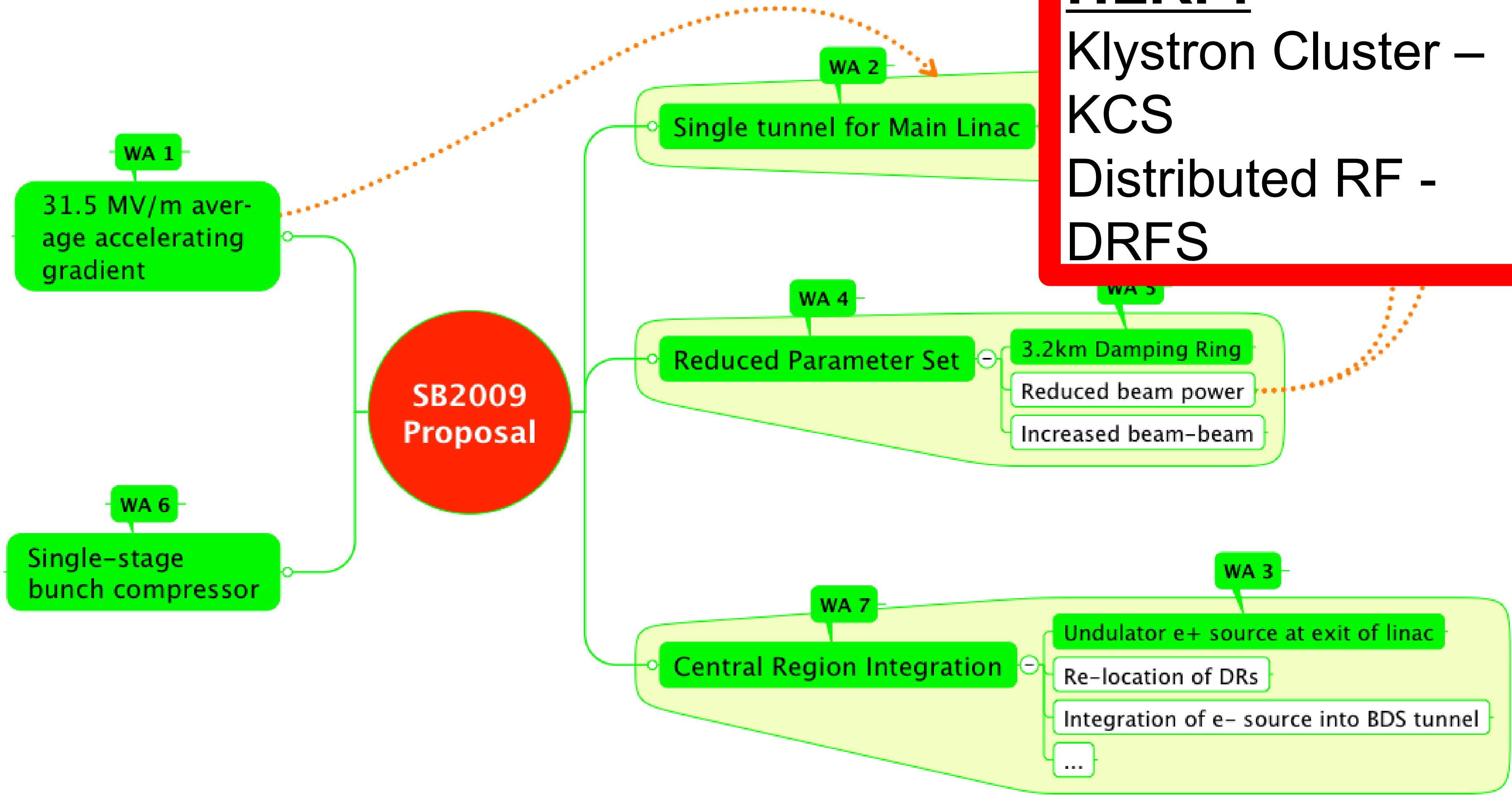
Topics

- **Reduced Beam Parameter set**
  - Day 1 (18 Jan): Accelerator and Technical
  - Day 2: Cost and Impact (Physics Performance)

- **Positron Source Relocation**
  - Day 3: Accelerator and Technical
  - Day 4: Cost and Wrap-up

- ***Independent Proposals… with a few common issues***

SB2009 Themes

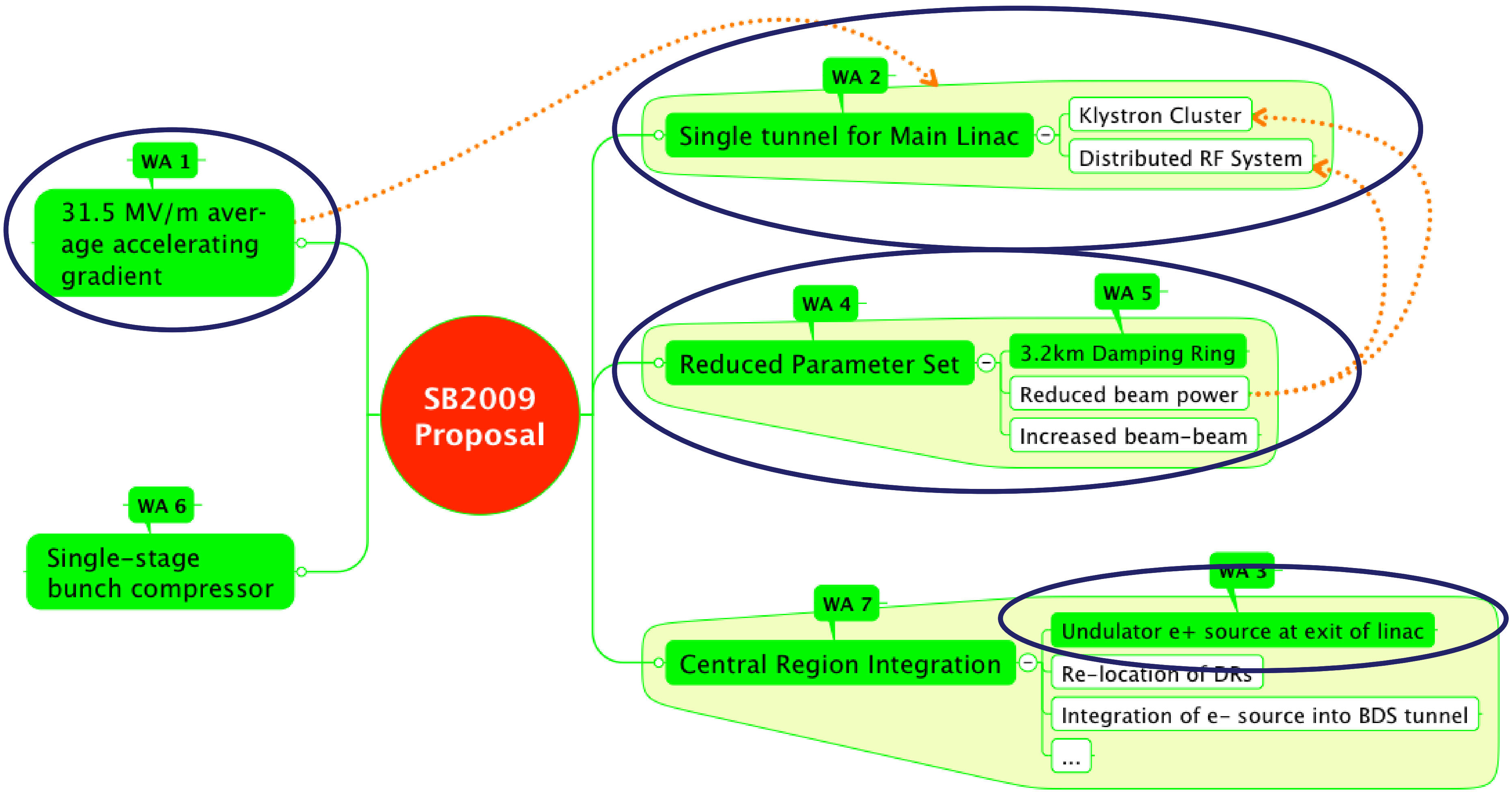


HLRF:

