SCRF Monthly WebEx Meeting 2009-8-21

Agenda

1. Report from PMs (15 min.)
2. Report from GLs (10 min.)

1. Progress Reports and Discussions: TOPIX (each 15 min.)
    1. S1-Global Preparation (N. Ohuchi et al.,)
    2. ALCPG/ILC-GDE meeting Plan (H. Hayano and C. Adolphsen)

2.Further meeting Plan: (5 min.)
    1. SCRF webex meeting to be held on Sept. 16, nominal time,
    2. Meeting plan for Industrial R&D. SRF-09 and IPAC-10

Report from PMs

- Report to ILCSC on Cavity Gradient Yield (AY, comment by RG)
  - Status Report by Global Database team submitted
- Visiting ORNL/SNS, Superconducting Linac (AY, MR)
  - Discussions specially on 'single tunnel and DRFS', and 'cryogenics hazard/safety'
- Plan for Marc Ross to visit KEK on Aug. 26 – 28 (MR)
  - Discussions on Availability and AD&I focused with KEK members
- Plan for Industrial R&D meetings (AY)
  - Preparation meeting during SRF-2009, Berlin
  - Satellite meeting prior to IPAC-2010, Kyoto
    - Proposal by AY, comment by MR
- Plan for ALCPG meeting (AY, HH, CA)
  - Objectives
  - Agenda

Cavity Gradient Yield Plots Update, August, 2009

As reported by Akira Yamamoto to the EC and the ILCSC
August, 13, 2009

On behalf of the ILC Cavity Global Database Team
(as part of SCRF Cavity, S0, Group):

Rongli Geng (Cavity Group leader, JLab),
Camille M. Ginsburg (Database Team leader, Fermilab)
Sebastian Aderhold (DESY),
Kirk Yamamoto (KEK),
Zack Conway (Cornell)

Understanding the Definition of 'Yield'

- Original S0 concept assumed:
  - Surface can be reset according to the EP process, and
  - Multiple processes may be integrated for statistics.
- Several years of experience shows
  - Repeat processing may cause degradation
- Processing and Test recipe has been updated
  - Complete the process and test only with the first cycle
    - no further processing if the results are acceptable
- Revision of the definition of 'yield' is required
  - Process (R&D) and Production definitions are different
  - A common means for collection and evaluation of the data is required

- New effort started by the Global Database Team
  - Try a new approach to be more appropriate
    - Production yield with the first/second pass RF test

From AD&I Meeting at DESY: Creation of a Global Database for Better Understanding of the 'Production Yield' defined in TDP-2

- **Global Data Base Team formed, May 2009:**
  - Camille Ginsburg (Fermilab) – Team Leader & Data Coordination
  - Zack Conway (Cornell University)
  - Sebastian Aderhold (DESY)
  - Yasuchika Yamamoto (KEK)
  - Rongli Geng (JLab) – GDE-SCRF Cavity TA Group Leader

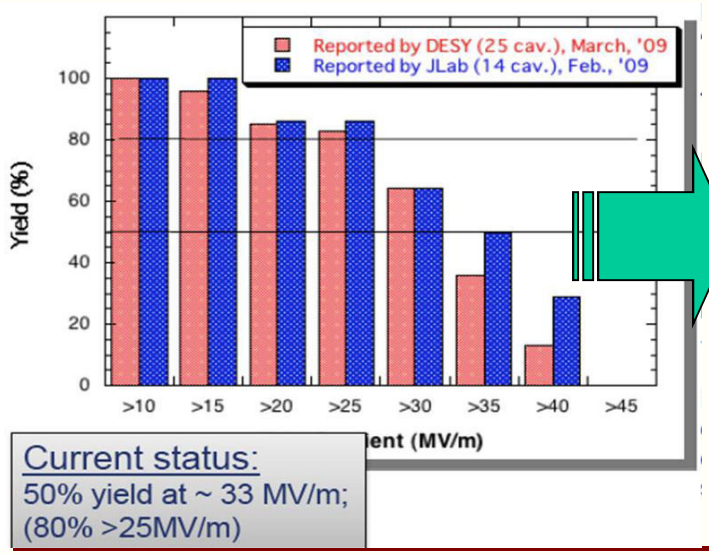
- **Activity Plan in 2009:**
  - Mid-July: Initial report to FALC
  - End July:
    - Determine whether DESY-DB is viable option (DONE→YES!)
  - Aug. 19: (ILCSC)
    - Status to be reported
  - Sept. 28 - Oct. 2, 2009: (ALCPG/GDE)
    - Dataset web-based
      - to be Supported by FNAL-TD or DESY
    - Explainable, and near-final plots, available, such as
      - Production (and process) yield with Qualified vendors and/or All vendors, and time evolution
  - End Nov. 2009, with input from a broader group of colleagues, finalize:
    - DB tool, web I/F, standard plots, w/ longer-term improvement plan

