

STF EP, VT commissioning by FNAL AES001

H. Hayano, KEK 11.17.2008

History

STF EP facility

Construction: 2005. April – 2008. March

Test, training, optimization, and upgrading: 2008. April –

Commissioning by AES001 cavity borrowed from FNAL: 2008. November

Move EP system at Nomura to STF (2nd EP facility)

Construction of additional facility at STF: 2008. April – 2009. October

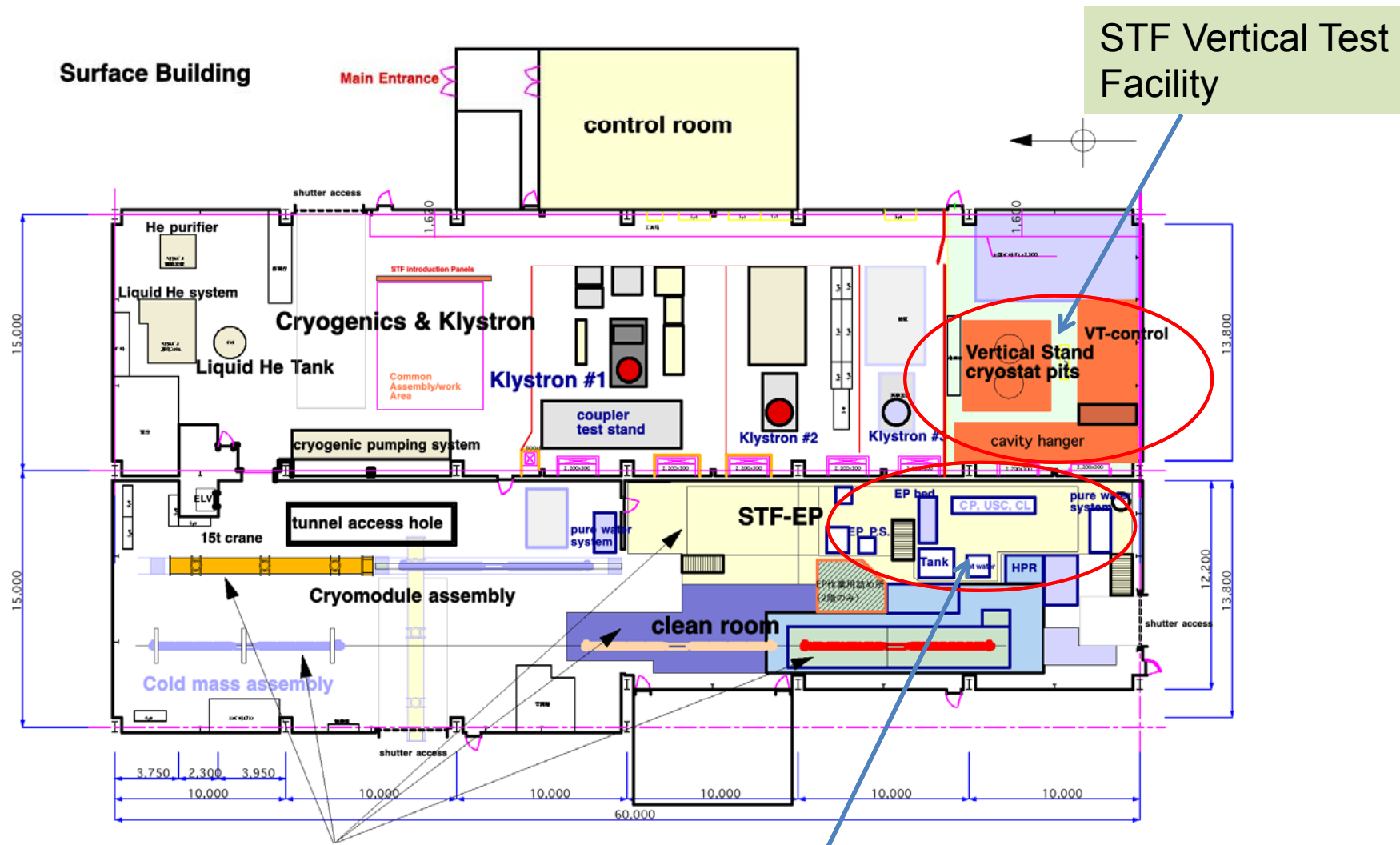
STF Vertical Test facility

Construction: 2006. April – 2008. June
(magnetic shield was delivered in July)

Commissioning by AES001 cavity (FNAL): 2008. July – 2008. November

- AES001 was measured by Jlab and FNAL several times.
Good to compare the performance of new coming facility STF.

STF (Superconducting RF Test Facility)