Klystron Cluster – KCS

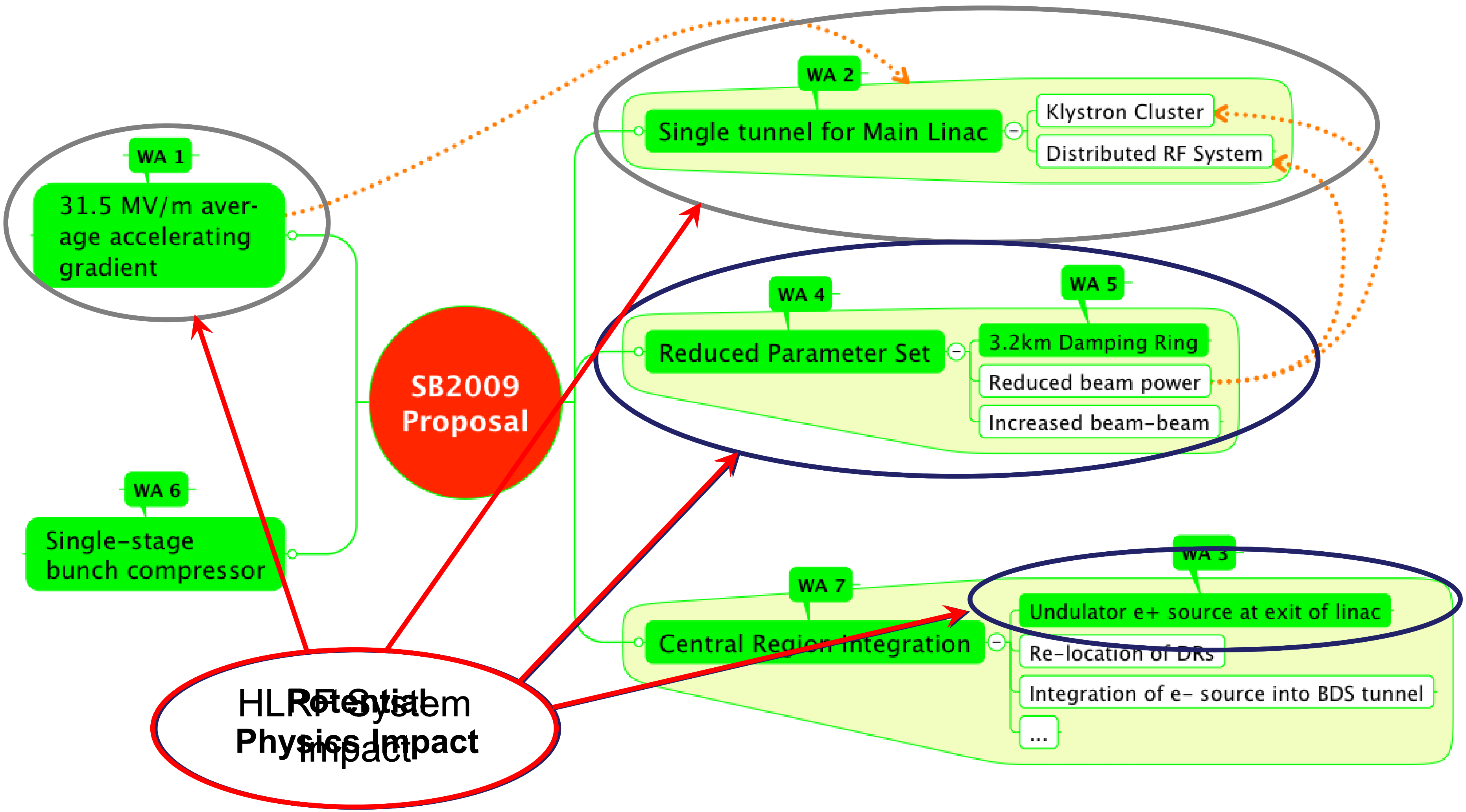
Distributed RF - DRFS

TLCC Themes



WA 1
31.5 MV/m average accelerating gradient
WA 6
Single-stage bunch compressor
SB2009 Proposal
WA 2
Single tunnel for Main Linac
Klystron Cluster
Distributed RF System
WA 4
WA 5
Reduced Parameter Set
3.2km Damping Ring
Reduced beam power
Increased beam-beam
WA 3
WA 7
Central Region Integration
Undulator e+ source at exit of linac
Re-location of DRs
Integration of e- source into BDS tunnel
...

TLCC Themes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Central Region Integration
Undulator e+ source at exit of linac
Re-location of DRs
Integration of e- source into BDS tunnel
...
HLRF System impact
Potential Physics Impact

BAW-1: Recommendations

Approx. 58 participants physics & detector reps.

1. **Gradient**
   - Remain at 31.5 MV/m average accelerating gradie
     - → fixed tunnel length
   - Additional RF power to accommodate a spread in gradient (±20%)
     - → higher mass-production yield expected ⇒ cost effective
   - TDP2 R&D remains ≥35 MV/m low-power vertical test (90% yield)
     - infers <*G*> ~38 MV/m VT (additional margin)

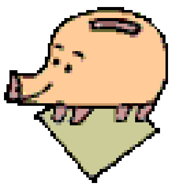
Now formally accepted as baseline!

2. **Single-Tunnel (Main Linac)**
   - Go forward with SB2009 proposal
   - Both KCS and DRFS R&D have significantly progressed
   - Inclusion of RDR HLRF Technology option as **back-up solution**

http://ilcagenda.linearcollider.org/conferenceTimeTable.py?confId=4593

BAW-2 Themes

- **Reduction of # bunches (2625 → 1312)**
  - Reduced beam power → reduced RF
  - Smaller damping rings (6.4 km → 3.2 km)
  - Regain luminosity via stronger focusing at IP



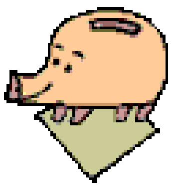
- **Re-location of e+ source to end of Main Linac**
  - Better integration (central campus) – higher overhead (at 500 GeV running) ⇒ reduced risk
  - Issues of running for Ecm < 300 GeV

Parameter Table link

								upgrade
Centre-of-mass energy	E_{cm}	**GeV**	**200**	**230**	**250**	**350**	**500**	**1000**
Luminosity	L	$\times 10^{34}$ cm^{-2}s^{-2}	**0.5**	**0.5**	**0.7**	**0.8**	**1.5**	**2.8**
Luminosity (Travelling Focus)	L_{TF}	$\times 10^{34}$ cm^{-2}s^{-2}	**0.5**		**0.8**	**1.0**	**2.0**	
Number of bunches	n_b		1312	1312	1312	1312	1312	2625
Collision rate	f_{rep}	Hz	5	5	5	5	5	4
Electron linac rate	f_{linac}	Hz	10	10	10	5	5	4
Positron bunch population	N_+	$\times 10^{10}$	2	2	2	2	2	2

BAW-2 Themes

- **Reduction of # bunches (2625 → 1312)**
  - Reduced beam power → reduced RF
  - Smaller damping rings (6.4 km → 3.2 km)
  - Regain luminosity via strong focusing at IP



- **Re-location of e+ source to end on Main Linac**
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10 Hz alternate pulse mode

								upgrade
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TLCC Process

Issue Identification
- Planning
- Identify further studies
- Canvas input from stakeholders
- …

Baseline Assessment Workshops
- Face to face meetings
- Open to all stakeholders
- Plenary

Formal Director Approval
- Change evaluation panel
- Chaired by Director

Process covered by B. Barish

keywords: open, transparent

BAW-2 Issues

Tra
Fo

Wednesday

some recent work

IWLC10 – solutions exist

10Hz
(L

Thursday

ator)

Upgrade / Risk-Mitigation

- Understand scenarios for re-establishing RDR bunch number
- Cost impact (mostly CFS)
- Considered either as possible luminosity upgrade or risk-mitigation (GDE PAC)

Wednesday →

BAW-2 Agenda – 'Low Power'

- **Overview**
- **Technical:**
  - HLRF – Chris N. and Shigeki
  - Cryo / CFS – Tom and Vic
- **Accelerator**
  - DR – Susanna and Mark
  - BDS - Andrei
  - Other AS – Axel and Nikolay
- **Cost – Peter**
- **Physics Impact →**
- ***Summary and Proposal development – Nick***

Physics Impact: Agenda

- Wednesday Afternoon (19.01)
  - **Organized with help from Jim Brau**

14:00	**Low-mass susy scenario study** *25'* Speaker: Paul Grannis (Stony Brook University)
14:25	**Higgs cross section and mass measurement** *25'* Speaker: Hengne Li (Lab. de l'Accelerateur Lineaire (IN2P3) (LAL) - Universite de Pa)
14:50	**Higgs branching ratios study** *20'* Speaker: Hiroaki Ono (Nippon Dental University)
15:10	**Background studies** *20'* Speaker: Takashi Maruyama (SLAC)
15:30	**break-->** *30'*
16:00	**physics requirements for positron polarization** *25'* Speaker: Sabine Riemann (DESY)
16:25	**physics studies with polarization** *25'* Speaker: Mikael Berggren (DESY Hamburg)

PAC Review* – 11.2010

PAC Comments on SCRF: (color added)

- The PAC is very pleased to note that the GDE's approach to cavity production in the ILC construction phase intends to follow the successful example of the LHC in the industrialization of complex superconducting components, rather than that of the much smaller-scale XFEL project.
- The PAC is very impressed by the recent progress on SCRF cavity gradients; 9 out of 10 cavities from one manufacturer meeting the nominal ILC gradient requirement is an outstanding achievement.
- There is a need to pay attention to the issue of field emission in the SCRF cavities.

* Project Advisory Committee – reports to ILCSC

PAC Review – 11.2010 (2)

PAC Comments on Baseline Assessment: (color added)

- The PAC endorses the methodology for GDE design change control which is now in place, and which appears to be working well. The Committee also notes positively the membership of a detector physicist on the GDE Change Evaluation Panel.
- The PAC sees significant progress in addressing the issues raised by the SB2009 proposals, including progress towards resolution of several hardware questions following from the proposals. The Committee is gratified to observe the greatly improved collaboration with the detector community in SB2009 discussions.

Overview

- Changing the ILC Baseline – TLCC
- **Background: Motivation for Cost Containment**
  - TDR will have updated cost estimates for *SRF* and *CFS*
- **Reduced Beam Parameter Set**
- **Positron Source Relocation**
  - (Ewan Paterson, Thursday Jan 20)
- **Summary**

Costing effort: 2011-2012

- *TDR will reflect SCRF and CFS progress*
  - (beyond RDR 2007)
  - Technical advancement (esp. R & D)
  - Project strategy (design, industrialization, siting)
  - AND COST
- **Balance performance scope and accelerator system design against these cost drivers**
- **Motivation for Cost – Containment**
  - Development of SCRF 2007→
  - Siting 2010 →