First Effort:
Check of DESY/JLab data in old yield plot

- **The gradients for DESY data were off by +2MV/m**
- **Not 08/09: large component of 2007, and very small component of 2009**
- **Not 1st or 2nd test: instead, last (DESY) or best (JLab)**
- **Included cavities fabricated by ACCEL, ZANON, AES, JLab-2, KEK-Ichiro**

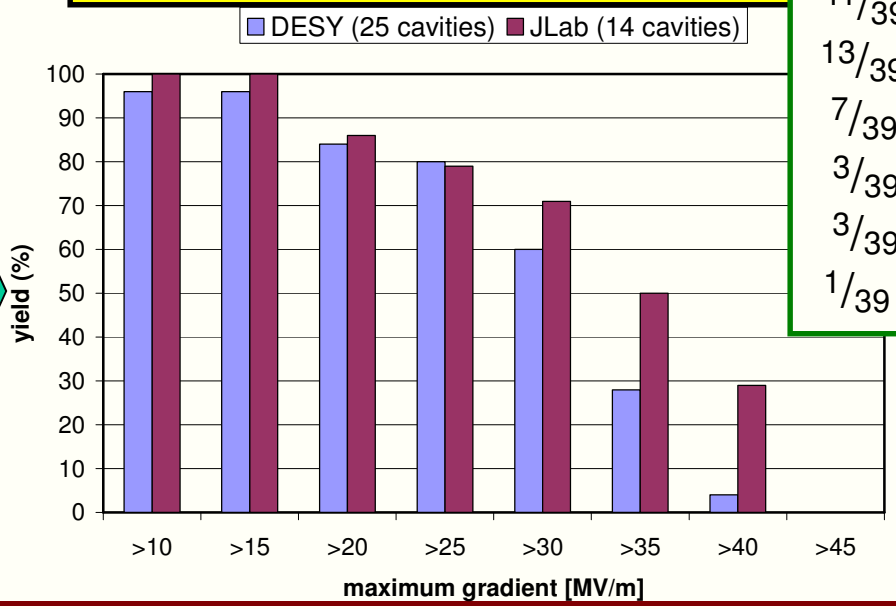
This is not the ideal data selection from which to infer a production yield

Old version, shown at PAC, 2009



Current status:
50% yield at ~ 33 MV/m;
(80% >25MV/m)

Revised version (corrected only for mistakes) - same data shown



$^{11}/_{39}$ 1st test
$^{13}/_{39}$ 2nd test
$^{7}/_{39}$ 3rd test
$^{3}/_{39}$ 4th test
$^{3}/_{39}$ 5th test
$^{1}/_{39}$ 8th test

A Guideline suggested by R. Geng

Global Data Collection - 1

- Proposition 1: all cavities fabricated and processed according to the following rough steps
  - **Fine grain sheet material**
  - **Deep drawing & EBW**
  - **Initial field flatness tuning**
  - **Bulk EP for heavy removal**
  - **H_2 removal with vacuum furnace**
  - **Final tuning field flatness (and frequency)**
  - **Final EP for light removal**
  - **Post-EP cleaning**
  - **Clean room assembly**
  - **Low temperature bake-out**
  - **2K RF test**

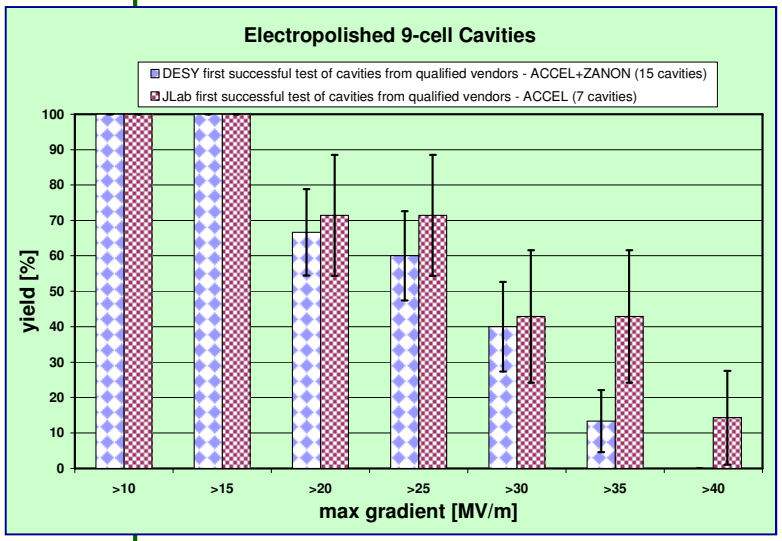
A Guideline suggested by R. Geng

Global Data Collection -2

- Proposition 2: accept understood variations, and combine samples to maximize statistics, for example:
  - **Fine grain niobium irrespective of vendor**
  - **EBW irrespective of prep design welding parameter**
  - **Cavities with or without helium tank**
  - **With or without pre-EP treatment (BCP, CBP…)**
  - **EP irrespective of parameters & protocols**
    - Horizontal or (future) vertical EP
    - H_2SO_4/HF/H_2O ratio, pre-mixing or on-site mixing
    - Cell temp. control or return acid temp. control
    - With or without acid circulation after voltage shut off
    - Post-EP cleaning: Ethanol rinse or Ultrasonic cleaning or H_2O_2 rinsing
  - **H2 out-gassing irrespective of temp. & time**
  - **HPR irrespective of nozzle style, HPR time**
  - **Clean Room assembly irrespective of practice variability**
- *Additional note: The variations of BCP/EP, fine-grain/large-grain are not considered as acceptable variation in this statistical evaluation.*

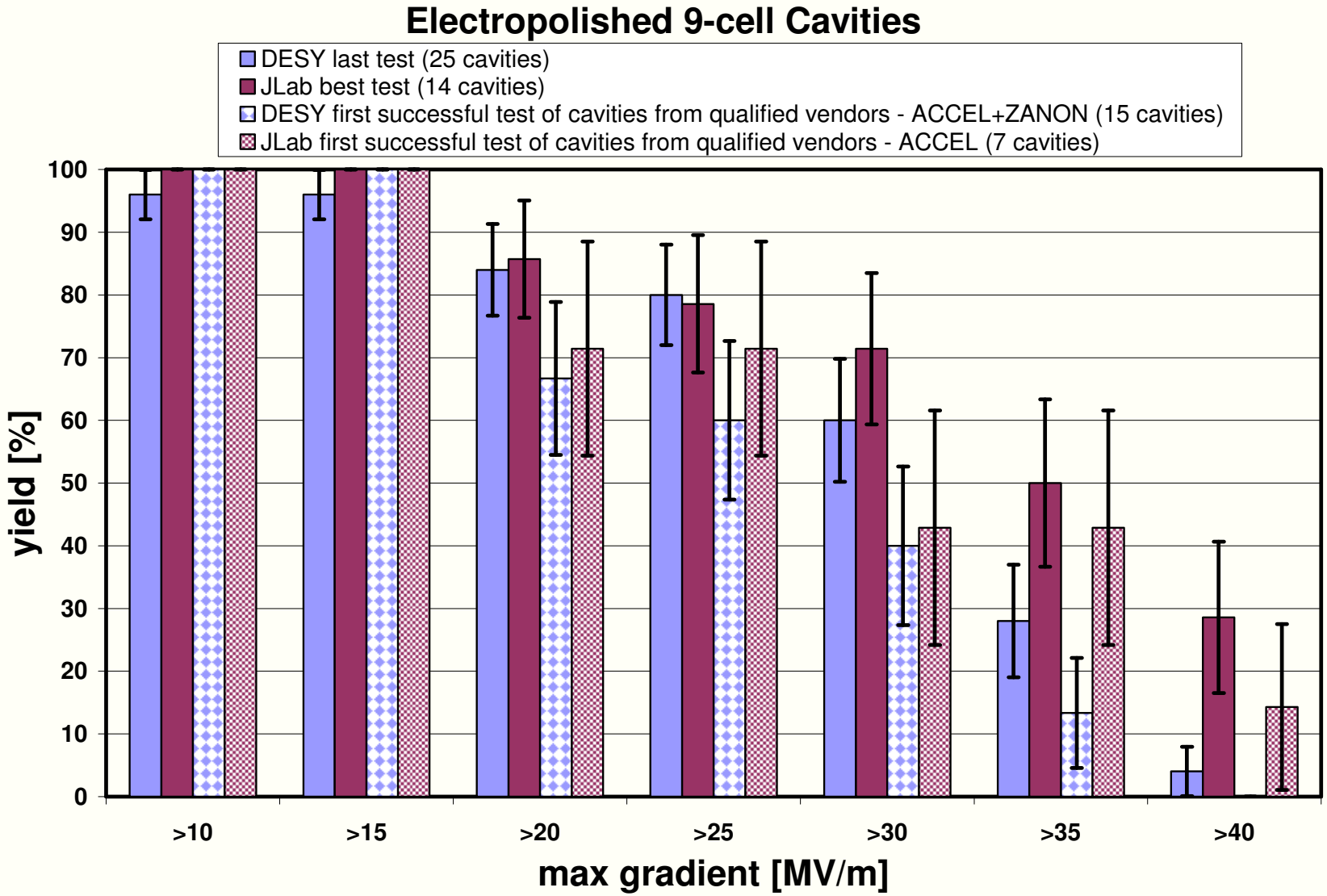
Example New Yield Plot from the 1st Successful Vertital RF Test

- **Vertical axis:** fraction of cavities satisfying criteria where:
  - Denominator (logical and of the following):
    - Fabricated by ACCEL or ZANON
    - Delivered to labs within last 2-3 years
    - Electro-polished at DESY and JLab
    - Fine-grain material
  - Numerator (logical and of the following):
    - Denominator
    - Accepted by the lab after incoming inspection
    - 1st successful vertical RF test,
      - excluding any test with system failure, has max gradient > (horizontal axis bin) MV/m;
      - ignore Q-disease and field emission (to be implemented in future)
- **Horizontal axis:** max gradient MV/m
- Exclude cavities which are work-in-progress, i.e., before rejection or 1st successful RF test



Note: These are results from the vertical CW test at DESY and JLab

Comparison of 'Gradient Yield' using old (left two bars) and new (right two bars)



Summary and Subjects to be Further Investigated

- The global database team has been formed to
  - Understand the cavity gradient status in a common-way, world wide
- The effort has started with
  - Checking of the 'old' yield plot presented in PAC, Vancouver
  - Revision of the yield plot with some correction:
    - The yield at 35 MV/m in a vertical test remains 50+/-13% for JLab results, and is corrected to 28+/-9% for DESY results
  - Agreement to use the DESY Database system for superconducting cavities
- A new 'production yield' is being defined with the 1st pass (and 2nd pass)
  - Introduced and under evaluation.
    - The yield at 35 MV/m in a vertical test with the yield 43+/-19% for JLab results, and with the yield 13+/-9% for DESY results
- Further analysis and evaluation will be carried out for:
  - 2nd pass production yield
  - Q_0 value, and field-emission onset in the overall performance evaluation
- Further report and discussion in the next ILC-GDE in Albuquerque
- Prospects for further improvement in TDP-2 and updates to the baseline field gradient will be included in AD& I effort

End

- **Backup**

Details of DESY/JLab data in (old and revised) plots

DESY

- Last test results (not first or almost first) as of March 2009
- Production 4:
  - EP (without helium tank) [10 cavities]
    - Z88, Z93, Z97, Z100, Z101, Z104, Z106, Z107, Z108, Z109
  - EP (with helium tank) [0 cavities]
- Production 6:
  - EP (without helium tank) [5 cavities]
    - AC115, AC117, Z130, Z131, Z137
  - EP (with helium tank) [10 cavities]
    - AC122, AC124, AC125, AC126, AC127, AC149, AC150, Z132, Z139, Z143

JLAB

- Best test results (not 1st or almost 1st test)
- 14 cavities EP'd and tested at JLab
  - Accel/RI: A6, A7, A8, TB9ACC011, TB9ACC012, TB9ACC013, TB9ACC014, TB9ACC015

Including cavities, fabricated by AES, and with inhouse effort at KEK (Ichiro) and Jlab (Jlab-2): currently not treated as qualified venders for 9-cell cavities, or end-group not completed

- AES: AES001, AES002, AES003, AES004
- KEK: Ichiro-5, JLab: JLab-2

Detailed data description for first production plots

- For Plot 1 (see Appendix) : first cavity test, qualified vendor [40 cavities]
  - JLab, Cornell [9 cavities]: A5, ACCEL6, ACCEL7, A8, A9, TB9ACC011, TB9ACC012, TB9ACC013, TB9ACC015 [had accidentally omitted TB9ACC014]
  - DESY [31 cavities]: AC112, AC113, AC114, AC115, AC116, AC117, AC118, AC119, AC121, AC122, AC123, AC124, AC125, AC126, AC127, AC128, AC129, Z130, Z131, Z132, Z133, Z135, Z137, *Z138*, Z139, Z140, Z141, Z143, AC147, AC149, AC150
- **For Plot 1-b: first cavity test, qualified vendor, fine-grain, EP'd with standard techniques [22 cavities]**
  - JLab [7 cavities]: ACCEL6, ACCEL7, TB9ACC011, TB9ACC012, TB9ACC013, TB9ACC014, TB9ACC015
  - DESY [15 cavities]: AC115, AC122, AC124, AC125, AC126, AC127, Z130, Z131, Z132, Z137, Z139, Z141, Z143, AC149, AC150
- Vast majority are first tests, except underlined are second tests, *underlined+italicized* are third tests

Error Evaluation Implemented

- **Binomial distribution**
  - Probability of success and failure add up to 1
  - Success and failure probabilities are assumed unknown
- **Error on the yields was calculated like this:**
  - c>> efficiency is number of successes divided by number of tries
  - $\mathbf{eff = x_{suc} / x_{try}}$
  - c>> error on the number of successes
  - $\mathbf{sig = sqrt\ (x_{try} * (x_{suc} / x_{try}) * ((x_{try} - x_{suc}) / x_{try}))}$
  - c>> error on the efficiency
  - $\mathbf{err = eff * (sig / x_{suc})}$

A New Guideline suggested by R. Geng

First-Pass Data

- What it is?
  - **First RF test result following all steps applied**
  - **Should be the final power rise data**
- What it is not?
  - **May not necessarily be the first RF test of the cavity**
    - Example: some cavities were tested before low temperature bake-out for FE screening purpose
  - **Should not include data of cavities with**
    - known material flaw
    - equipment malfunctioning
    - human error, etc.

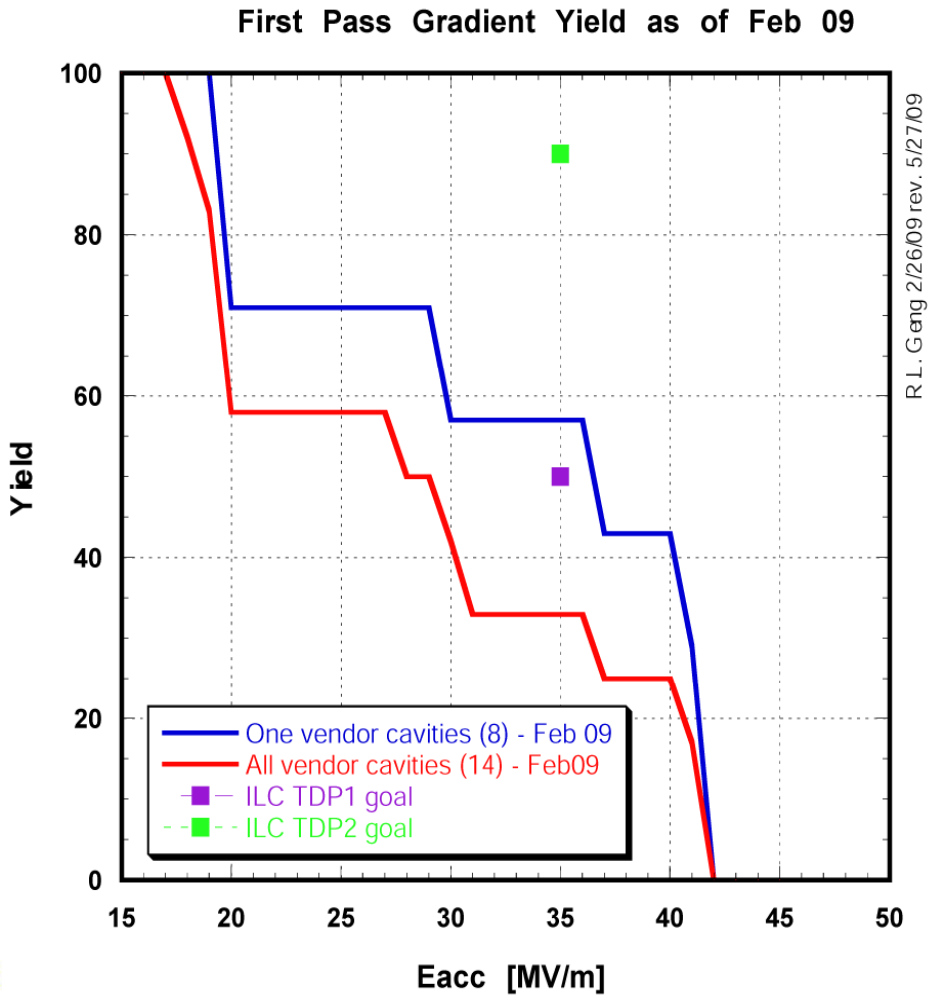
Second-Pass Data

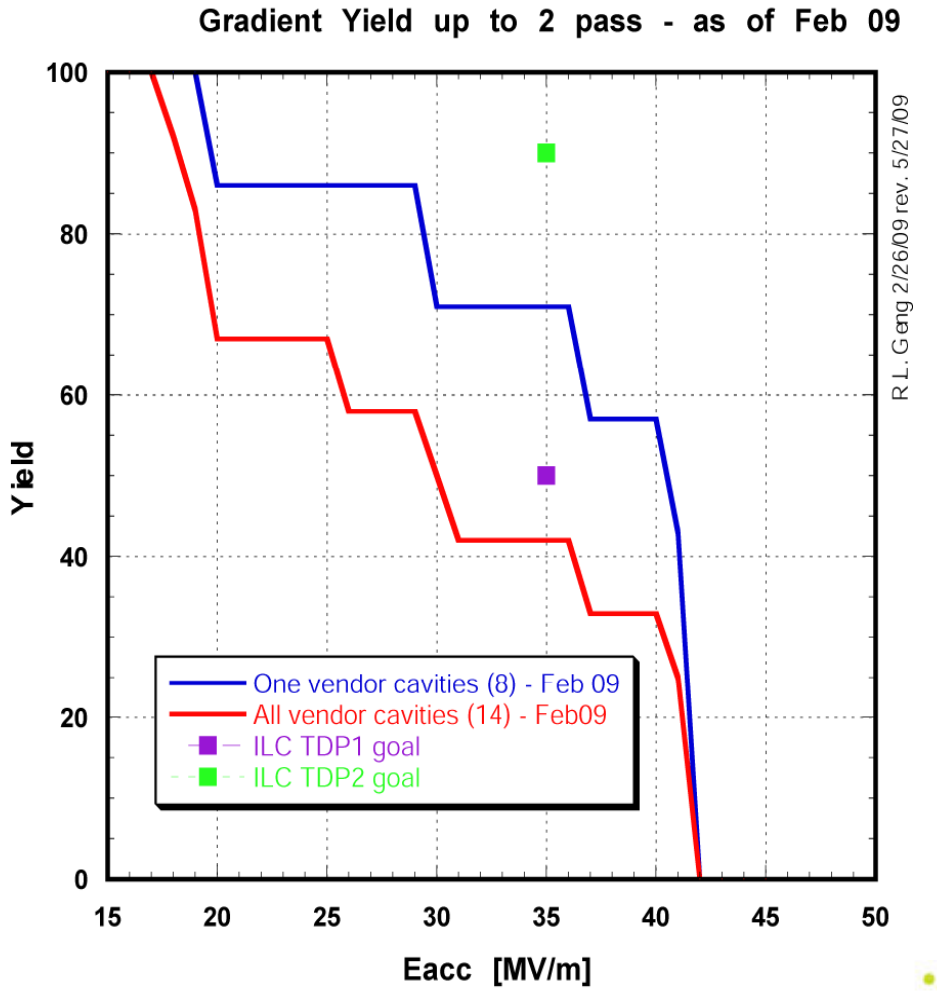
- What it is
  - **Cavities failed to meet ILC gradient and Q spec**
  - **Re-treated and re-tested for a second time; re-treatment can be:**
    - Re-HPR (for FE reduction)
    - Re-EP (for FE reduction or defect removal)
    - Post-purification (for defect stabilization) ?
    - Repair (local grinding, local re-melting…) followed by re-process and re-test (for defect removal)
- What it is not
  - **Cavities already passing ILC spec**
  - **Re-test without physical changes on RF surface (e.g. T-mapping test)**

Two-Pass Yield Proposal @ AD&I Mtg

First-pass result decides path forward:
- Move on for S1 if spec met
- Re-process (Re-HPR; Re-EP; Local repair) if spec not met

An example based on real data from JLab





Beyond Two Pass…

- Some cavities may be re-processed and re-tested more than two passes anyway for various reasons
- We may still want to monitor these data for purpose of learning.
- Cavity exchange effort falls into this category
  - **For cross checking facilities**
  - **For cross checking processing variability**
  - **For cross-calibrating measurement error bars**

Plan for ML-SCRF: ALCPG/ILC-GDE

Sept. 29 – Oct. 3, Albuquerque

- Conveners: H. Hayano and C. Adolphsen, (N. Soy
- Subjects:
  - **Technical Summary from SRF-09**
  - **Cavity Gradient Yield**
    - Redefinition of the 'Yield' and standard processing and cycle
    - Further R&D subject for the gradient improvement
    - Plan/process for re-baseline of 'Gradient/Yield' (# cavities, time-line)
  - **Cavity Integration and Plug-compatibility**
    - Focusing on the input-coupler interface to cryomodule
  - **Quadrupole magnet design and R&D**
    - Focusing on conductively cooled magnet design
  - **S1-Global Preparation**
    - Cavity delivery and assembly into Cryomodule
    - Cryogenics and RF test plan
  - **HLRF design w/ single tunnel (hopefully joint discussion with AD& I, CFS):**
    - Clustered or Distributed RF/Klystron System
    - Common discussion with CFS and Safety, in AD&I study
  - **Cryogenics/High-pres-gas safety w/ single tunnel (hopefully with AD&I, CFS):**
    - Hazard analysis and the safety plan
  - **SCRF Industrialization R&D**
    - Preparation for the R&D facilities
    - Specific R&D themes
  - **Joint discussion with cost-management group,**

Further Plan

- **Next SCRF WebEx Meeting**
  - **Sept. 16, (Wed), at nominal time (13:00 GMT)**

- **SCRF Industrial R&D meetings**
  - **An informal meeting during SRF 2009, Berlin**
    - Hopefully at some lunch time, either on Thursday, Friday,
  - **A satellite meeting prior to IPAC-2010, Kyoto**
    - A full day meeting on Sunday, May 23,
  - **Advices will be welcome**
    - Who may be invited, in addition to
      - 6 companies visited by ILC-PM delegation, and
      - SCRF laboratories,
    - Appropriate size (< ~ 50 participants) may be important,