Facility expansion
for STF phase2

STF Electro-chemical Polish
Facility

H. Hayano, 06252008

STF new EP facility

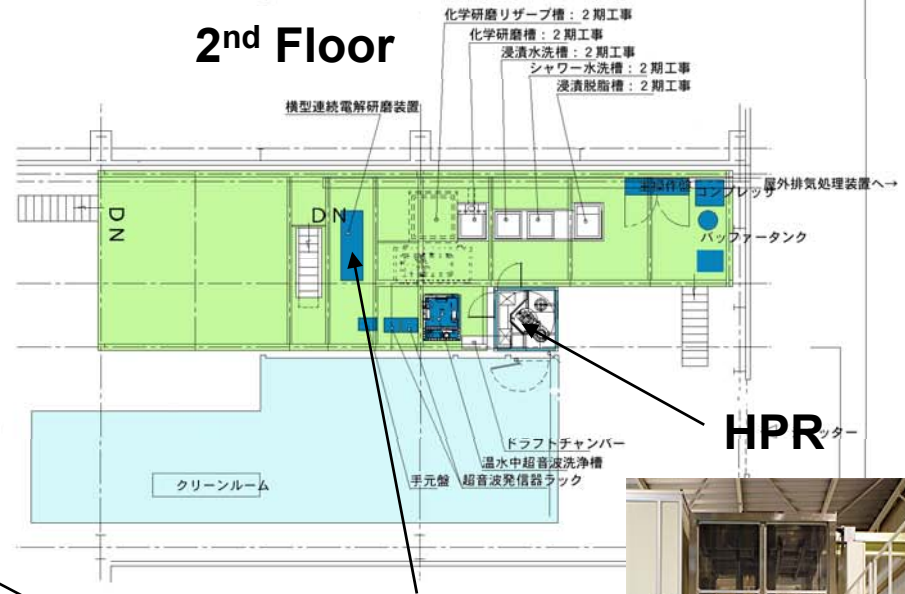
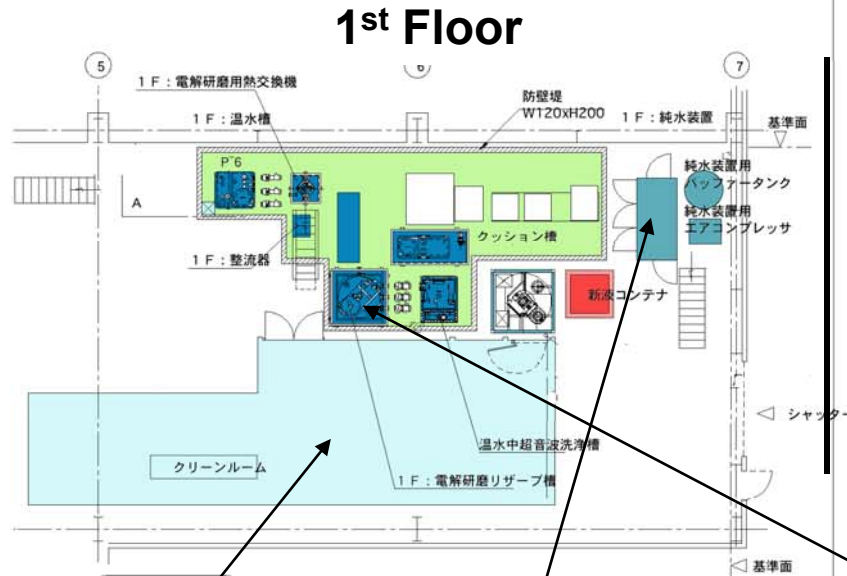
Clean Room (ISO class4 and ISO class 6)

Ultra-Pure Water (UPW)

High Pressure water Rinsing (HPR)

Electro-chemical Polishing (EP),

small-scale BCP, Rinse (Alcohol, H2O2, detergent), Pre-EP & flash-EP function



Clean room

UPW

EP acid tank

EP bed



STF EP test and training

STF – EP system test using old MHI cavity

Picture shows acid draining by holding cavity up.

more than 5 times EP cycle (10+40+60+60+40+ μm removal) were done.

So far, 1.28g/l Nb melt into acid of 1100 l.

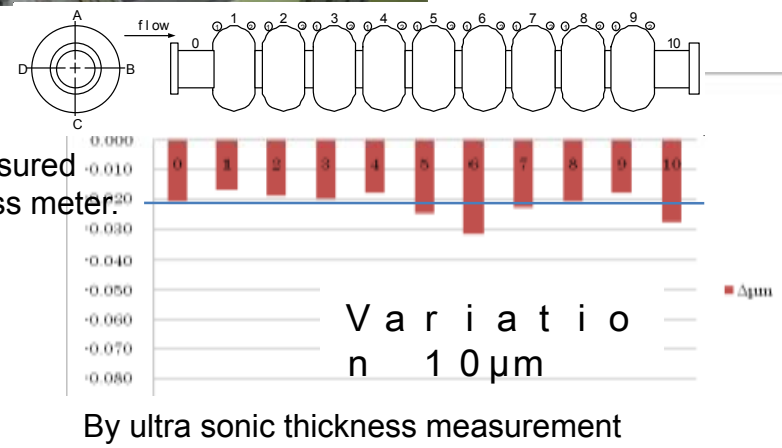


Surface check by
Kyoto camera;
No special residuals
were found.

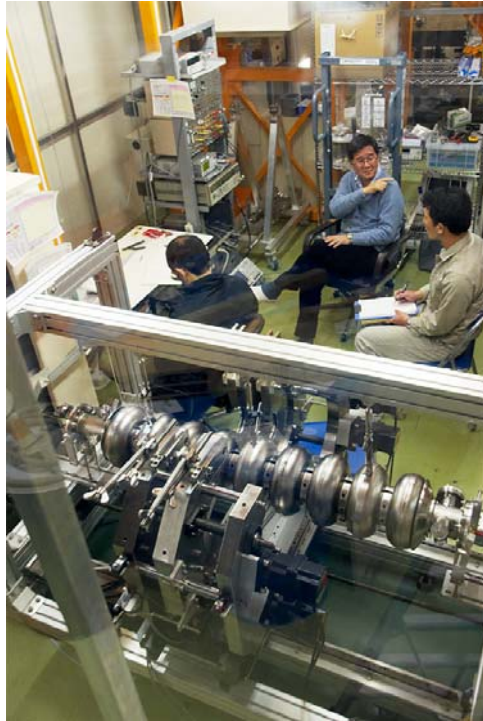


Material removal measured
by ultra-sonic thickness meter.
EP target was 20 μm .

Snap shot of
inner surface
after EP.



STF Vertical Test Facility



**AES001 Pre-tuning
tuned to 96.6% flatness.**



Cavity Installation test and pumping test



Installation test into cryostat

STF facilities Commissioning by using AES001 FNAL cavity

Jul. 3 – 4 system check of STF Vertical Test stand without magnetic shield.
(max 11.2MV/m)

magnetic shield was delivered in July 14, and installed. (residual field $\sim 50\text{mG}$)

Sep. 02 – 03 1st Vertical test : cold leak at beam pipe flange.

Oct. 08 – 09 2nd Vertical test (max 15.9MV/m)

Oct. 28 Flange CP at STF.

