AAP Review – SCRF

Summary and Discussion

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To be presented, April 19, 2009

SCRF Session Agenda, April 19

Time	Report	Charged by	Note
09:30	Introduction	A. Yamamoto	
	Path to finalizing cavity field gradient		S0
09:40	- R&Ds to improve the gradient	L. Lilje	
10:15	- **Decision process**	A. Yamamoto	
10:30	-- Coffee Break --		
11:00	Path towards industrialization		S1
11:00	- Cavity Integration	H. Hayano	
11:30	- Cryomodule	N. Ohuchi	
12:00	- **Role of plug-compatibility (cavity/cryo)**	J. Kerby (updated)	
12:20	- Cryogenics	T. Peterson	
12:30	-- Lunch break --		
14:00	- HLRF	S. Fukuda	
14:20	- MLI: beam dynamics and quadrupoles	C. Adolphsen	
14:40	Lesson expected from system tests		S2
14:40	- STF at KEK	H. Hayano	
15:00	- NML at FNAL	M. Champion	
15:20	Summary / Discussions (toward industrialization)	A. Yamamoto	
15:30	Adjourn		

Cavity R&D: Actions to be made

- **Focus on the fabrication process,**
  - specially on EBW and understand the reasons for defect/pit frequently observed near the heat affected zone,
- **Widely facilitate high-resolution optical inspection system**
  - Directly to cavity fabricators/manufacturers, and
  - Accumulate more inspection data and which can be shared by the cavity communities for better and quick feed-back to fabrication process,
- **Boost laboratory-industry cooperation**
  - fair contribution and fair benefit/return, between laboratories and industries,
  - It may lead best qualified technology transfer, indirectly through laboratories contribution and effort.

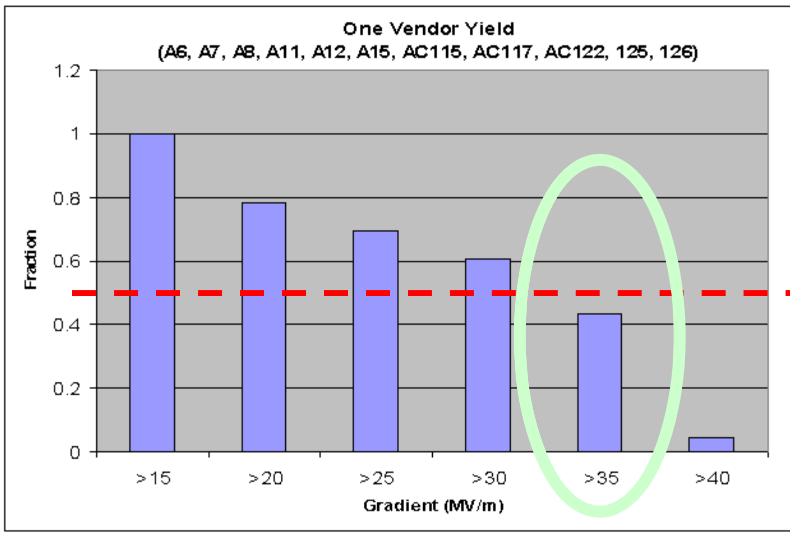
Global Yield of Cavities (November 2008) and Expectation

23 tests, 11 cavities

One Vendor

48 Tests, 19 cavities

ACCEL, AES, Zanon, Ichiro, Jlab



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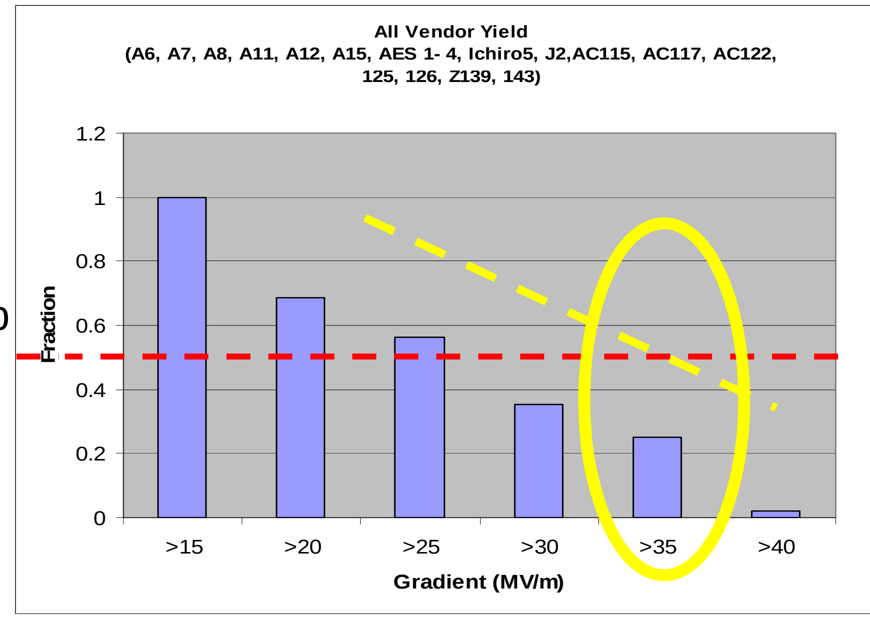