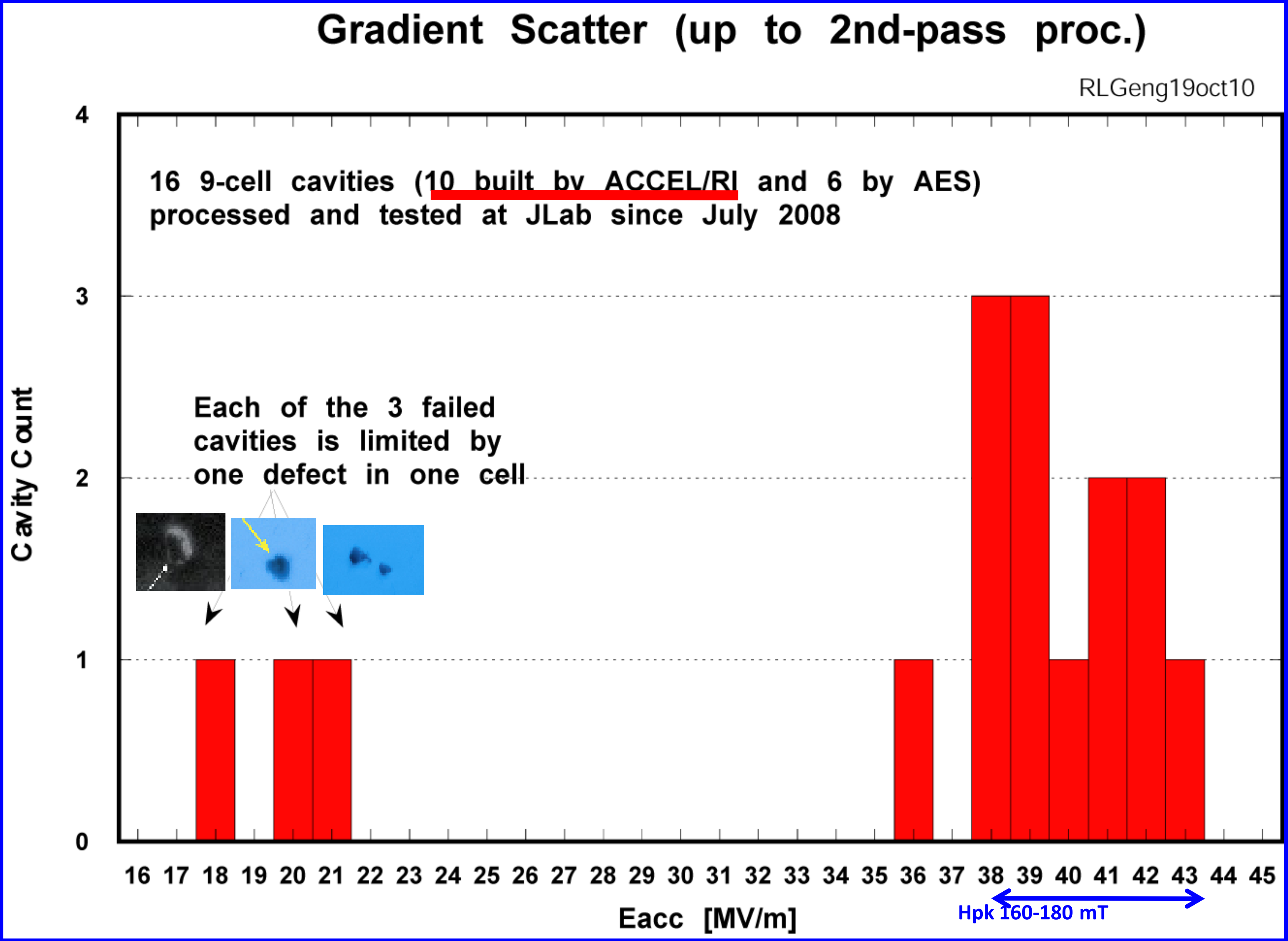
RDR → 2012 Technical Design

- **Strong Basis for SCRF technology in each ILC region**
  - Cavity fabrication and test: Each region
  - Global Cryomodule: KEK +
- **Large scale *Costed* technology demonstration**
  - EU XFEL (5% of ILC); first beam mid-2014
- **Siting: adaptation to best suit potential hosts**
- **Beam – based studies and demonstrations**
  - High power SCRF linac operation: DESY +
  - Electron-cloud beam dynamics: Cornell +
  - Beam delivery technology: KEK +

SRF – examples of ongoing R&D with possible cost impact

1. Cavity Production Yield – 35 MV/m nominal
   – **56% Global Team Production Yield**
   – **Special case – very encouraging:**
     • 13/16 yield Accel/RI and AES 2008-2010 (JLab)
2. Cavity Processing Cost reduction study (FNAL)
   – **Heavy 'Tumbling' / light EP: *First Result* 11.2010**
3. Cryomodule (KEK)
   – **'S1 Global' gradient performance: 26 MV/m avg.**
4. EU-XFEL (DESY)
   – **584 cavities ordered: complete 02.14 (2 x 25 M €)**

Cavity Gradient R & D – Rongli Geng, Jefferson Lab



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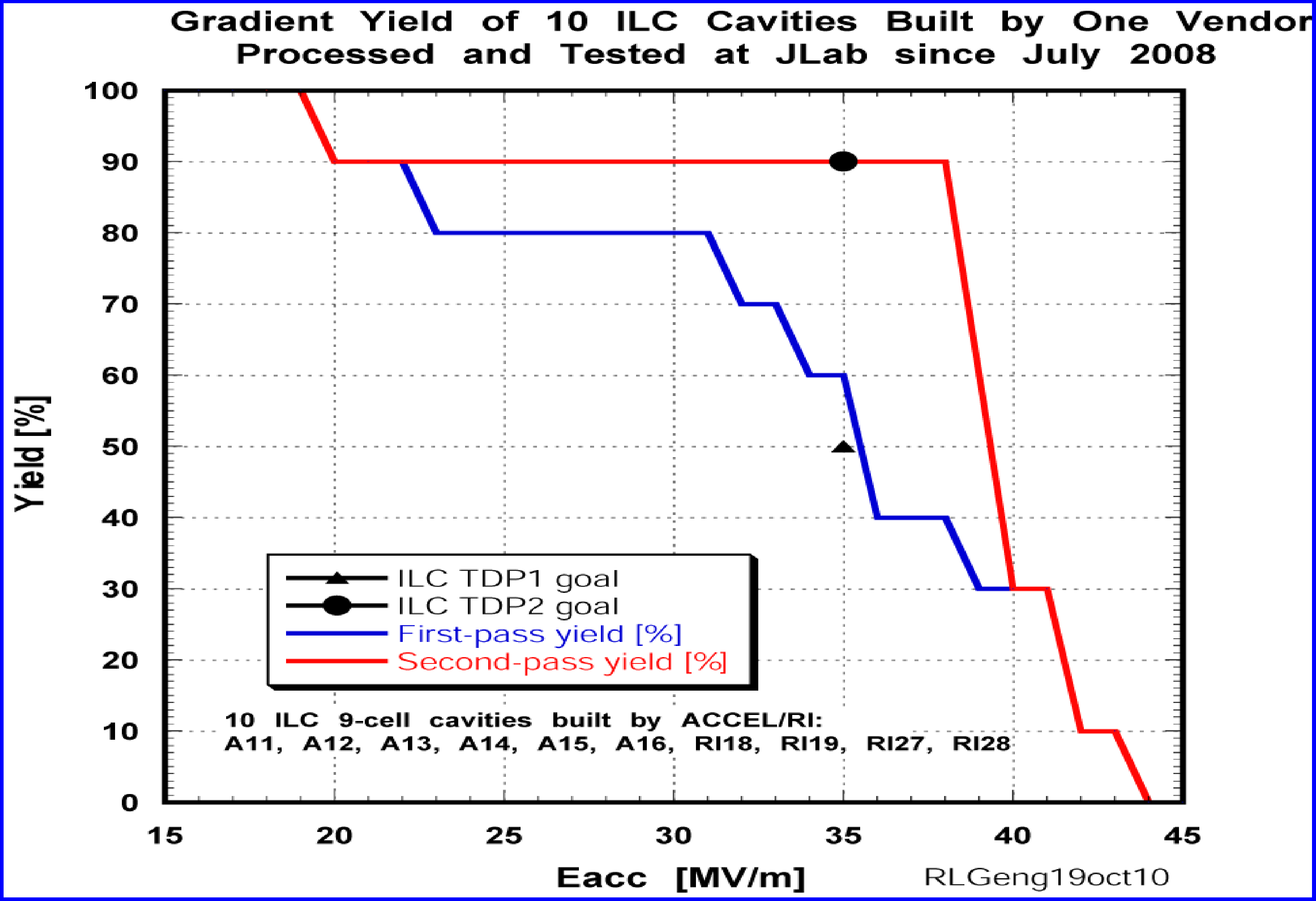

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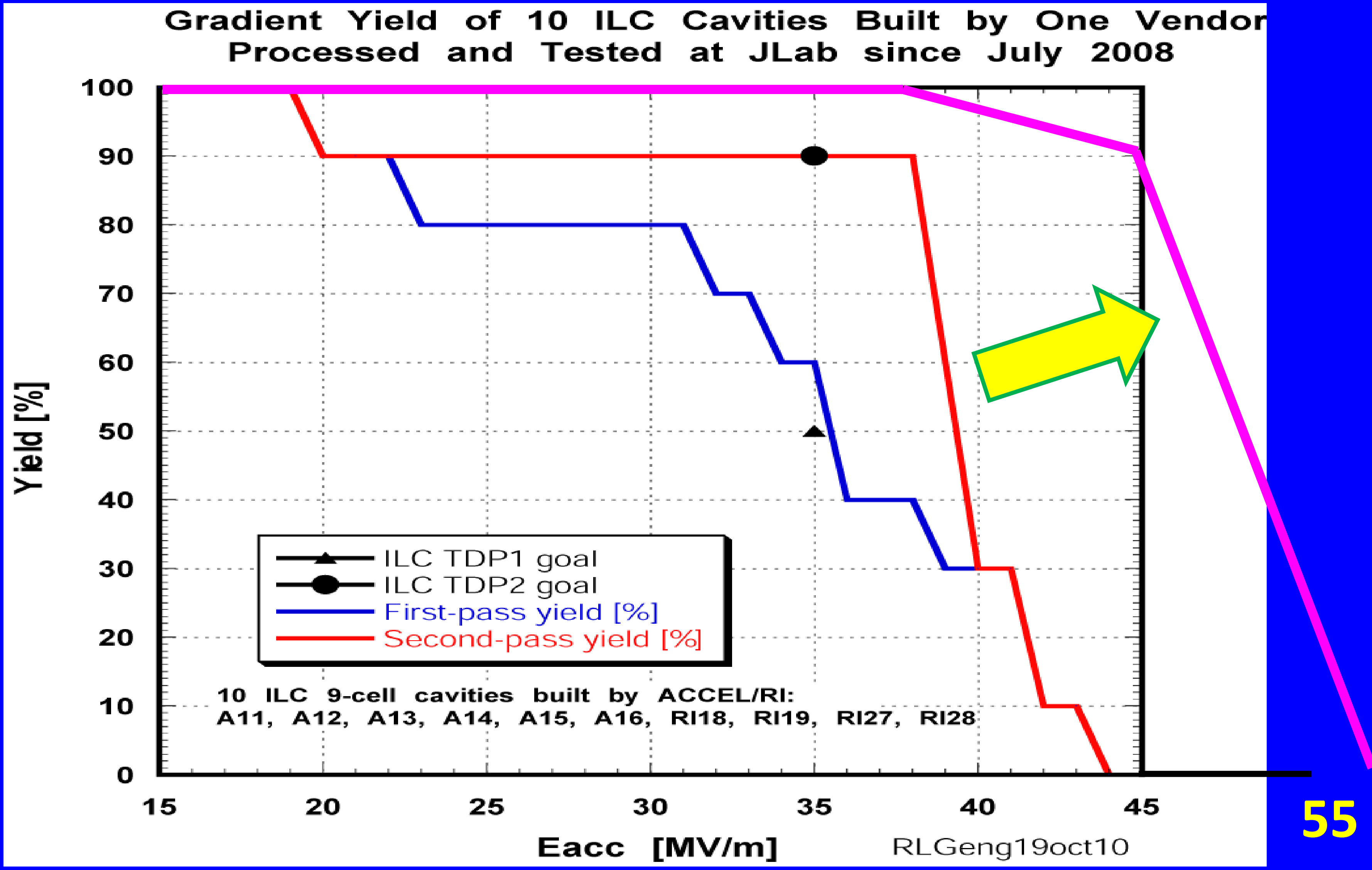
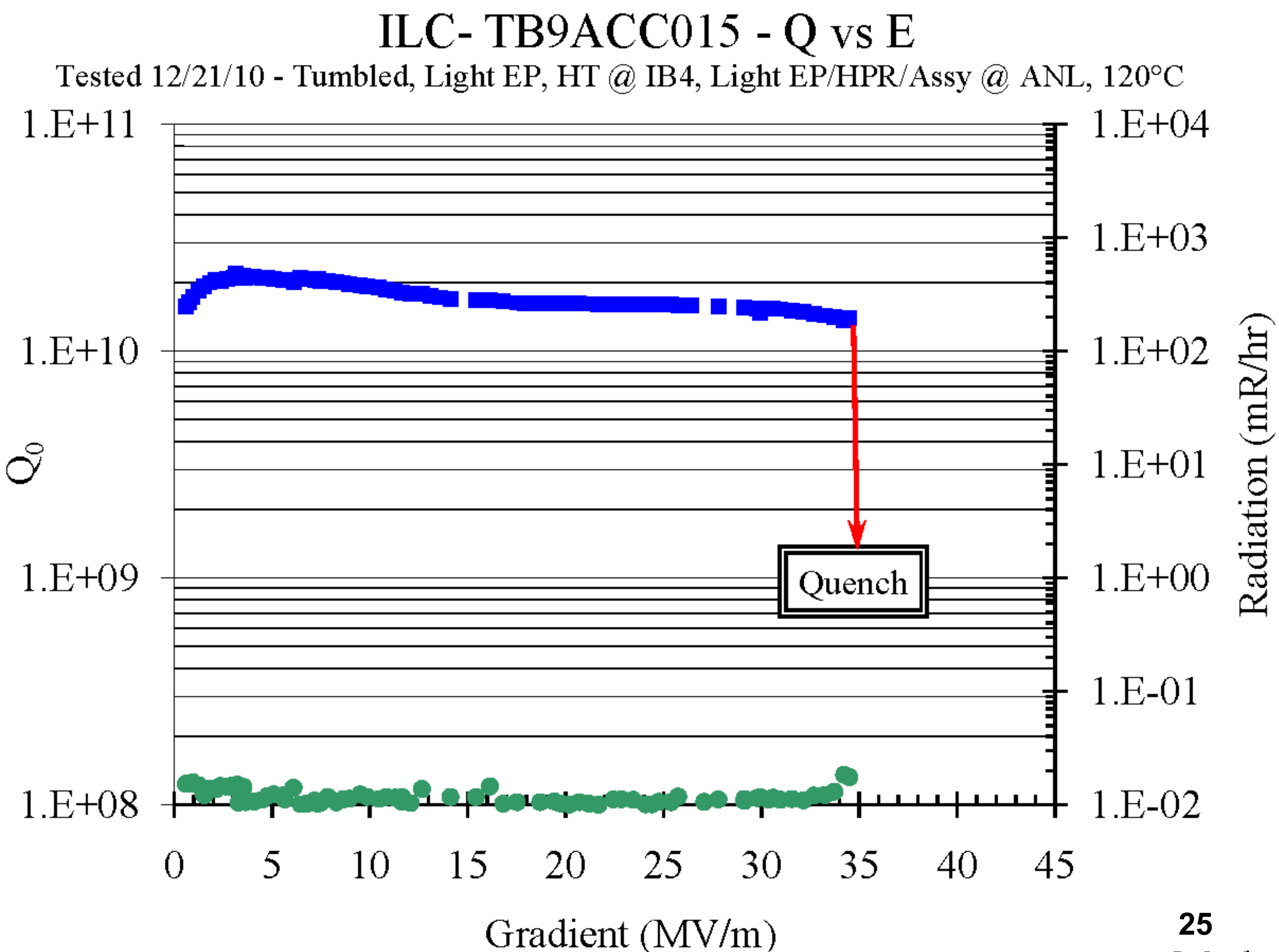
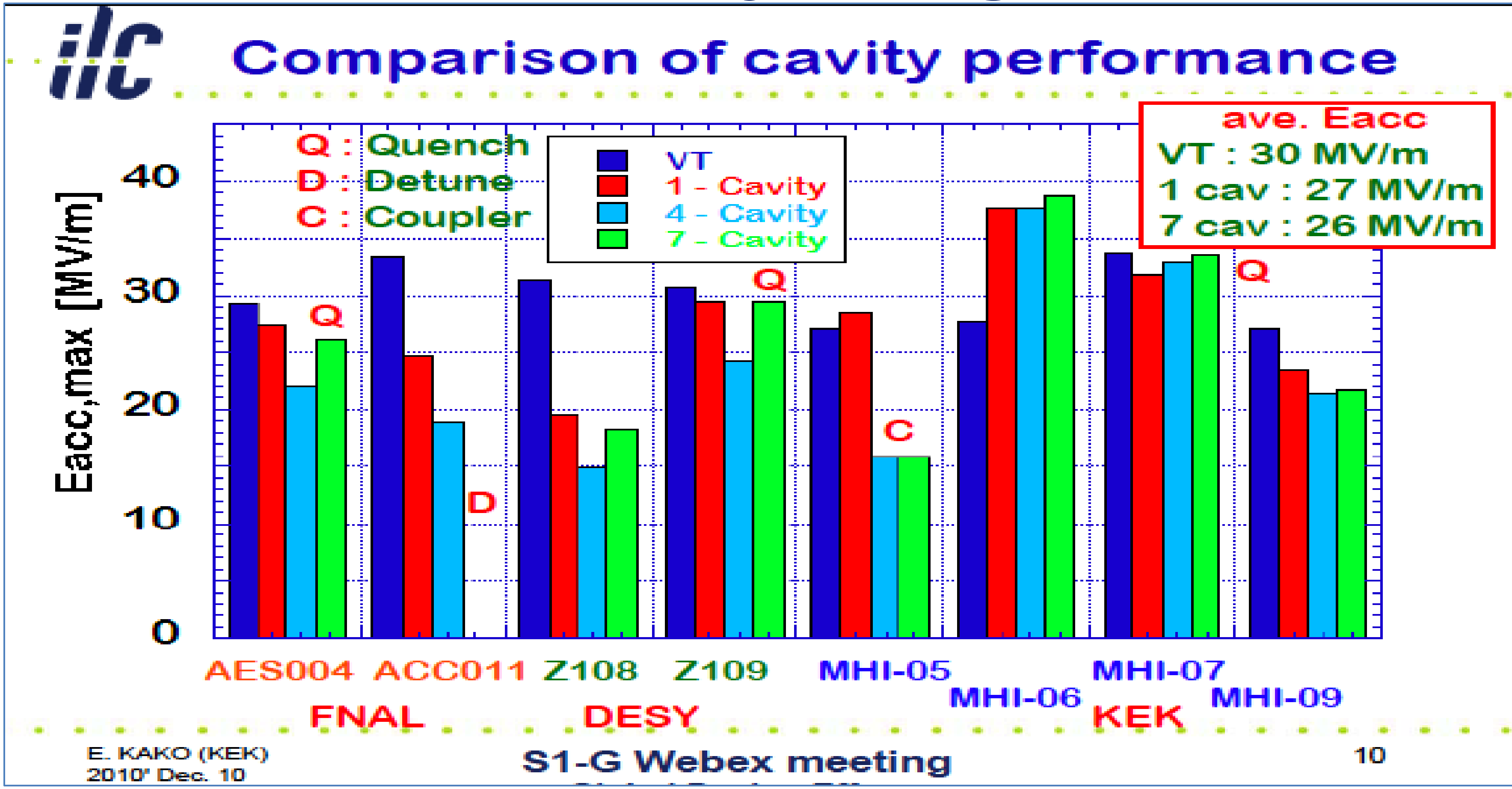


Tumbled Cavity (CBP) – re-Process & Test



J. Ozelis

S1-G: 7 Cavity-String Operation



Average field gradient achieved:

VT: 30 MV/m → S1G-Single: 27 MV/m, 7-string→ 26 MV/m

The contracts

- Research Instruments and E. Zanon were contracted to produce each
  - 4+4 pre-series cavities
  - 280 XFEL type series cavities
  - 12 ILC-HiGrade cavities, first used for quality assurance, later available for further investigations & treatments (high gradient R&D towards ILC)
- Additional 80 cavities will be ordered after the evaluation of the successful start of the series production (competitive element)
- First series cavities beginning of 2012; all cavities to be delivered within two years; He-vessels for RI cavities to be supplied by DESY
- Contracts have a volume of almost 25 M€ each

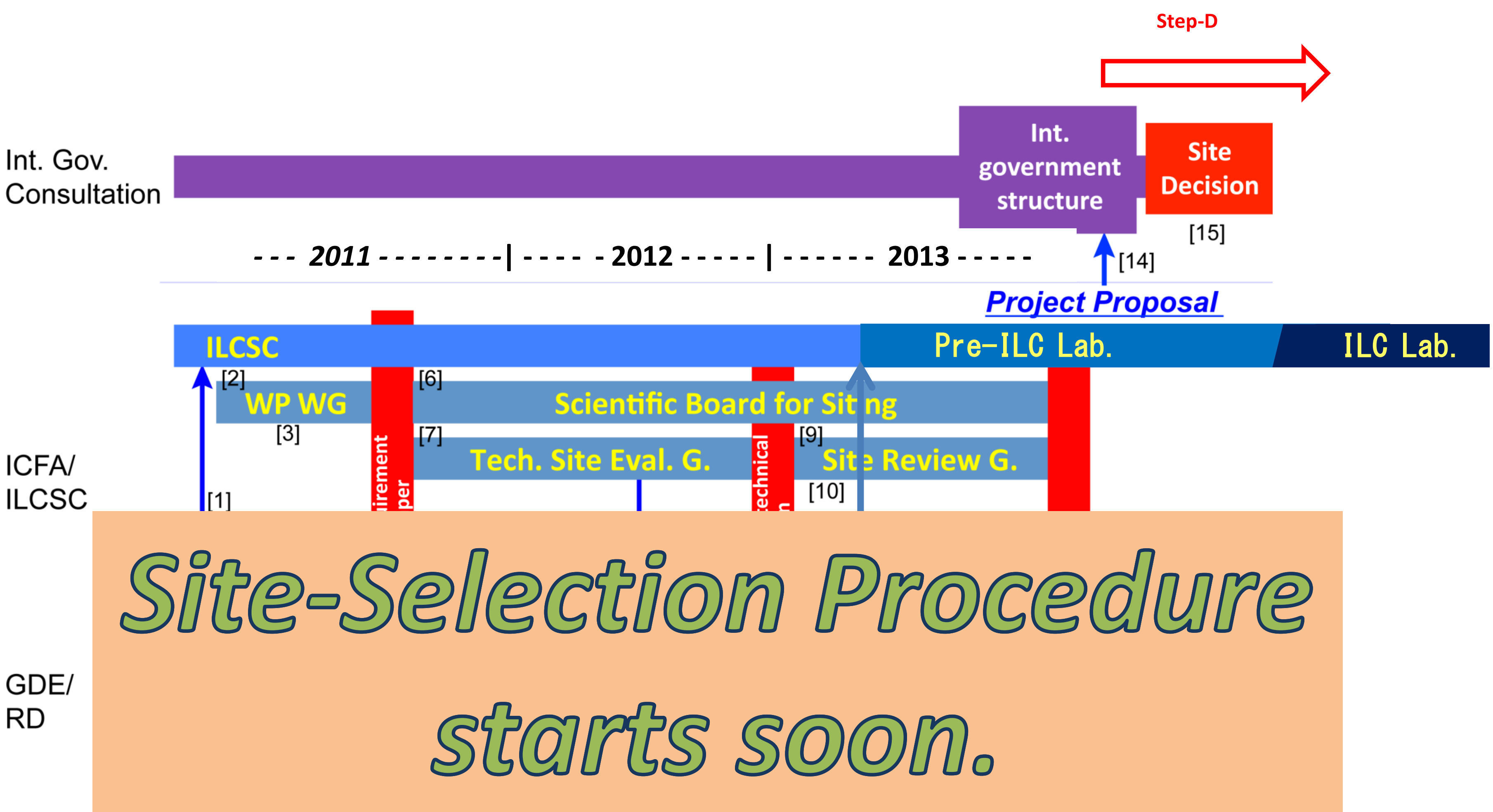
Siting Process - CFS

- RDR: Deep-Rock sites with similar characteristics
- TDP:
  - **Specific sites with geotechnical / environmental constraints**
  - **(e.g. Two Japanese mountainous region sites)**
  - **Preparation for Site Selection**
    - Adaptation of technical criteria to facilitate siting process
    - Supported through R & D and Design work

Siting – Site Selection Process (IL-2)

Atsuto Suzuki,
KEK DG (BAW -1)

- ◆ *Step-D: Process of narrowing-down the site candidates through an inter-governmental level consultation, including discussions on general political aspects*



Site-Selection Procedure starts soon.

ILC in a Mountainous Region

ILC - GDE - Director's Corner - 30 September 2010 - The ILC in a mountainous region - ... Page 1 of 2

international linear collider

Director's Corner

30 September 2010

The ILC in a mountainous region – A report on Japanese efforts to develop possible sites

Marc Ross

Today's issue features a Director's Corner from Marc Ross, Project Manager for the Global Design Effort.

Roughly six years ago the International Committee for Future Accelerators accepted the recommendation to adopt 'cold', superconducting radiofrequency (RF) technology for the linear collider's main linac. The recommendation came shortly after an extensive review of the designs of the ILC's forerunner projects, TESLA, NLC and JLC. The main linac technology planned for the ILC, now under development in each region, is quite similar to that of the TESLA design.

Of course, the TESLA design included much more than a plan to deploy cold RF technology. In particular, the TESLA *Technical Design Report* included a conventional facilities design and a plan for a site in Germany located along a line stretching towards the northwest from DESY. In contrast to our adoption of cold RF technology, the conventional facilities design for TESLA was not adopted; a quite different design for the ILC has emerged and this has broad implications for several subsystems. The TESLA underground construction scheme was optimised to best suit a site in sandy, flat, water-logged ground with much of the underground construction below the water table, requiring appropriate design techniques.

In the Technical Design Phase, we now face a new challenge, namely how to make sure the ILC design is suitable for a variety of possible sites, including those similar to the DESY site and those quite unlike it. This includes, for example, sites in mountainous regions. If the ILC is to be constructed in Japan, it will almost certainly be situated in a mountainous region. After all, about 70 percent of Japan is mountainous and remains relatively uninhabited.

Review committee members at the Kannagawa hydroelectric power plant during the CFS review meeting held in June. *Image : Nobuko Kobayashi/ courtesy of Tokyo Electric Power Company*

There is an encouraging possibility that Japan will bid to host the ILC. Earlier this month, at the autumn meeting of the Physical Society of Japan held at the Kyushu Institute of Technology, representatives of the Japanese ILC community announced two potential ILC sites. The two locations are at opposite ends of the Japanese archipelago, one in the Seburi-area, 30 kilometers south of the city of Fukuoka in northwestern Kyushu island, and the other in the Kitakami-area, 100 kilometers north of the city of Sendai in northern Honshu island. In both cases, local prefectural governments and universities have partnered to study these potential sites. Studies include exploratory bore-hole drilling and survey.

Given the general aspects of a typical mountain region site, it is up to us, the Global Design Effort (GDE) and our partners, to interpret criteria we developed for the Reference Design such that all involved can readily conclude whether such a site would work and would be cost-effective. This means, for example, developing a better understanding of how the high-power microwave systems and basic utilities such as water, power and cryogenics, could be built differently from the Reference Design Report in order to suit such a place. In a typical mountain site, the surface of the land is undeveloped and inaccessible and the tunnel could be quite deep. Also the geology could be quite complicated, and might consist of fractured, water-bearing rock.

http://www.linearcollider.org/GDE/Director%27s-Corner/2010/30-September-2010---The-... 1/12/2011

ILC - GDE - Director's Corner - 30 September 2010 - The ILC in a mountainous region - ... Page 2 of 2

ent and groups. wn as in June comes -tunnel 010. It er of Fermilab.

[1] Read full text of *"Investigating the Single Tunnel Proposal in a Japanese Mountainous Site"* submitted to the CF Review in June 2010. Copyright AAA CF Working Group, All rights reserved

untain ranges can sometimes be as quite positive. Following the nstruction in Japan at the Tokyo

Initial consideration of mountain-region ILC sites comes at the same time as the GDE initiative to reduce the project's conventional construction estimated cost through a 'Baseline Assessment' process. One of the most important changes proposed to the Reference Design baseline is the elimination of the main linac support tunnel. This reduces the total ILC fully-finished tunnel length by about 40%, and represents a significant reduction in cost and construction risk. We expect the change control process for the new baseline to be completed early next year. With a new baseline in hand, and with guidance from the groups who produced the AAA report, we will be able to provide clear criteria to the Japanese site development teams and can look forward to a well-understood, cost-effective design for the *Technical Design Report*.

-- *Marc Ross*

http://www.linearcollider.org/GDE/Director%27s-Corner/2010/30-September-2010---The-... 1/12/2011

How to make the ILC design suitable for a variety of sites?

There is an encouraging possibility Japan will bid to host the ILC…

It is up to us to interpret RDR CFS criteria to clearly show that such a site would work and would be cost-effective…

Costing Effort: Summary

- **SCRF:**
  - Interaction with Industries in each region – 2011
  - XFEL Contract exposure 01.2011 (after 6 months)
  - Impact of allowing Gradient Spread - 2010

- **CFS + HLRF:**
  - Engineering and Design Contracts - 2011
  - Mountain site and DRFS preliminary cost – mid 2011