Oct. 29 - 30 20 μm EP at STF, 1 hour ultrasonic, 11 hours HPR.

Oct. 31 antenna assemble, bake

Nov. 4-5 VT preparation

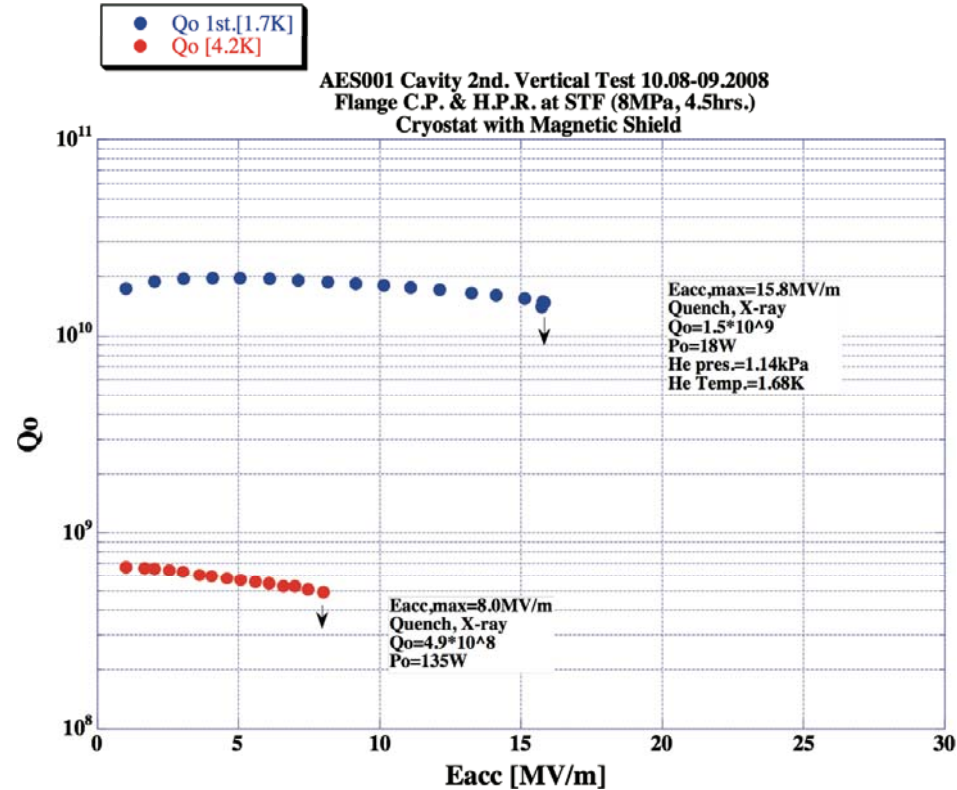
Nov. 6-7 Vertical test (3rd Test)

Nov.10-14 Field flatness meas. / Inner surface inspection

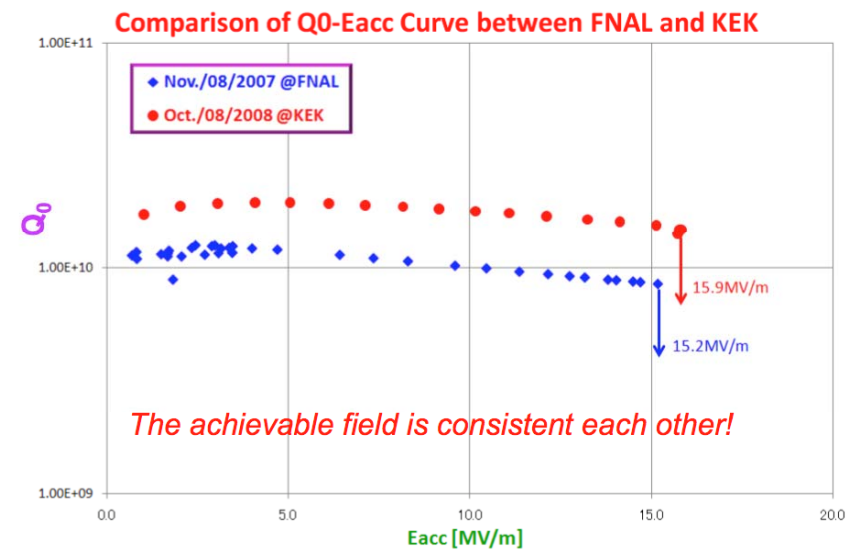
* ~ 6 months delay of commissioning originated from delay of magnetic shield delivery



2nd Vertical Test results (no EP, HPR + bake only)



Comparison of Q_0 - E_{acc} curve between FNAL and KEK



TTC Meeting at India 21/Oct/2008

2nd Vertical Test

Summary of T-mapping result

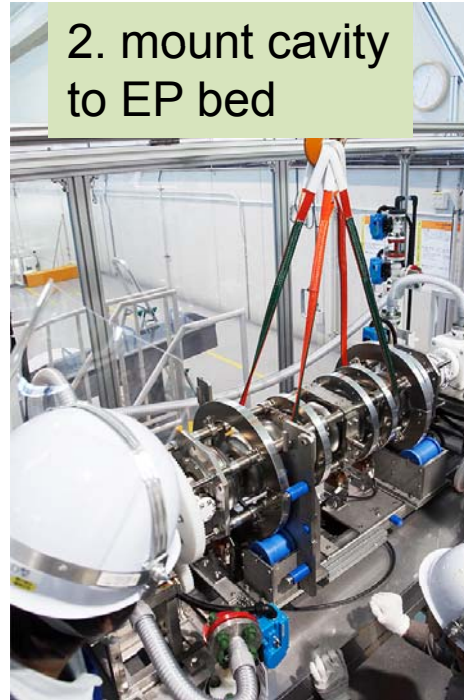
- π
 - 7 resistors responded at the suspicious position at #3 cell
 - **Max. heating occurred at 168~169° from the input coupler port.**
- $8\pi/9$
 - 7 resistors responded at the suspicious position at #3 cell
 - Some heating occurred at #1 (multipacting?).
- $7\pi/9$
 - No Quench / RF Power Limit
 - Some heating occurred at #1 (multipacting?).
 - Some heating occurred everywhere on the equator at #6 (multipacting?).
- $6\pi/9$
 - 7 resistors responded at the suspicious position at #3 cell.
- $5\pi/9$
 - 7 resistors responded at the suspicious position at #3 cell.
- $4\pi/9$
 - Some heating occurred at #8 (multipacting?).
 - $\pi/9$ was excited (Another Excitation) / RF Power Limit
- $3\pi/9$
 - slightly heating (only one resistor) at the suspicious position at #3 cell
 - No Quench / RF Power Limit