45% yield at 35 MV/m being achieved by cavities with a qualified vendor

H. Padamsee, TTC-08 (IUAC), ILC-08 (Chicago)

Numbers of R&D Cavities for ILC

partly from the TDP R&D Plan (release 3)

Order	Bef TDP	2008	2009	2010	Sum 2010	~ 2012
Ams (FY)	34	20	40	15	109	TBD
AS (FY)	15	3	13+1*	17+2	48+3	TBD
EU (CY)	68		26 (+808)**		94 (+808)	TBD
Sum	117	23	48 (+808)	34	222 (+808)	

•Japan + China
•** 26 specific for ILC-R&D, 808 for XFEL mass production
- Order in 2010 and later is to be subject to budget available

Tests			2009	2010	2011	2012
Ams (FY)			45	70	TBD	TBD
AS (FY)			12	14	TBD	TBD
EU (CY)			15	10	20	TBD
Sum			72	94	TBD	TBD

Cavity R&D -- Summary

- **Status of Cavity Performance**
  - Field gradient : reaching 35 MV/m (at the yield of 50 % with the fabrication by the best qualified vender and with surface process with two leading laboratories,
- **Progress being made pushing the yield curve**
  - We expect more statistics (> 60) in 2009-2010
- **Re-baseline is to be made in 2010**
  - Need to have a practical scope in re-optimization of
    - Field Gradient : 35 MV/m (TBD) with the success yield of 90 % (TBD) at vertical test, and 31.5 MV/m for the ILC operation,

Specific Questions by AAP and Answers

Specific Questions	Short Answers
•What are the sources of present limitations in gradient yields due to preparation processes?	Control of preparation parameters e.g. temperature, acid quality, particle contamination of rinse liquids. Effects at gradients 25 – 30 MV/ partially unknown or not understood.
•What approaches are underway to increase the process yield?	Systematic application of surface inspection methods and cavity test diagnostics (t-map, second sound). Improved QC of rinsing. Training of personnel. Sample studies to understand possible contamination problems in a better way.
•What are the sources of present limitations in gradient yields from cavity to cavity?	Surface defects have been identified in several cases. Some defects especially causing quenches around 20 MV/m can be traced to manufacturing problems: Imprints due to defective tooling. Irregular weld patterns. Formation of some defects not yet understood. Likely relation to etching or electro-polishing process.
•What approaches will be pursued to increase the cavity yield/vendor yield?	Systematic application of surface inspection methods and cavity test diagnostics (t-map, second sound). Direct feedback to vendor. Improve QC on fabrication tolerances e.g. wall thickness. Use samples to optimize weld quality. Study formation of surface defects.
•How will sufficient number of cycles be made available?	~ 60 or more. A clean data sample (same preparation etc) is likely smaller. (We hope to understand the mean of "sufficient")
• How will sufficient number cavities/cycles be made available to 2012?	We consider that ~ 3 x 30 or higher may be reasonable, Yield is more important than high statistics of fabrication.

Why Plug Compatibility?