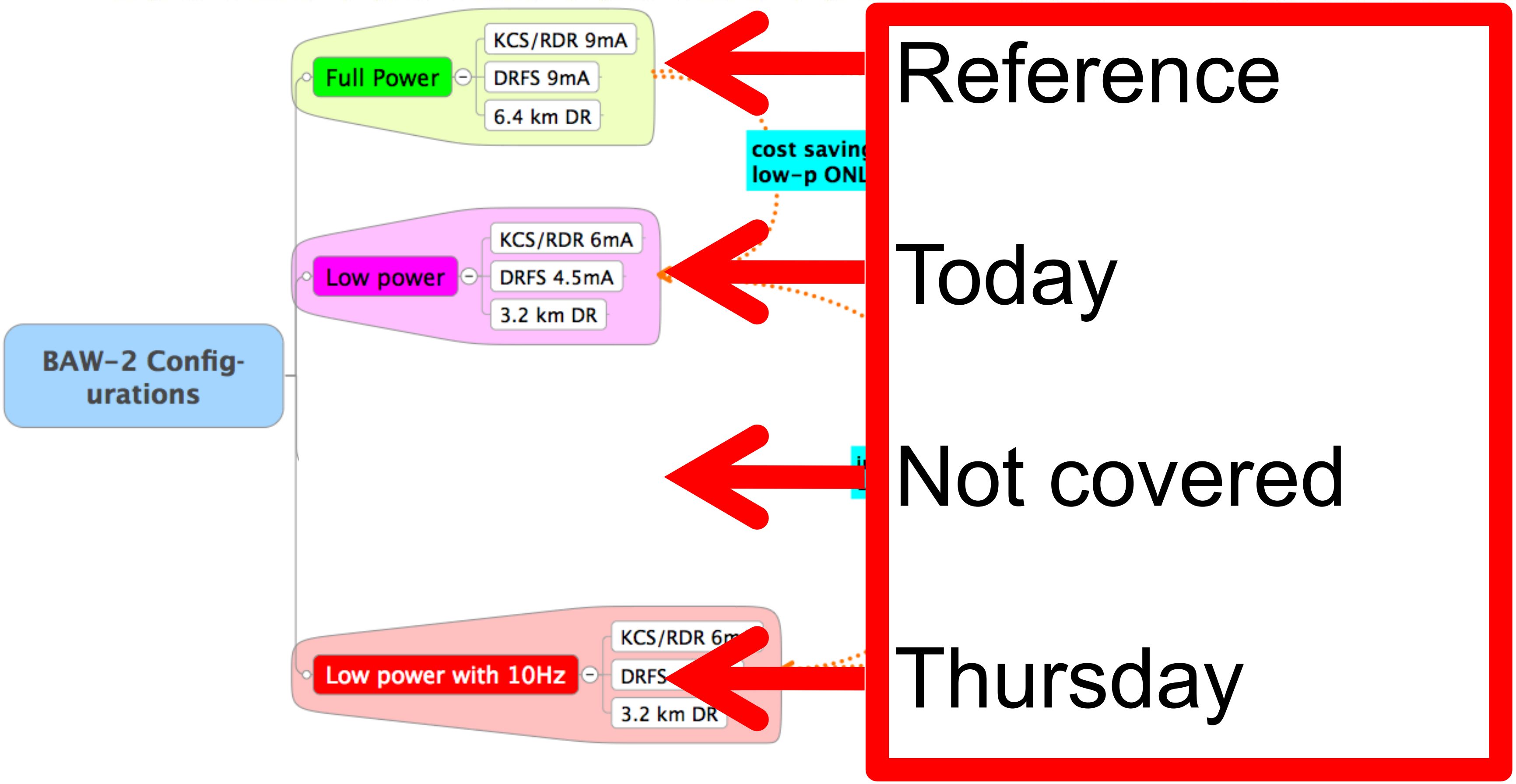
Cost Containment Estimated Impact:

- **RDR ML Technical Cost:**
  - 2/3 cold SCRF
  - 1/3 Modulator/infrastructure, Klystron, Power Distribution
    - ½ Modulator
    - ¼ Klystron
    - ¼ PDS
- **Half-Power ~ 16% ML technical reduction**
- **Could offset ~25% cold SCRF ‘increase’**
- **TDR cost breakdown will differ → 2011**
- **(see talks by Peter Garbincius, Wed/Fri)**

Overview

- Changing the ILC Baseline – TLCC
- Background: Motivation for Cost Containment
  - TDR will have updated cost estimates for SRF and CFS
- **Reduced Beam Parameter Set**
  - HLRF, DR, other Accel. Sys. and CFS/Cryo
- **Positron Source Relocation**
  - (Ewan Paterson, Thursday Jan 20)
- **Summary**

Proposed Baseline Changes:



Independent Proposals… with a few common issues

Cross – terms not fully developed

Reduced beam parameter set - Proposal

1. A *reduction of the number of bunches* per pulse (n_b) by a factor of two from 2625 to 1312.
2. A corresponding *reduction in Main Linac beam current*, and therefore beam power, and an associated reduction in the number of klystrons, modulators and power supplies (primary cost saving).
    - Key conventional facilities support for the full RDR RF power will be installed upfront during construction, in support of future possible upgrade to higher bunch numbers (risk mitigation).
3. A corresponding *reduction in the circumference of the damping rings* from 6476 m to 3238 m (i.e. 50%), while maintaining the DR current approximately constant. This includes the associated reduction in DR RF power by approximately 50% (primary cost saving).
4. An increase in the DR tunnel diameter to accommodate the *possibility of installing a third damping ring* (second positron damping ring) at some later date, if required (risk mitigation).
5. Adoption of *stronger focusing at the interaction point* (enhanced beam-beam) – including the possibility of travelling focus – to provide the required luminosity (maintaining performance at higher risk).

Positron Source Relocation - Proposal

1) A **relocation of the positron source** systems from the nominal 150 GeV point of the electron Main Linac to the **exit of the electron Main Linac** (≤250 GeV depending on physics scenario), integrated into the beginning of the Beam Delivery System.
2) The new baseline proposal includes a description of a possible low energy operational scheme. The scheme (**10 Hz running alternate pulse**) is consistent with the RDR: "Physics runs are possible for every energy above $\sqrt{s}$ = 200 GeV". The positron yield is ≥1.5 over this energy range and enables operation with the RDR parameters or the **'Reduced Beam Parameter Set.'**

- **Ewan Paterson – Thursday**
  - some overlap Technical presentations

Reduced Bunch Number - Introduction

As outlined in the SB2009 report.

- **reduce cost with fewer ML HLRF stations and a half the damping ring circumference.**
- **Luminosity performance is restored either in-part or completely through stronger interaction region focusing, including possible use of the 'travelling focus' scheme.**
- **key addition to the original SB2009 proposal is the explicit inclusion of support for increasing the number of bunches at a later**
- **Include 'gradient spread' and KCS / DRFS ('single tunnel HLRF')**
- **(Key high-power systems, such as beam dumps, would not be reduced and would retain nominal RDR performance)**

Low Power Parameters

Parameter	unit	RDR (nom.)	TLCC
E_{cm}	GeV	500	500
Rep. rate	Hz	5	5
Q_{bunch}	nC	3.2	3.2
Bunches/pulse		2625	1312
LINAC RF parameters:			
RF pulse length	ms	1.6	KCS: 1.6 DRFS: 2.2
Beam current	mA	9	KCS: 6 DRFS: 4.5
Damping Ring:			
Circumference	m	6476	3238
Avg. Current	mA	388	390
Damping time	ms	21	24
RF power	MW	3.97	1.76

- Focus on 500 GeV centre-of-mass
  - **Low E_{cm} →cf 'Positron Source Relocation'**
- ***Different parameters for DRFS and KCS***
- 2x3.2km DR with reduced bunch number (@5Hz)

Since RDR / SB2009:

- **Gradient Spread (BAW 1)**
  - RDR design: each cavity set to 31.5 MV/m
  - TDR baseline: 31.5 avg +/- 20%
  - Penalty: Increased HLRF overhead (10 - 15%)
  - (offset by decreased cavity cost; model dependent)
- **Single Tunnel (BAW 1)**
  - Facilitate siting through flexible HLRF technology
  - Penalty: different criteria for CFS / Cryo design
- **Consider restoration of full beam parameters**
  - Penalty: Identify and reserve space / support equipment needs

Gradient Spread: HLRF overhead

9 mA – Full beam parameters

RF Power						
Installed capacity	#'d pg 81		slide 44		slide 9	
	RDR 2.6-2	RDR 2.6-2	KCS	KCS	DRFS	
	No gradient spre	w/ gradient spre	equal CTO power	tailored CTO power		
beam current	9	9	9	9	9	mA
gradient	31.5	31.5	31.5	31.5	31.5	MV/m
power to beam	294.3	294.3	294.3	294.3	294.3	KW
cavity spread - limited tuning ability	1	1.06	1.06	1.06	1	
cavity spread statistics - excess for high power combination	1.00	1.00	1.06	1.00	1.21	
cavities/RF unit	26	26	26	26	2	
local dist loss	0.93	0.93	0.95	0.95	0.975	
peak power / RF unit	8227	8721	9058	8529	728	KW
RF unit assemblies	1	1	28	28	1	
Additional losses	1	1	0.86	0.86	1	
total power/ unit	8,227	8,721	294,742	277,535	728	KW
Controls overhead	1.16	1.14	1.07	1.07	1.09	
required power	9,543	9,941	315,374	296,963	794	KW
nominal available klystron power	10000	10000	10000	10000	800	KW
number of klystrons	**1**	**1**	**32**	**30**	**1**	
additional overhead (in fractional klystrc	4.6%	0.6%	46.3%	30.4%	0.8%	

Nantista, SLAC

KCS HLRF Overhead Summary

9 mA – Full beam parameters

There are multiple reasons for the increase in required klystrons per 28 rf units:

klystrons:

28	equivalent to the RDR requirement, 1 per rf unit.
+2	7% more for long range distribution for eliminating service tunnel.
+2	for redundancy (allowing one failure). In the RDR, such failures had to be covered by including additional rf units.
+2	to recover enough for 5(7)% LLRF overhead after a 12.5% hit due to cavity gradient spread (flat gradient w/ common timing and feed statistics). Most of this hit would exist in the RDR scheme.
34	

NOTE: The preceding calculations could well be off by ~2-3 percent, depending on actual cavity distribution and error margins in loss estimates.

HLRF – two technical options

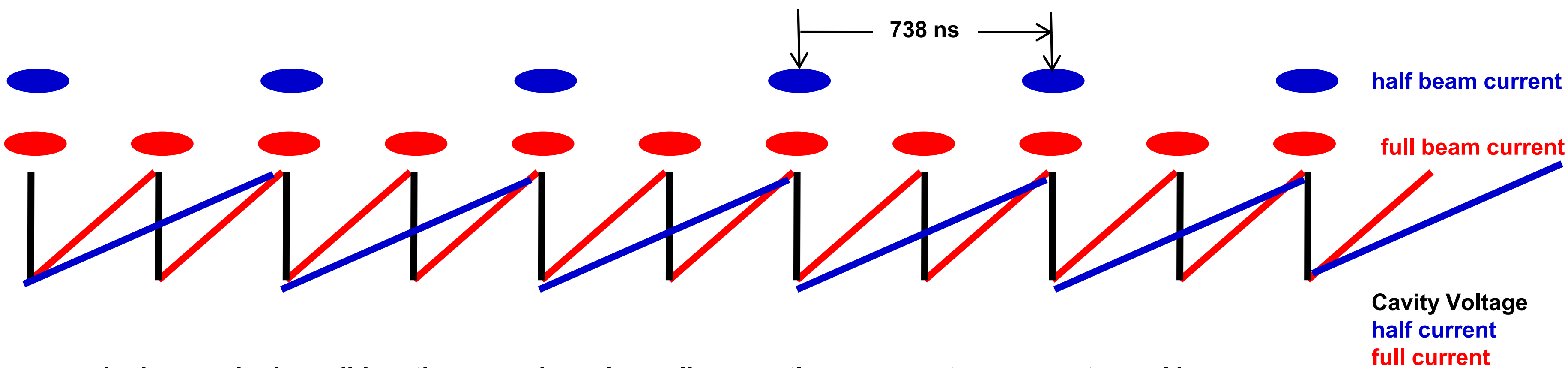
- **Both options subject to R & D;**
  - both to be included in TDR if resp. R & D successful
- **Different optimum bunch parameters**
  - Both have reduced plug–to-beam efficiency

Key Main Linac HLRF parameters at 500 GeV centre-of-mass (approximate numbers)

Parameter	unit	RDR (nominal)	KCS	DRFS
Beam current	mA	9	6	4.5
Bunch spacing	ns	369	535	738
Beam pulse length	µs	969	702	969
RF fill time	µs	595	862	1190
RF pulse	µs	1564	1564	2159

SRF Linac Matched Condition –

- Minimal CW losses + matched condition: all power to the beam
- lower current --- less power needed during pulse
- less power available --- longer filling time (before pulse) – could be offset by additional peak power
- explore trade-off between peak power / average power
- mismatch may actually help reduce plug power needs



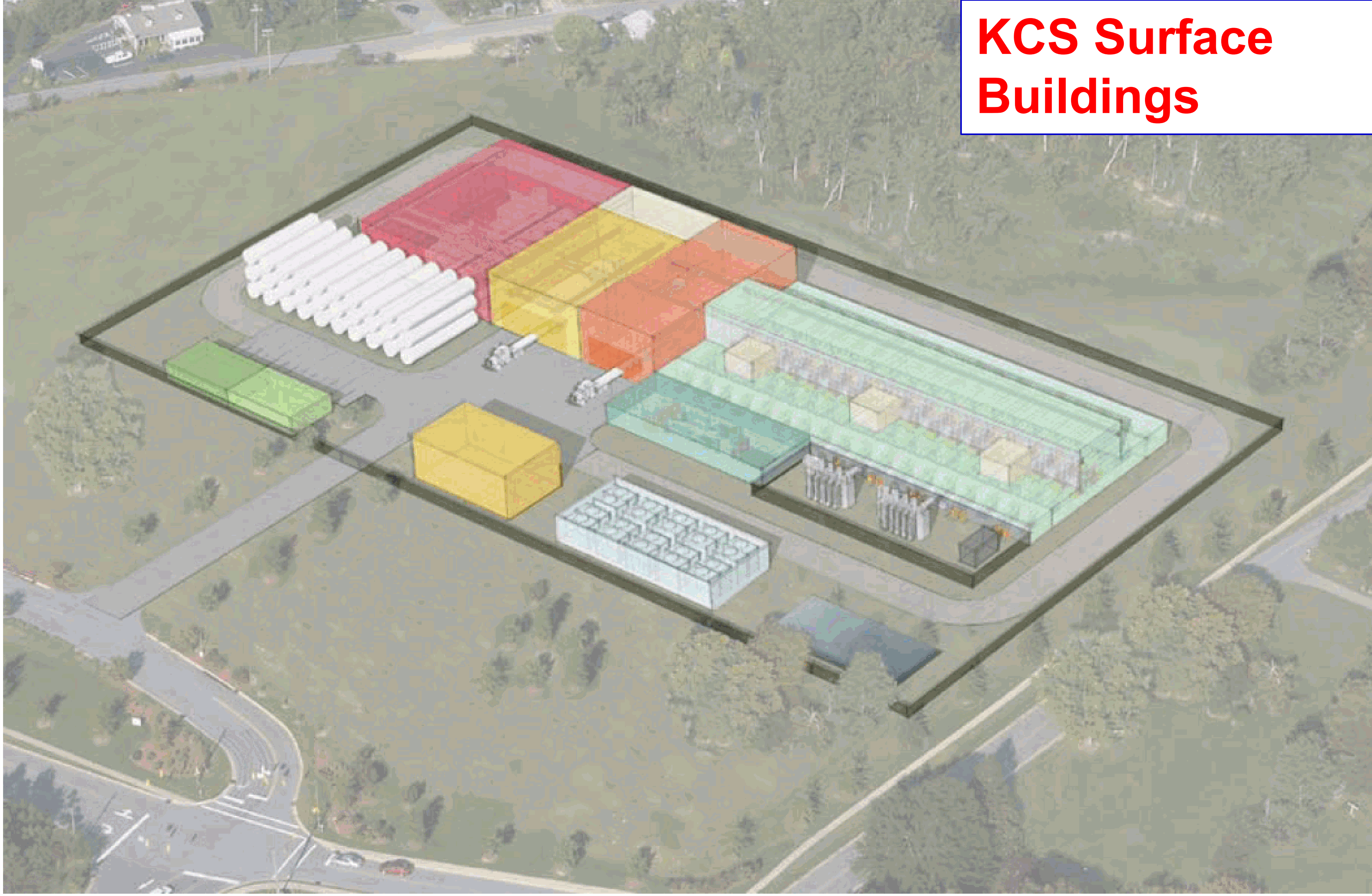
In the matched condition, the power in and coupling exactly compensate power extracted by a single bunch – no reflected power during beam pulse

KCS – optimum bunch parameters

- **(Chris Nantista)**
- ***Half current or reduced current / reduced train length?***

1. **doubling the cavity fill time, same acceleration gradient,**
   - thereby increasing the required rf pulse width by 38% from 1.56ms to 2.16ms.
   - This pushes the specification for the klystrons and modulators beyond
   - The longer fill time also increases the cryogenic dynamic heat-load.
2. **change both the bunch train current and the bunch train length.**
   - Current reduced to 69% and train length to 72.5%,
   - the required rf pulse duration would remain unchanged.
   - increase in fill time is balanced by the shortened beam pulse.
   - number of bunches would still be halved, with their spacing increased by a factor of 1.45, rather than doubled.

KCS Surface Buildings



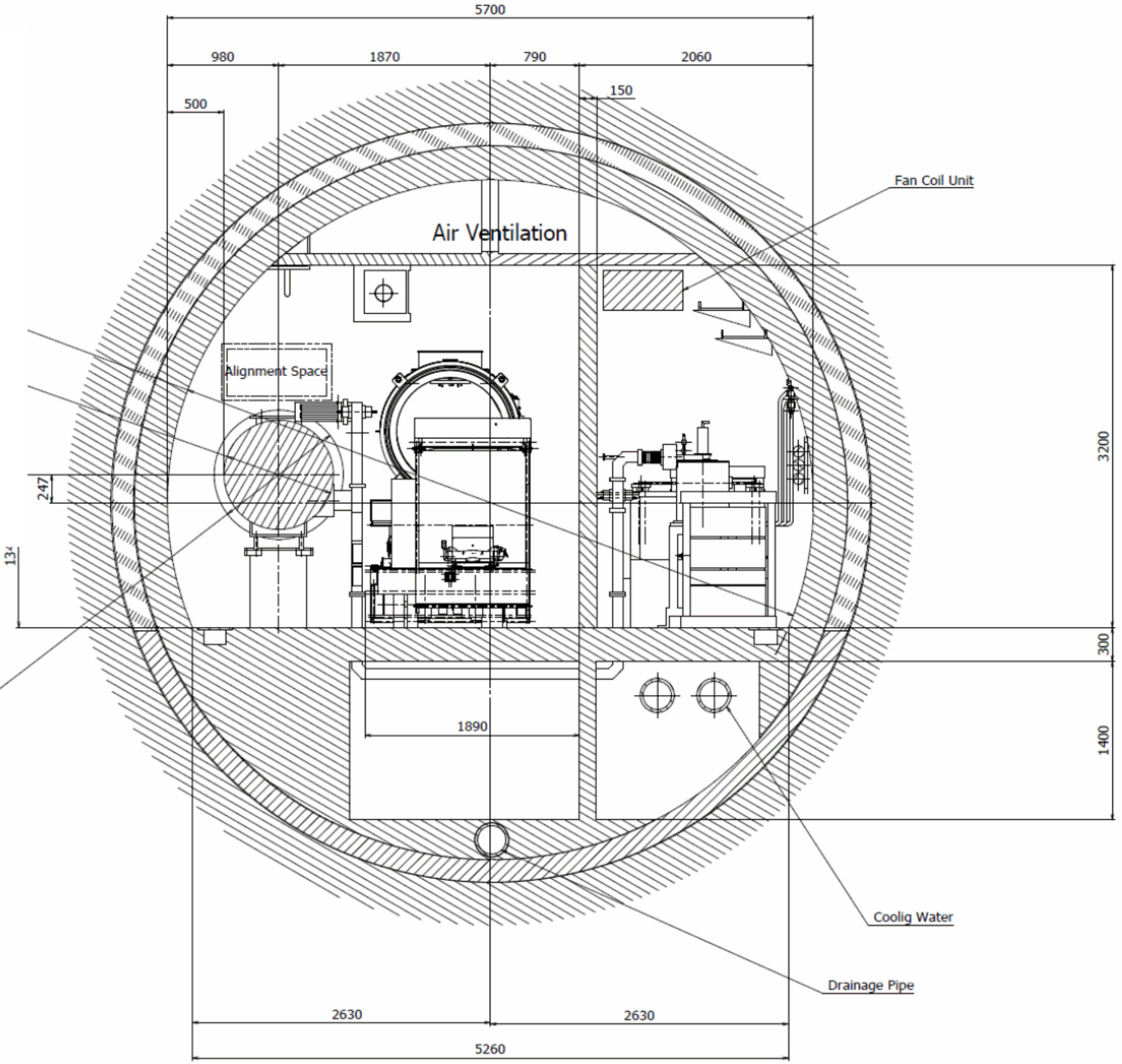
	RF UNIT BUILDING		CRYO BUILDING		ADMIN
	SURFACE PROCESS COOLING DI PLANT		SHAFT ACCESS BUILDING		WORKSHOP
	FAN-HOUSE		SUPPORT		LOADING BAY

DRFS Scheme

(Shigeki Fukuda)

- **Consider upgrade process for HLRF hardware in the tunnel →**
  - It is necessary to develop a model ILC Construction/Operation Schedule
- **Consistent model and scheme is invaluable for all over the periods of ILC schedule.**
- **Layout and cost are depends on this consistent model.**

DRFS – ML tunnel cross section



Shigeki Fukuda and Atsushi Enomoto, KEK

ILC Construction/Operation Scheme and DRFS

Shigeki Fukuda, KEK

Revised schedule scheme and base of the presentation for BAW-2

Step	Status	Mode	Center of Mass Energy(GeV)	Current (mA)	Electron Energy(GeV)	Electron Rep(Hz)	Positron Energy(GeV)	Positron Rep(Hz)	Rel. Beam Power
0 ? 0-0	Operation Upgrade	Low Energy Option	250	4.5	125	5	125	5	0.25
0-1	Operation	Low Energy Option 10 Hz	250	4.5	150 125	5 5	125	5	<0.5
		Revised from 10Hz Operation Mode to SB2009							
0-2 0-3…… 1-0	Operation ↓ Upgarde	300 GeV Operation ↓	300 ↓	4.5 ↓	150 ↓	5 ↓	150 ↓	5 ↓	0.3
1-1	Operation	Low Power Option SB2009	500	4.5	250	5	250	5	0.5
2-0	Upgrade	4000 RF Sources are installed							
2-1	Operation	RDR	500	9	250	5	250	5	1

Scope of presentation in BAW-2

- <u>**Jan. 18 11:00-12:30 HLRF considerations (KCS/RDR and DRFS)**</u>

  In order to show the consistent HLRF configuration, *<u>introduction of low energy 10 Hz operation and main feature of RF layout will be presented.</u>*

  (Detail will be presented in Jan. 20)

The SB2009 scheme which is upgraded for the10 Hz option will be presented.

- **Since hardware is determined, heat dissipation and rough cost estimation can progress.**
- **Effects of cavity gradient variations are included.**
- **(Partial) over-coupling scheme to reduce the pulse width will also be discussed.**
- **Using this model, we will discuss maintaining high efficiency and the successive upgrade process.**

Damping Ring

(Susanna, Mark and Junji)

Reduce Circumference 2x:

- **Design of 3.2 km DR**
- **(including component counts, cost savings and upgrade path configurations with 2 and 3 rings)**

Evaluate e+ instability thresholds for

- ***increasing the number of bunches at a later stage***
- **Electron cloud issues at 1312 and 2625 bunches**

- **DR cost ~ 10% RDR (1/3 CFS)**
  - Technical cost does not scale → some component counts are fixed

BDS

Andrei

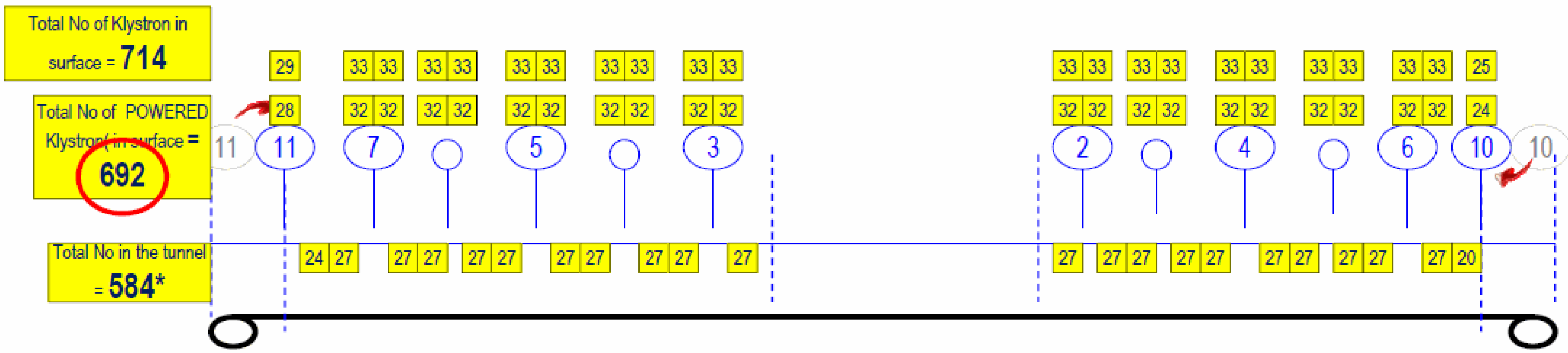
- **50% reduction P_{beam} ⇒ ×2 L recovery via enhanced beam-beam (BDS)**
  - stronger focusing (tighter tolerances, see below)
  - higher disruption / beamstrahlung etc.
  - travelling focus
  - Collimation depth issues
  - Modular FD concept (for low Ecm running)
- **Cost neutral**
  - travelling focus hardware has negligible cost
- **Concern with operational aspects and tighter tolerances**
  - Collision (luminosity) stability
  - more demands on beam-beam feedback
  - Emittance preservation in RTML, ML and BDS
  - Overall tuning strategies and *integrated* luminosity performance

A higher risk scenario?

Note reduced average beam power reduces risk in many subsystems

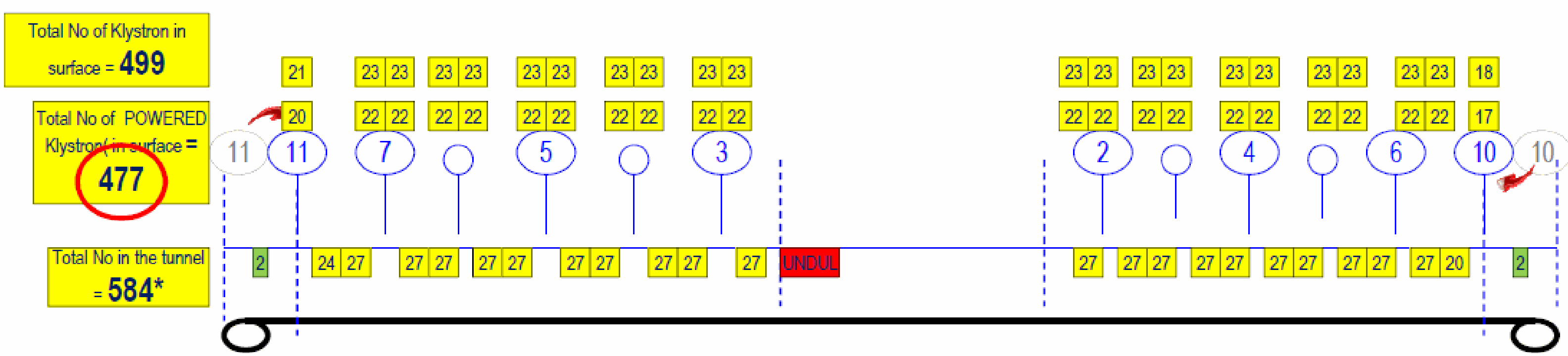
CFS – KCS Power Load

KCS



A. FULL POWER

Klystrons = (Power Supply, Modulator, Klystron etc)
584* RF =584 (3-cryomodule sections)



B. LOW POWER

Diagram Courtesy E. Huedem
Information Courtesy of C. Nantista

DRAFT 12/06/2010 E. Huedem

CFS – KCS/DRFS Power Summary

SUMMARY POWER LOAD

Low=Reduced Bunch numbers* **JAN 13 2011**

Low Power* = Reduced Bunch Number

	ML POWER in MW	
	Full-5Hz	Low*-5Hz
KCS	**152**	**120**
DRFS	**164**	**131**

RDR (ML) =134 MW (reference)

	DR total POWER in MW	
	Full-5Hz-2 rings-6.4Km-2 rings	Low*-5Hz-3.2Km -2 rings
DR	**26.3**	**12.81**

RDR (DR) =26.3 MW (reference)

green= numbers to be checked

Overview

- Changing the ILC Baseline – TLCC
- Cost Containment
  - TDR will have updated cost estimates for SRF and CFS
- Reduced Beam Parameter Set
- Positron Source Relocation
  - (Ewan Paterson, Thursday Jan 20)
- **Summary**

Bunch number "restoration"

- **Scenarios for increasing the bunch number 1300→2600**
  - At some later date, after initial construction.
- **Damping Ring:**
  - Additional 3.2km ring for positrons → no parameter changes
  - 2625 bunches in single (existing) electron ring
    - 780 mA avg. current
    - 4.84 MW power
  - Tunnel/alcoves spec'd for 3 stacked rings.
- **HLRF**
  - Add klystrons/modulators/power supplies
  - Scenarios for CFS support
    - what must we invest in up-front to support this
- **Complete studies left for TDP-2**
  - but qualitatively, scenarios need to be discussed at BAW-2

+ / - Reduced Beam Parameters

- **Pro’s:**
  - Largest *single-item* cost impact
  - Minimum technical risk for the change itself
  - Manageable restoration path
    - KCS, DRFS, DR
- **Con’s:**
  - Luminosity reduction to be compensated in BDS
  - Reduced ML efficiency
  - Significant cost penalty to maintain restoration path
    - DR, CFS

Summary

- **HLRF system / DR cost reduction intended to offset possible SRF / CFS cost increase**
  - Second only to cavity R & D
- **R & D on HLRF – KCS, DRFS and System test (FLASH)**
  - KCS components under test at SLAC
  - DRFS now being connected to S1 Global
  - FLASH high current beam studies in Feb 2011

- **From ALCPG11 – SRF/CFS Costing 2011**