STF EP procedure

1. Flange CP for clean-up of surface



2. mount cavity to EP bed



3. Wash Electrode

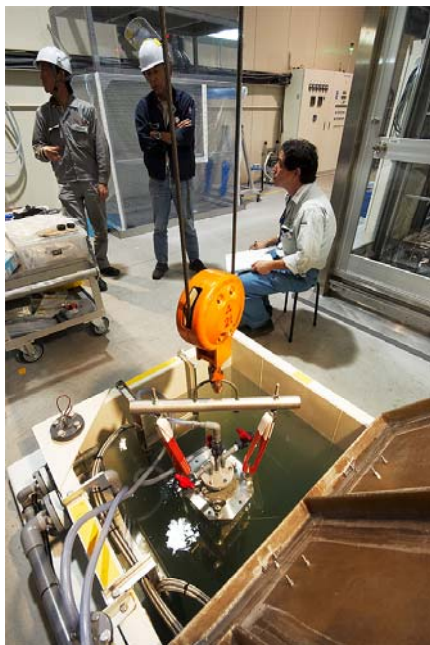
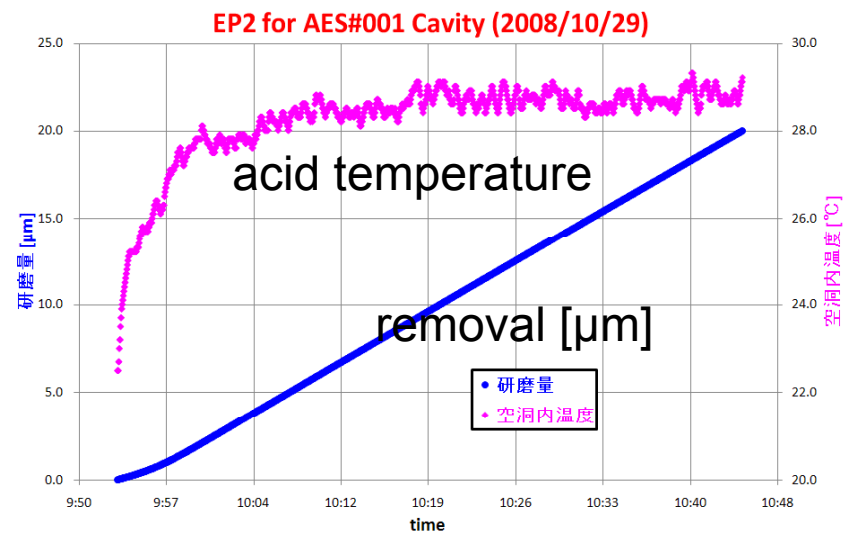
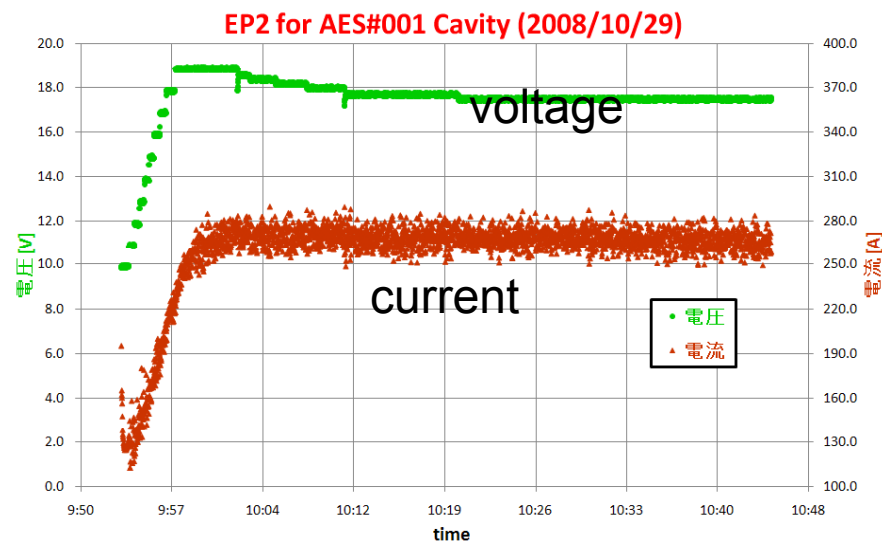


4. Insert Electrode vertically (motorized)

5. final assembly to EP bed



STF EP procedure, cont.