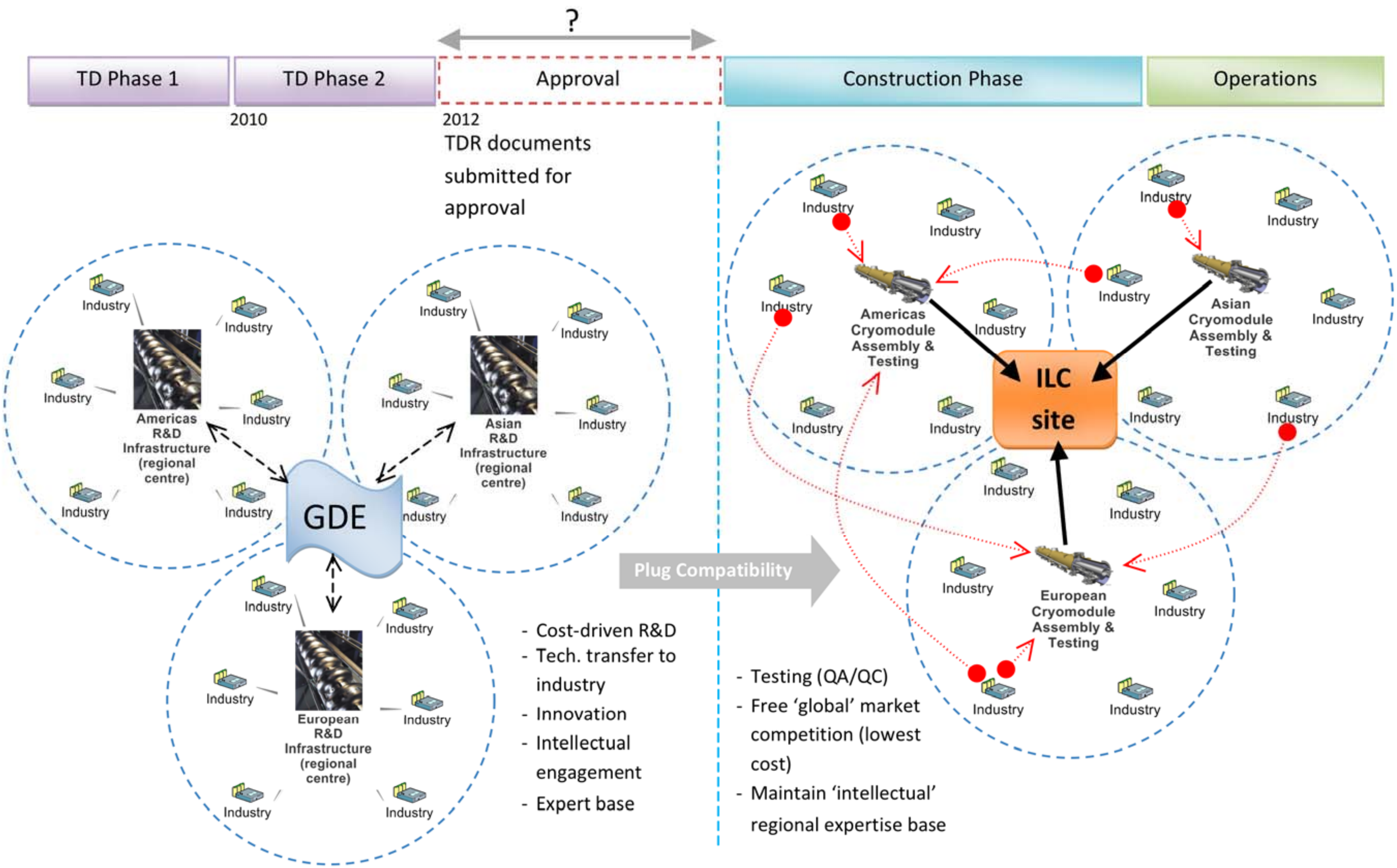
- R&D Phase
  - Encourage creative work and innovation for performance improvement from a common baseline
  - Global transfer of information
  - Sharing of components to continue progress world wide despite outside uncertainties
  - Development of the RDR design for system tests and in preparation for construction phase

- Production/Construction Phase
  - Keep competitive condition with free market/multiple-suppliers, and effort for const-reduction,
  - Keep flexibility to accept industrial effort, with features and constraints, to reduce the cost under acceptable flexibilities,
  - Maintain intellectual regional expertise base

Plug-compatibility: Summary

- **Plug Compatibility is**
  - a means to allow continued innovation from existing and new(!) collaborators while acknowledging the work is part of a larger effort.
  - a way to segregate work such that efforts on components and systems can proceed in parallel
  - a means in the longer term to be more efficient in infrastructure usage
- **Plug Compatibility does**
  - have an initial setup cost
  - impose some minimal boundary conditions, though strong efforts are made to keep them as minimal as possible

The Role of Compatibility



- Cost-driven R&D
- Tech. transfer to industry
- Innovation
- Intellectual engagement
- Expert base

- Testing (QA/QC)
- Free 'global' market competition (lowest cost)
- Maintain 'intellectual' regional expertise base