ultra-sonic cleaning



HPR installation

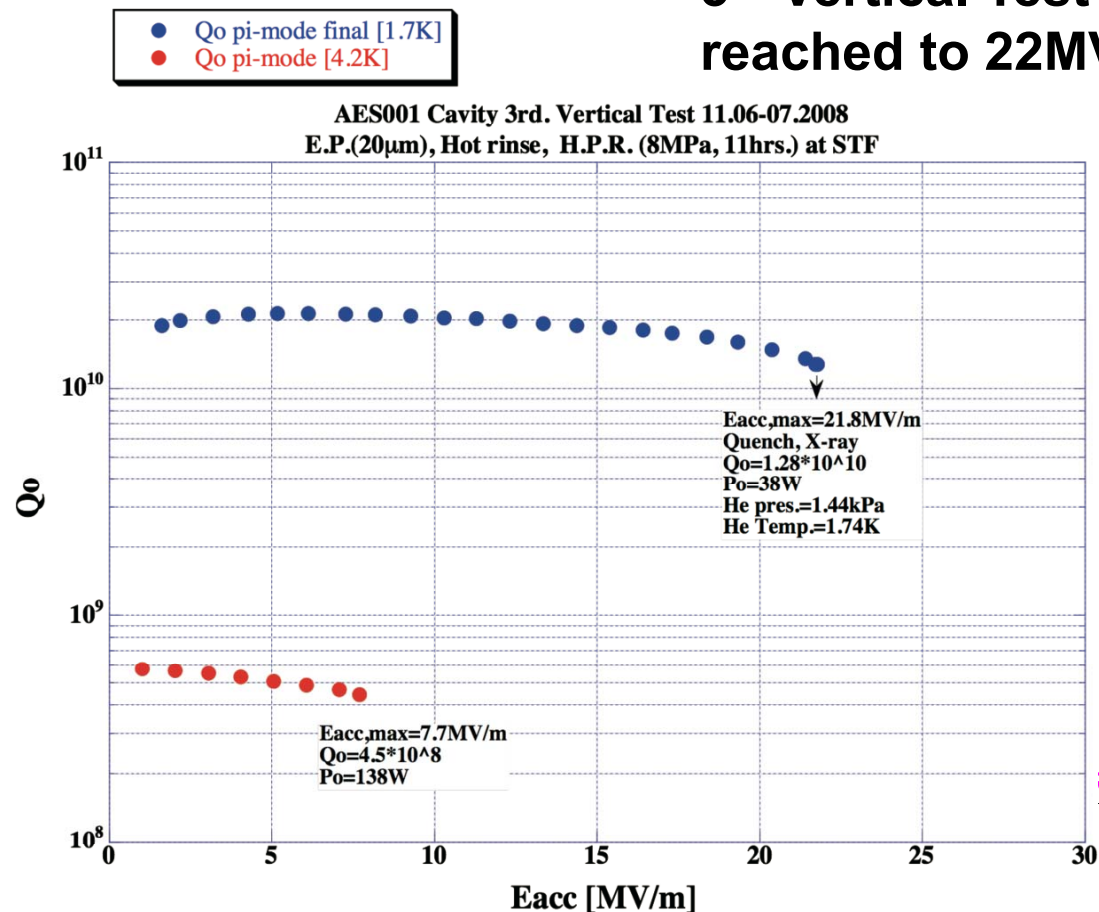


HPR dismounting



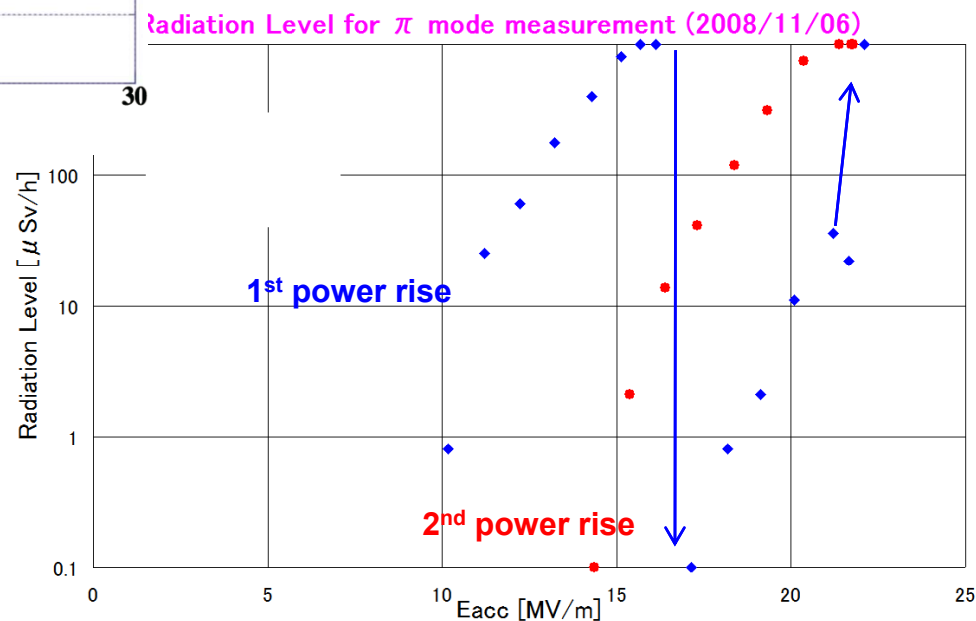
120C bake

3rd Vertical Test after STF-EP 20μm removal, reached to 22MV/m.



STF-EP system was proven up to 22MV/m gradient reach.

X-ray at cryostat top



E_{acc} (on axis) per Cell

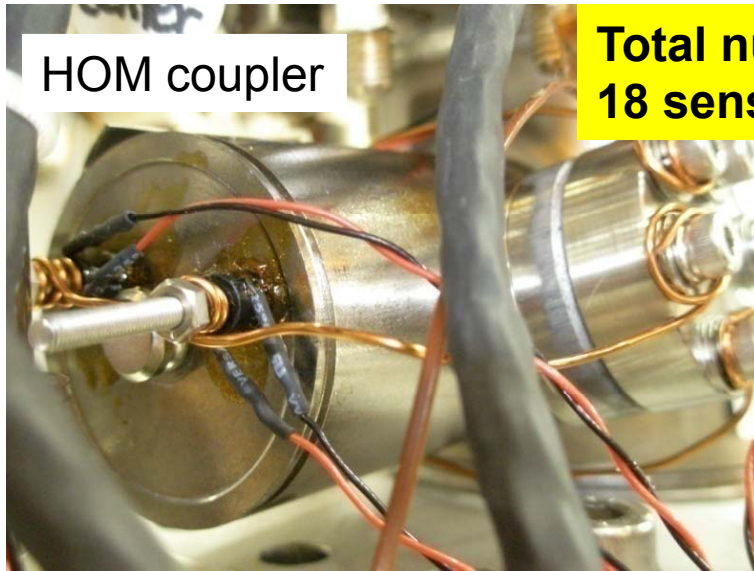
cell	π	$8\pi/9$	$7\pi/9$	$6\pi/9$	$5\pi/9$	$4\pi/9$	$3\pi/9$
1 & 9	22.1	33.9	34.3	21.8	17.9	23.9	20.0
2 & 8	22.1	30.2	18.2	0.0	12.2	31.3	40.0
3 & 7	22.1	22.4	6.9	21.8	21.1	13.6	20.0
4 & 6	22.1	12.5	26.4	0.0	3.6	34.7	20.0
5	22.1	0.0	36.7	21.8	22.7	0.0	40.0
limited by;	#3 cell	#3 cell	Power Limit	#3 cell	#3 cell	intentional stop	#5 or #8 cell

gradient limitation came from #3 cell,
gradient reach are well aligned.

unit : [MV/m]

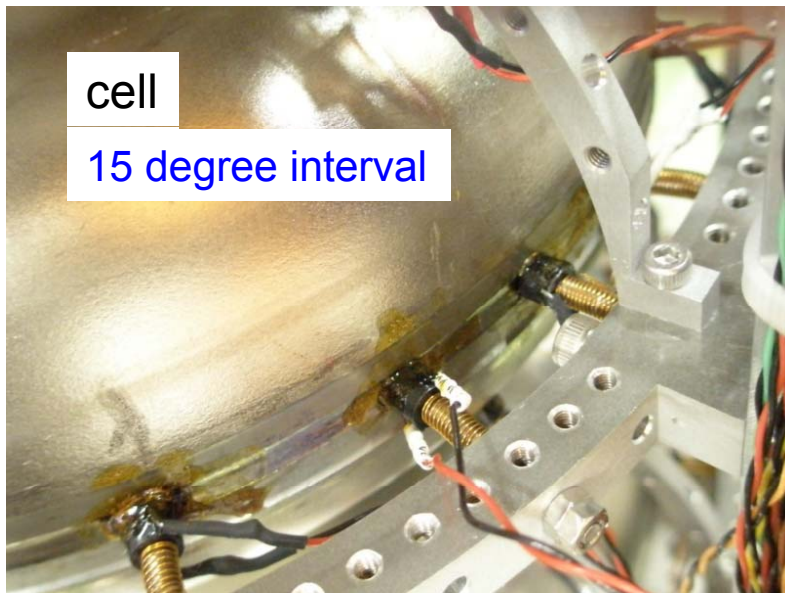
Cells except #3,#7 went up >34MV/m

Temperature Sensors



HOM coupler

**Total number of sensor:176
18 sensors/cell**



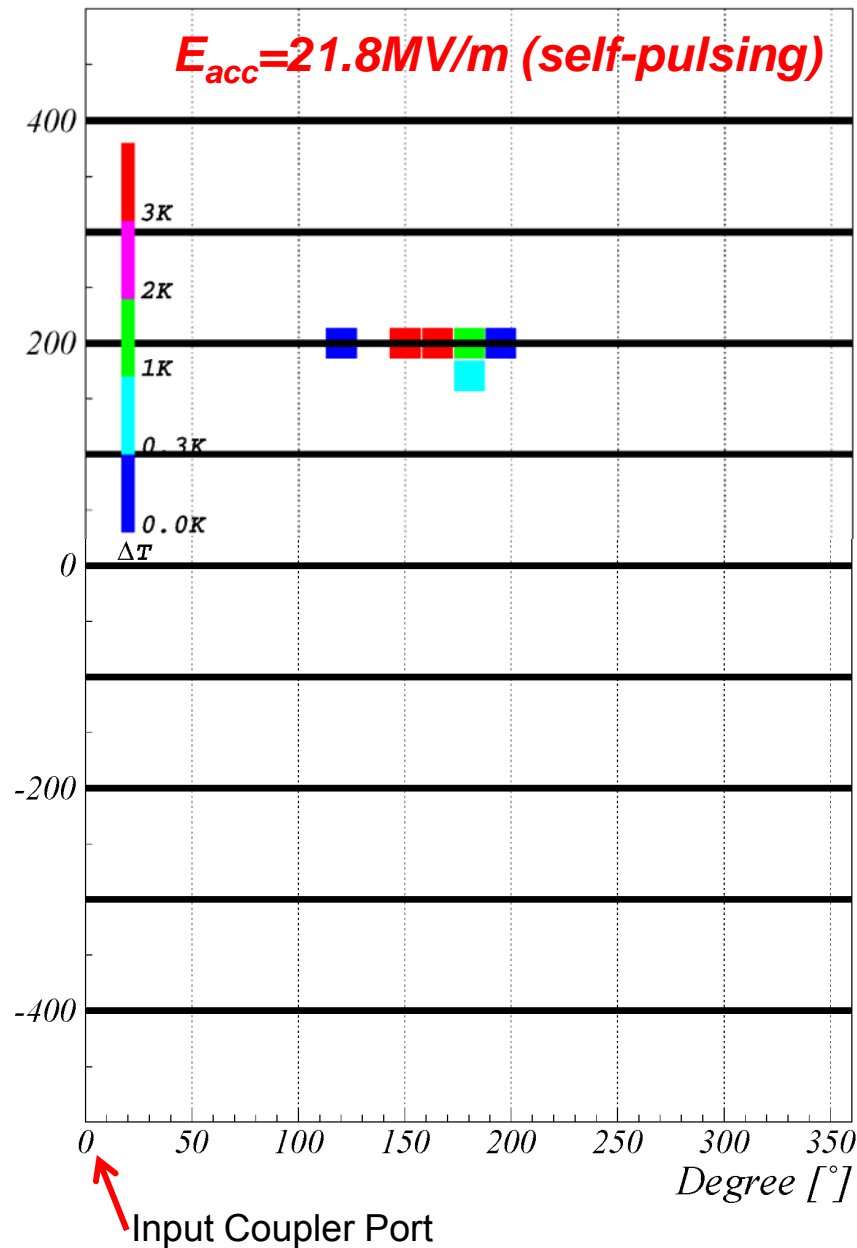
cell

15 degree interval



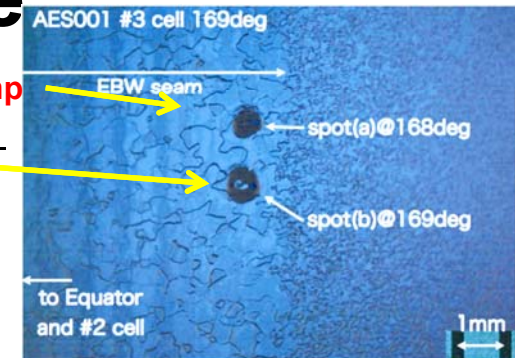
3rd Vertical Test

T-Mapping for π mode



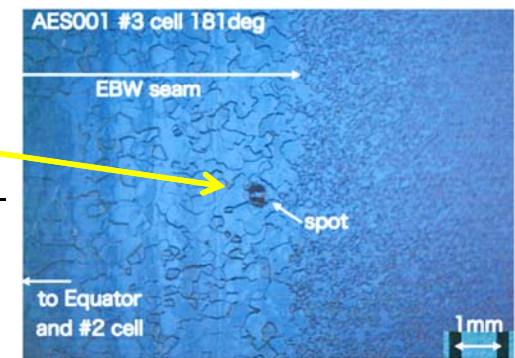
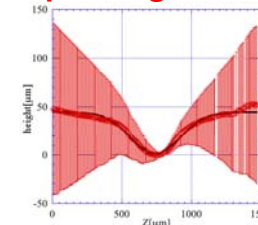
84 μm ? height bump

60 μm ? height bump



~21mm

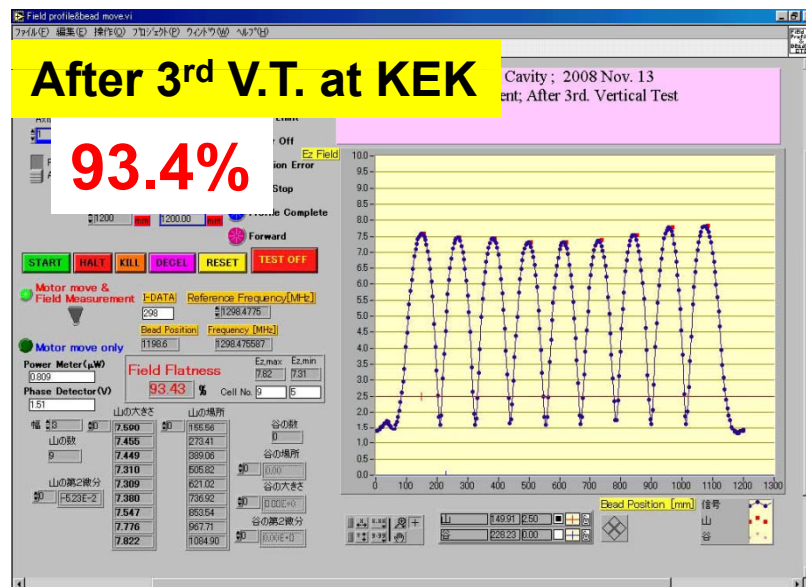
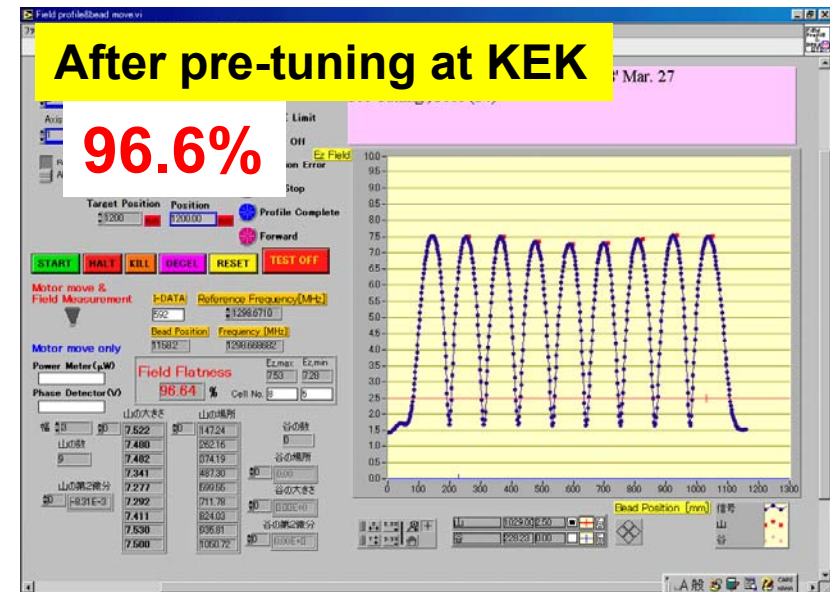
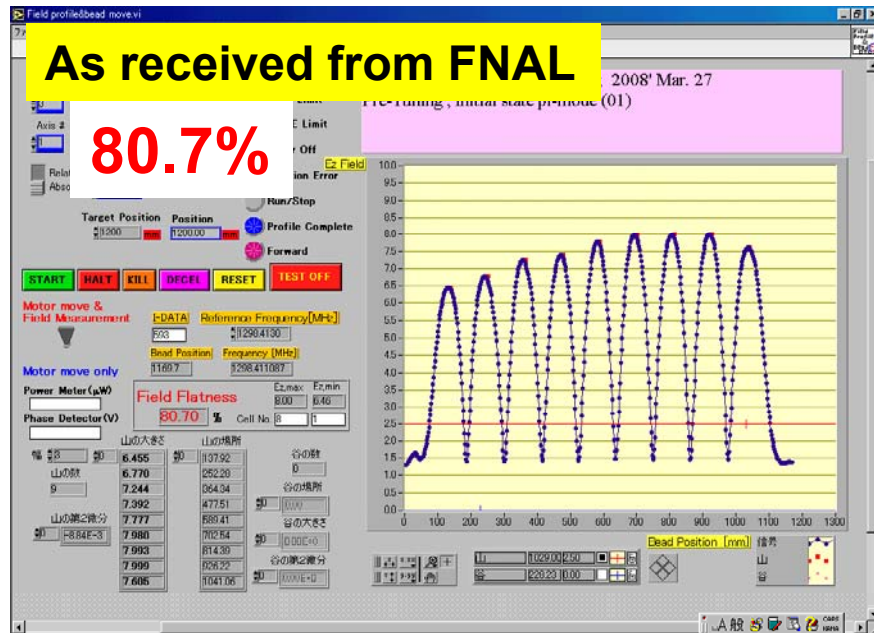
43 μm height bump



sensors with Temp. rise

π	Cell #3 (58,69,76,77,80,87,88,98,99,157) HOM#2 Weld (11,33) Cell #1 (109, 110), Cell #2 (101)
$8\pi/9$	Cell #3 (58,69,76,77,80,87,88,98,99,157) HOM #2 Weld (11,33)
$7\pi/9$	Cell #6 (72,83,94,105,160,164,165)
$6\pi/9$	Cell #3 (69,76,77,80,87,88,98,99,157)
$5\pi/9$	Cell #3 (69,76,77,80,87,88,98,99,157)
$4\pi/9$	Cell #1 (1,12,23,34,45,67,78,89,109,110,111,122,133,155,166) Cell #6 (72,83,94,160,164,165) Cell #9 (9,20,31,75,86,97,108,119,130,141,163,174)
$3\pi/9$	Cell #5 (115,126) Cell #8 (52,63,74,151)

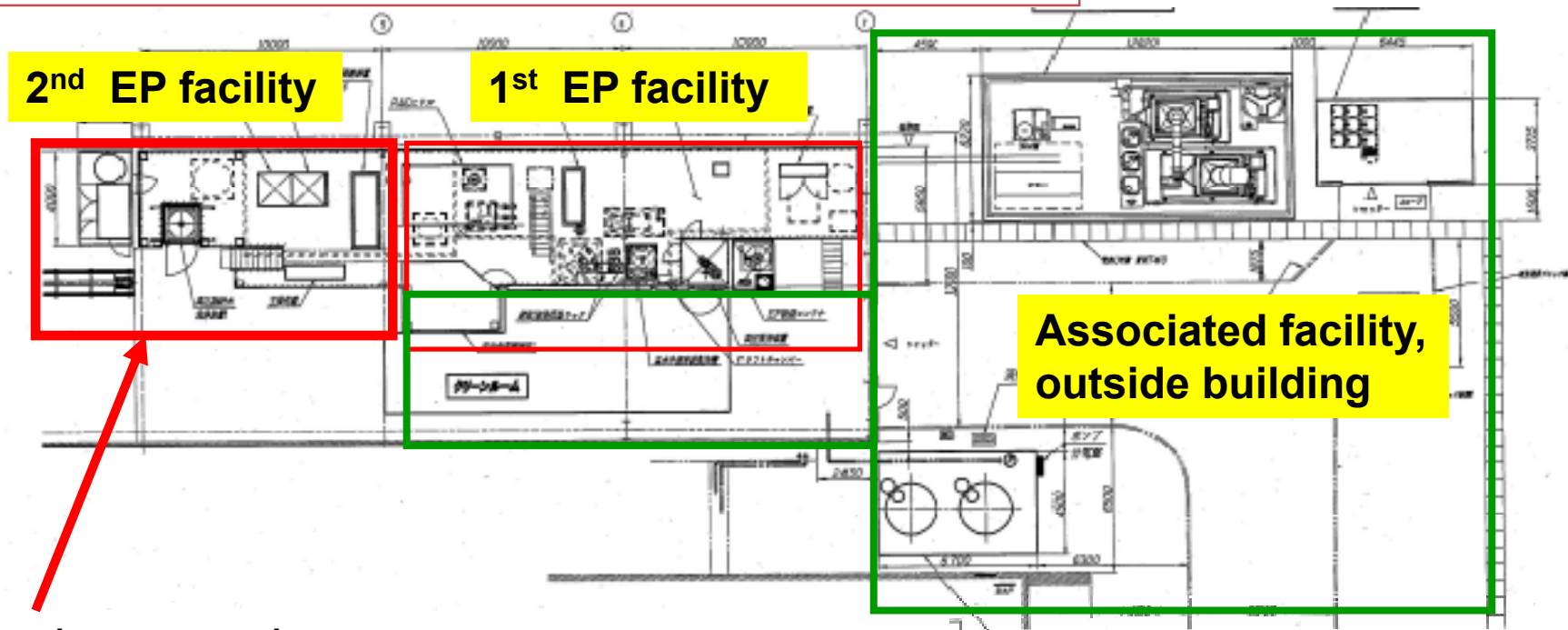
Field flatness of AES001 cavity



2nd EP facility at KEK: moving back from Nomura, with renewal

New Area under construction

For KEKB, Crab, ERL & ILC cavity



2nd UPW, 2nd HPR, Water Shower, Water tank, 2nd Ultra sonic rinse, 2nd EP Bed, 500ℓ EP tank

will be completed in Oct. 2009

Next plan of STF EP,VT

- (1) TESLA-shape BL#5, BL#6 are planned to process and vertical test from end of November to December.
- (2) Three more cavities (BL#7, #8, #9) were ordered, will be come in March 2009.
- (3) 2nd EP facility construction until October 2009.
- (4) Clean room expansion for STF phase 2 in 2009.

Acknowledgment: B. Kephart, M. Shekhar,
M. Champion, C. Ginsburg (FNAL)