Question and Answer

Plug-Compatibility

Specific Question	Short answer
•While the topic of "Plug compatibility" relates both to R&D and industrialization phases, it would be more suitable for the review goals to focus on the role for the R&D phase. Some of the related issues that would be helpful to address are: •What are the expected cost/performance advantages of each of the options being considered (for cavities, couplers, tuners), especially relative to the XFEL choices?	Overall the ILC cavity /couple package in the RDR is slightly more compact than that of the XFEL. This, and the desire to continue to improve on the XFEL design, leads us to plan with a system that allows for improvements and innovation in the time leading up to construction. The improvements may be technical / cost / or based on some regional expertise. The P-C process allows for this, and gives the opportunity for insertion during the R&D phase with minimal impact to the remainder of the system. At this point in time we do not have concrete data in many cases to support one design above another. In the end, a decision on which design(s) will be used will be made on a technical and economic basis, and could for instance be different by region.

Toward Industrialization

- **Global status of Industries**
  - ACCEL and Zanon in Europe
  - AES and Niowave (and PAVAK in plan) in Americas
  - MHI in Asia
- **Project Scope**
  - XFEL: 1/20 scale of ILC
    - 800 cavities / 2 yrs = ~ 400 cavity / yr = 2 cavity/day
    - Including setup, 800 cavities / 3~4 year,
  - Project-X:
    - ~ 400 cavities / 3 yrs = 130 cavity /yr = < 1 cavity /day
  - ILC:
    - 15,500 cavities/4 yrs = ~ 4000 /yr = 15~20 cavities/day
    - If shared by three regions: 5 ~6 cavities / day /region
- **Industrial Capacity: status and scope**
  - No companies yet to be ready in 2012, to meet this requirement/plan,

How we may prepare for Industrialization and cost reduction?

- **Re-visit previous effort, and update the cost-estimate for production**
  - Understand the cost estimate in RDR
    - mainly based on TESLA design work at ~ 10 years ago and the subsequent experience,
  - Reflect recent R&D experience with laboratories and industries,
- **Encourage R&D Facilities for industrialization**
  - To Learn cost-effective manufacturing, quality control and cost-reduction in cooperation with industries,
    - It is important to facilitate them at major SCRF laboratories and extend the experiences at various laboratories (DESY, Jlab, Cornell and others),
- **Reflect the R&D progress for cost-reduction**
    - Main effort for Baseline >> Forming, EBW, assembly work …
    - Alternate effort with limited scale>> large-grain, seamless, or …

Acknowledgements

- **We (PMs) would thank**
  - AAP for its guidance for the review and various advices being made,
  - ILC-SCRF technical area collaborators for their much effort to prepare for the review and to respond to questions,
  - Special thanks for Dr. Lutz Lilje for his leadership as the Cavity Group Leader, (transfer to Dr. Rongli Geng).

backup

AAP Review Context for SCRF

Context	Charge	Note
What is the path to finalizing the gradient choice? - Current Experimental status - Established standards, and Extrapolation of results - Role of "plug-compatibility", in R&D stage - Time (limitation) and Decision Process	L. Lilje M. Champion H. Hayano R. Geng A. Yamamoto	S0
What is the path toward industrialization? - Current experimental status - Established standards, and extrapolation of results - Internationalization of efforts, - Outline tendering process - Role of Plug-compatibility, in Production Stage	N. Ohuchi P. Perini D. Mitchell H. Hayano C. Pagani J. Kerby A. Yamamoto	S1/S2
Lesson expected from system test - FLASH at DESY (operational limitation of ILC cavities) - STF at KEK, time-line and benefit - NMF at FNAL: time-line and benefit	(J. Carwardine) H. Hayano M. Champion	S2

Response from AAP for SCRF

The SRF R&D started with a well-laid out international R&D plan, which required the intricate interaction of the participating laboratories already in the phase of the Reference Design Report. Goals defined during that phase have been elaborated in an often demanding decision process. Naturally, as time went on priorities shifted and so did the R&D activities. How did and does the process affect the readiness for the decision process of the gradient? What level of confidence can be reached in the various technical areas?

It would be beneficial for the committee to have a short introductory review of the critical R&D gradient goals for TDP 1 and 2 and their timelines, with mention of targets for number of cycles/number of cavities, and number of cryomodules, as laid out in the TDP document. The status report should cover activities in both cavity and cryomodule gradients. On the continuing R&D Plan, there is a need to discuss fully how the gaps between the current status for cavity gradients and the goals for TDP phases 1 and 2 will be addressed. For example: