Failure Report on HPR/CR at KEK/Nomura

SMTF meeting

6 October 2005

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Introduction

- What happened since 1st ILC WS at KEK (Nov. 2004) are reported.
- We have two HPR facilities, at KEK and at Nomura Plating Co.
- Oil contamination in HPR water at KEK.
- Valve usage in HPR at Nomura.
- Clean-room for assembly at KEK

Three problems mixed

In cavity performance

In EP operations

1) Field emission ⟷ **1) Oil contamination in HPR water**

2) Q-disease ⟷ **2) EP acid level & temp. control**

3) Q-slope at low field (only partially solved?) ⟷ **3) HF density in EP acid**

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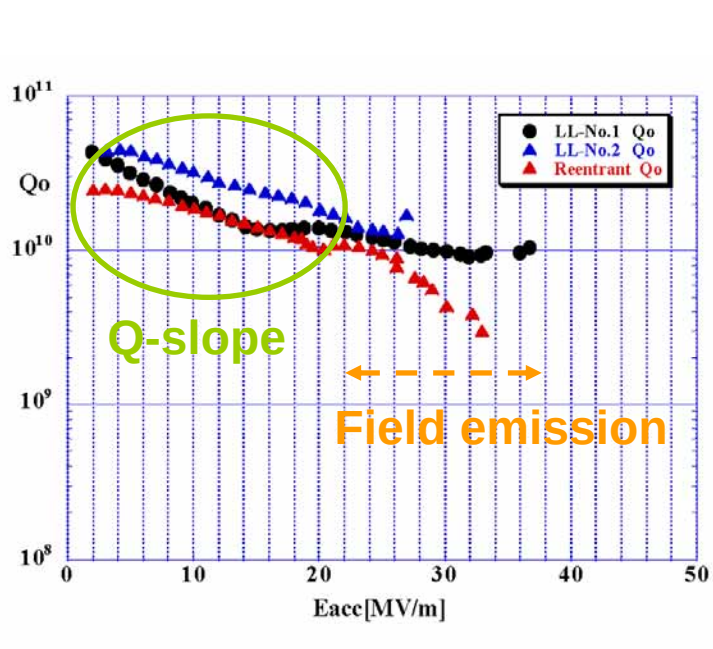
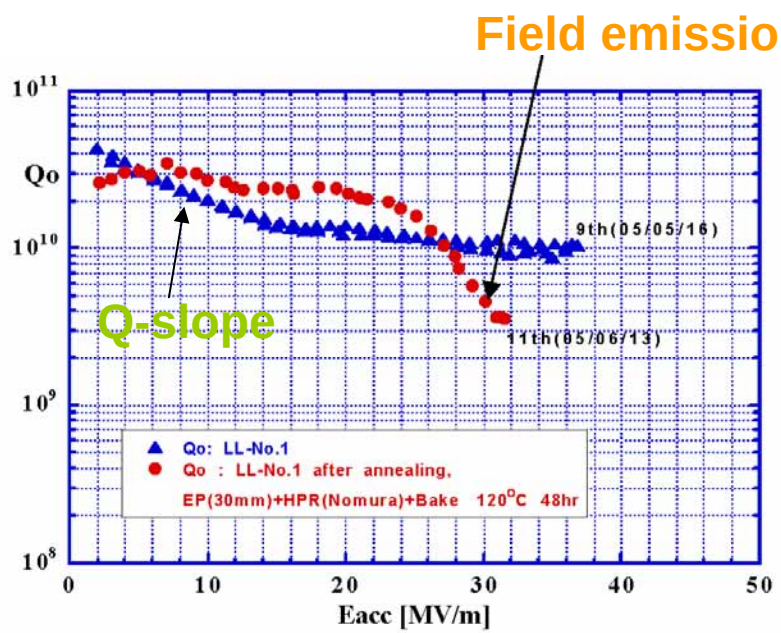
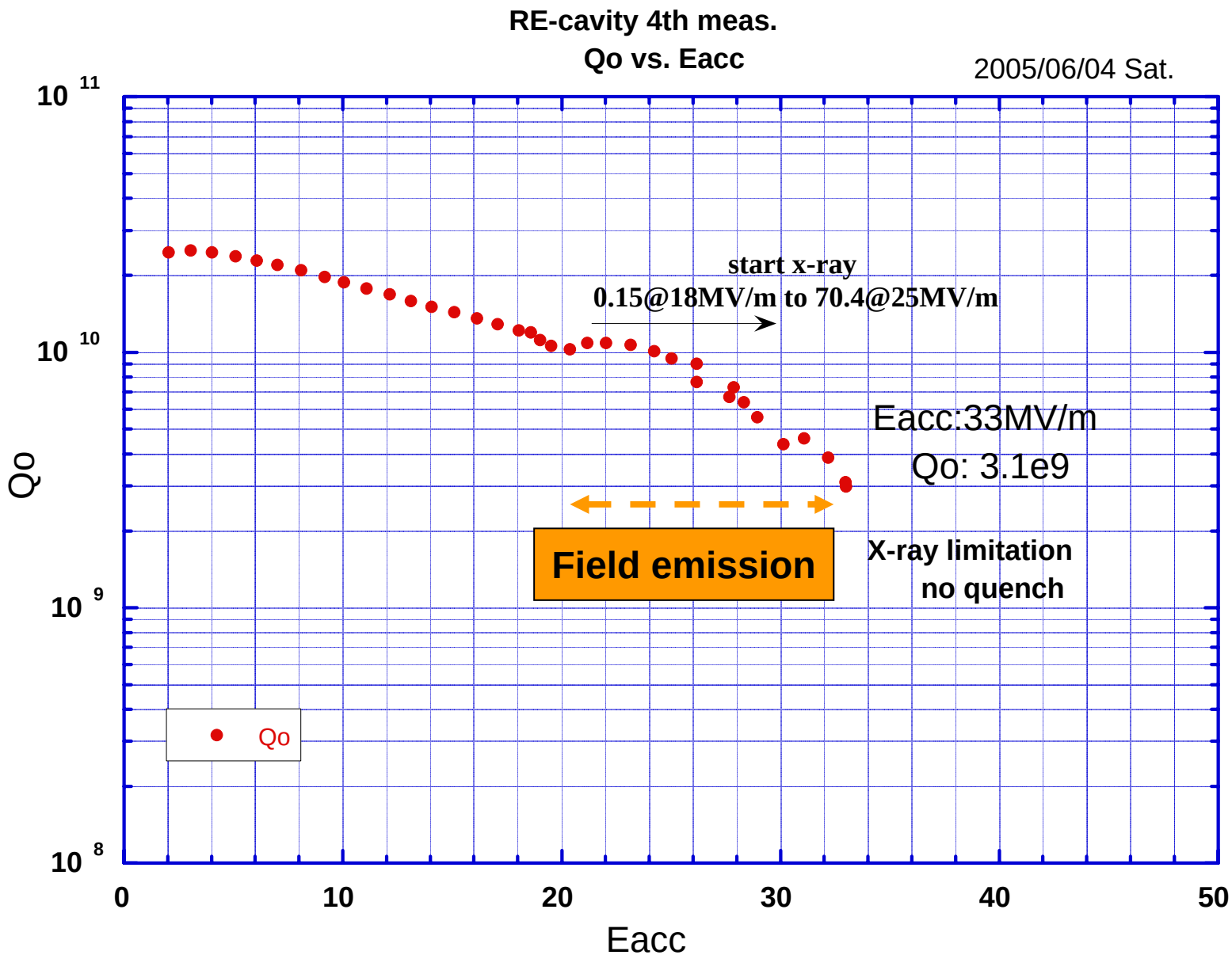
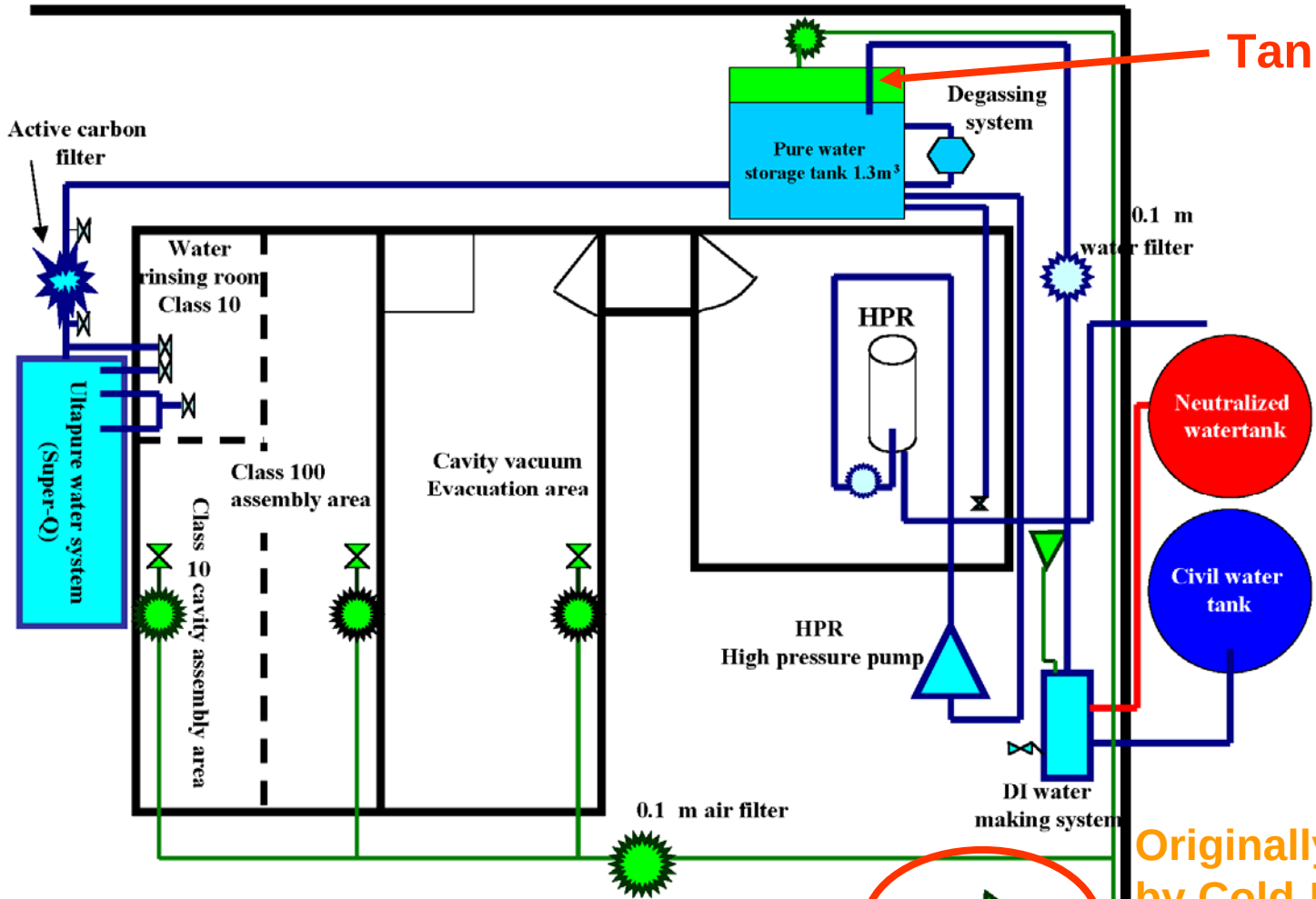




Oil-contamination problem



Oil contamination problem

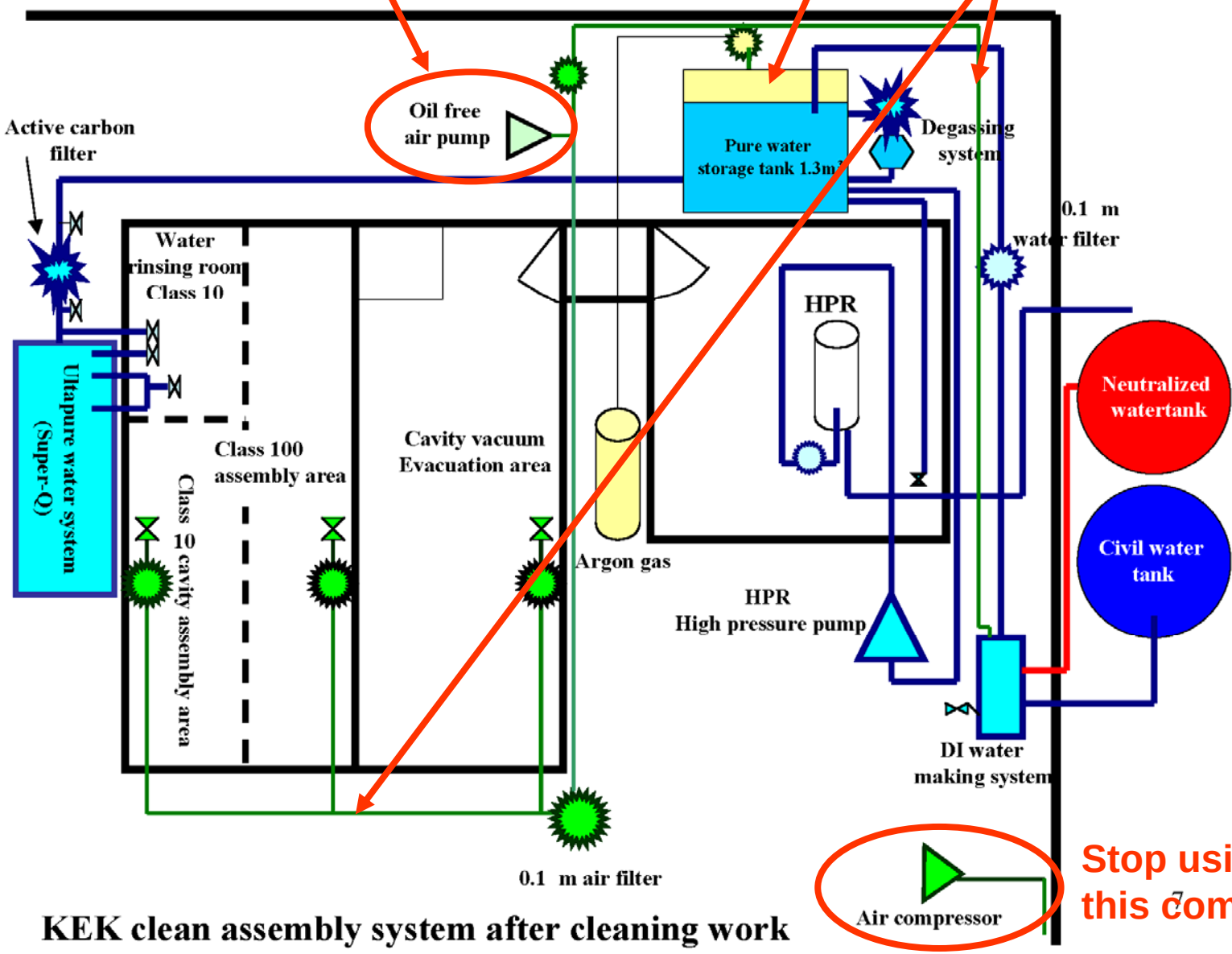


KEK clean assembly system in KEK

Air-compressor was miss-chosen

Originally provided by Cold-Evaporator(N2) line => terminated

New oil-free compressor + cleaning tank and pipes.



KEK clean assembly system after cleaning work

Stop using
this compressor

Oil-contamination level before/after cleaning work

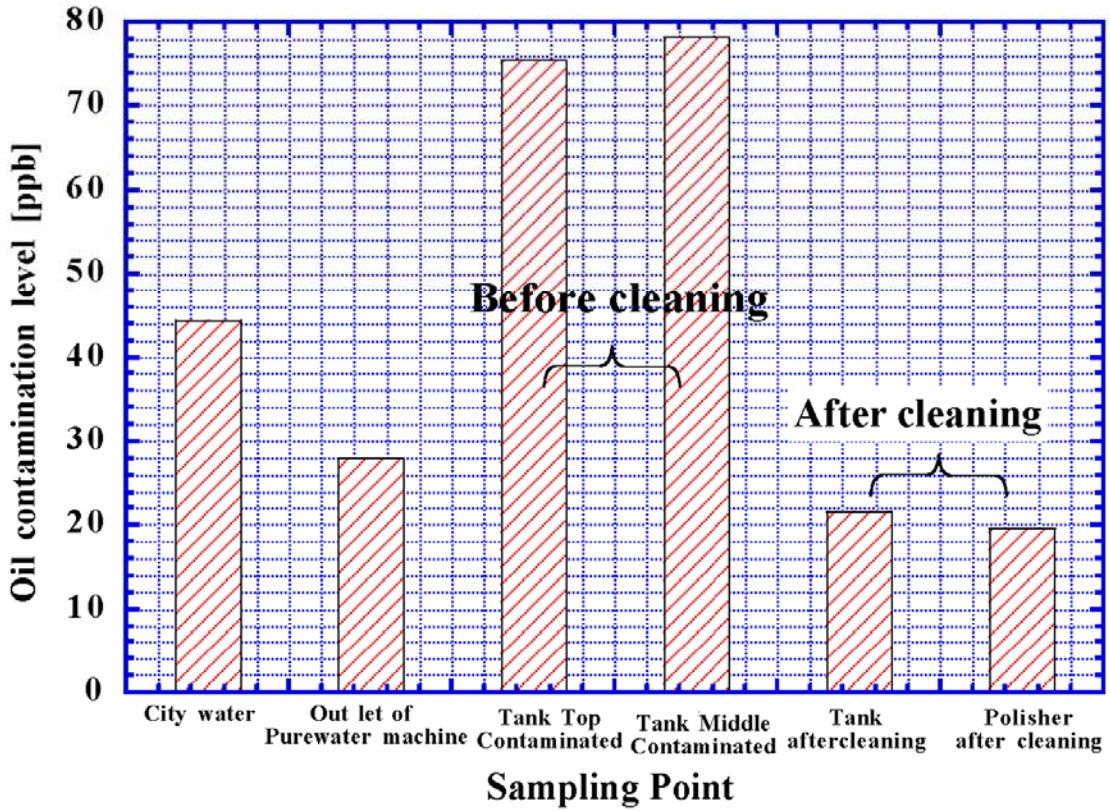


Fig.5 : Oil contamination level decreased to 1/4 by the cleaning work.

No in-line water monitor
=> contamination was found after several VTs.

Even after cleaning work at KEK, we are using HPR @ Nomura (UPW).
All high-gradient results of single-cell cavities are with HPR @ Nomura (UPW).

What was learned (Oil contamination)

Cause of failure

- The water system needed minor change because Cold-Evaporator (CE) line terminated.
- Miss-choice of an air-compressor.

Current status

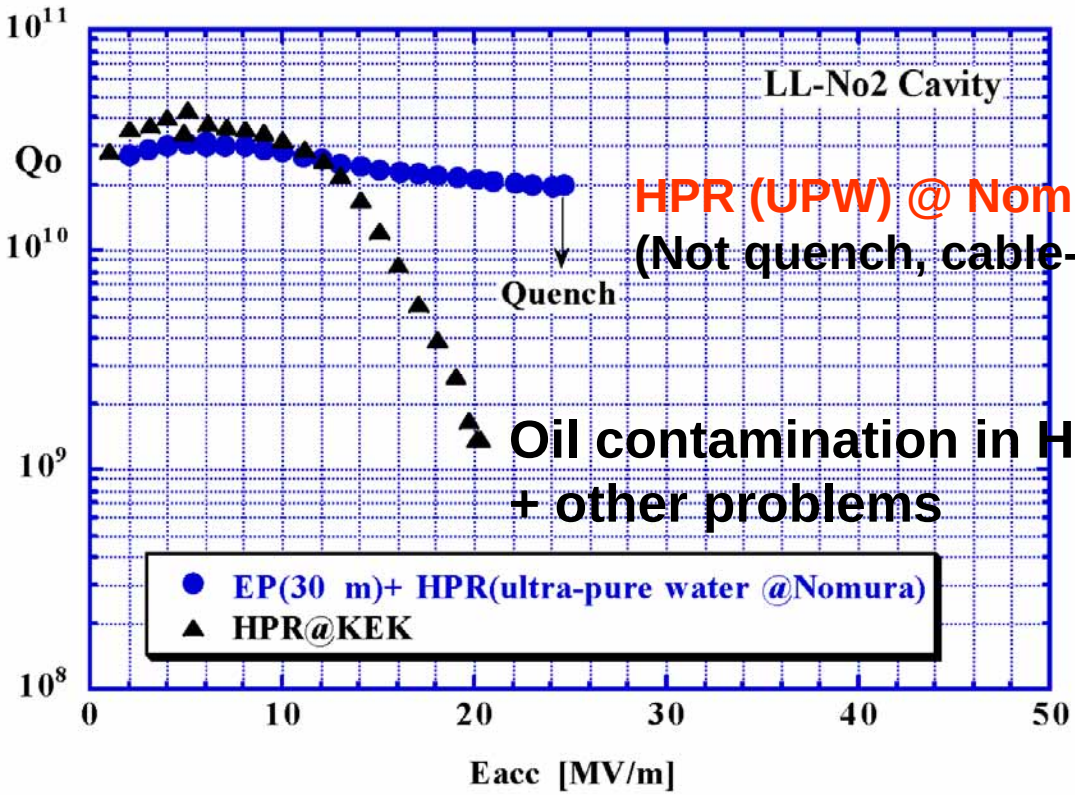
- New oil-free air-compressor was bought.
- Clean-up the tank and pipes.
- For the moment, HPR at Nomura (UPW) becomes the default process.

Recommended system

- Future plan: in-line monitor of TOC and particle counter. Periodic analysis of bacteria by KEK staff.

Cavity performance
with / without oil-contamination problem

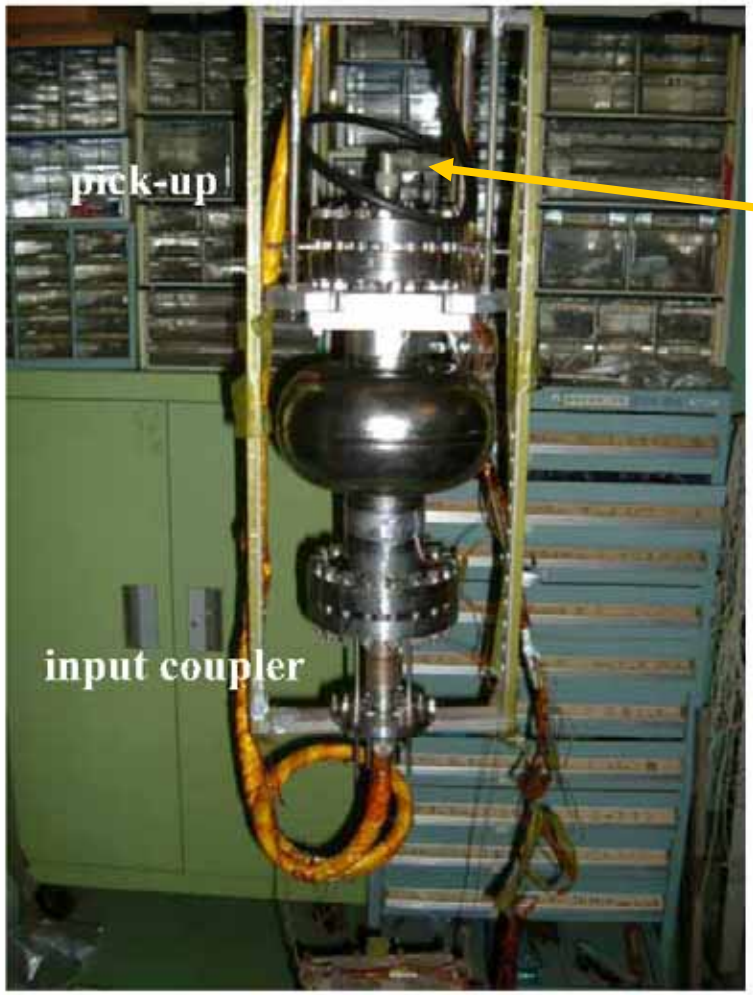
Q0 vs Eacc with HPR (UPW @ Nomura) and
Field-emission at low Eacc with HPR (oil-contamination at KEK)



HPR (UPW) @ Nomura
(Not quench, cable-contact was bad)

Oil contamination in HPR @ KEK
+ other problems

Cable problem

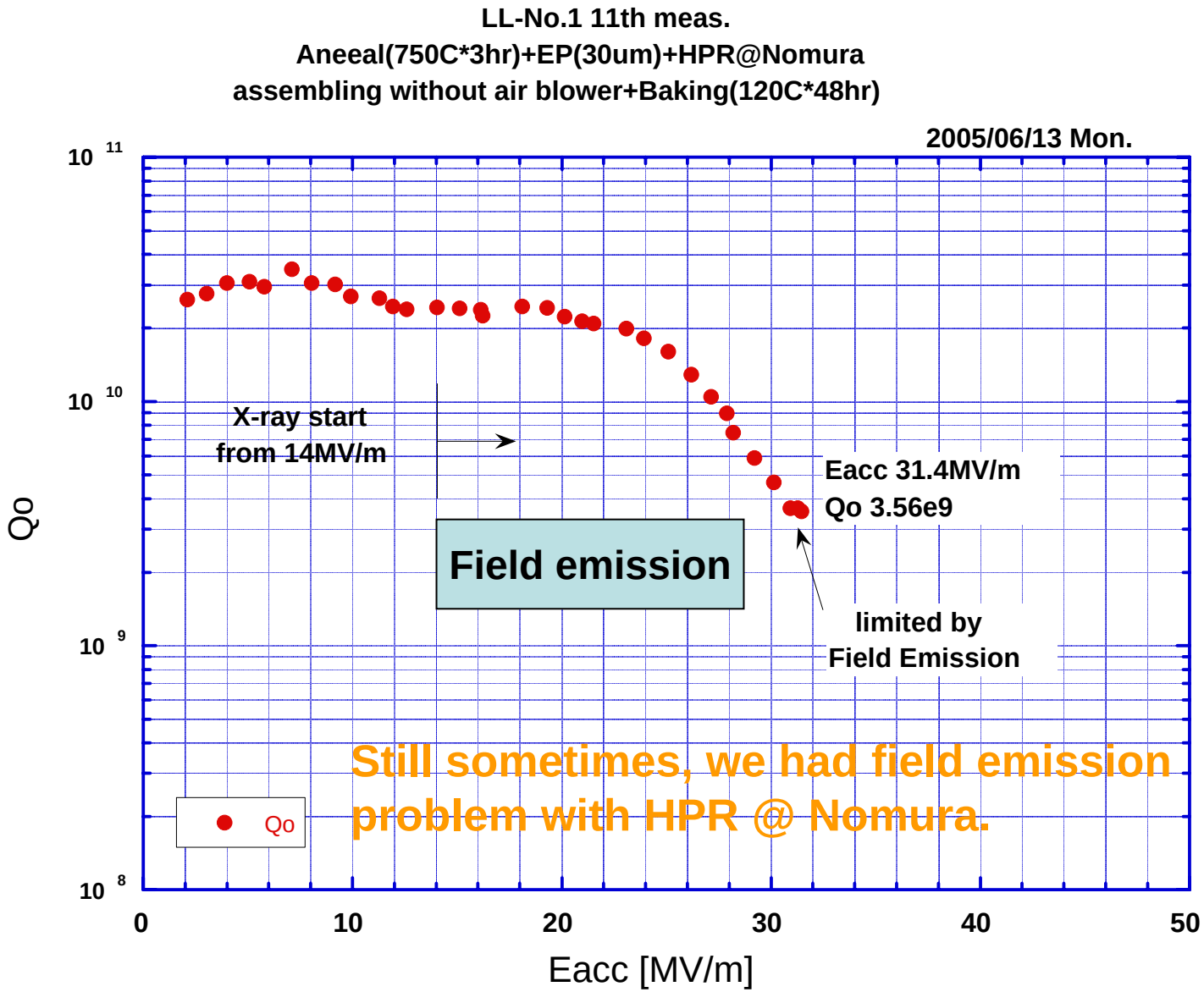


Pickup cable :
Bad contact at connector.

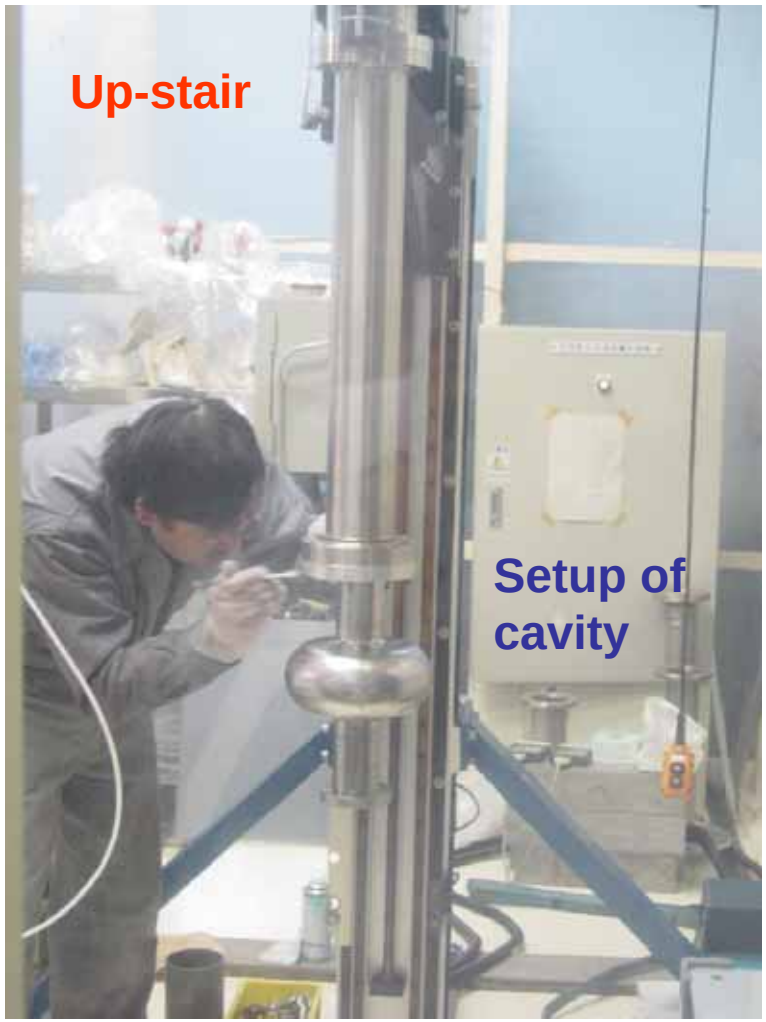
Cycling of cool-down and warm-up damages the cable.

Changing pick-up cable solved this problem.

HPR clean-room problem at Nomura



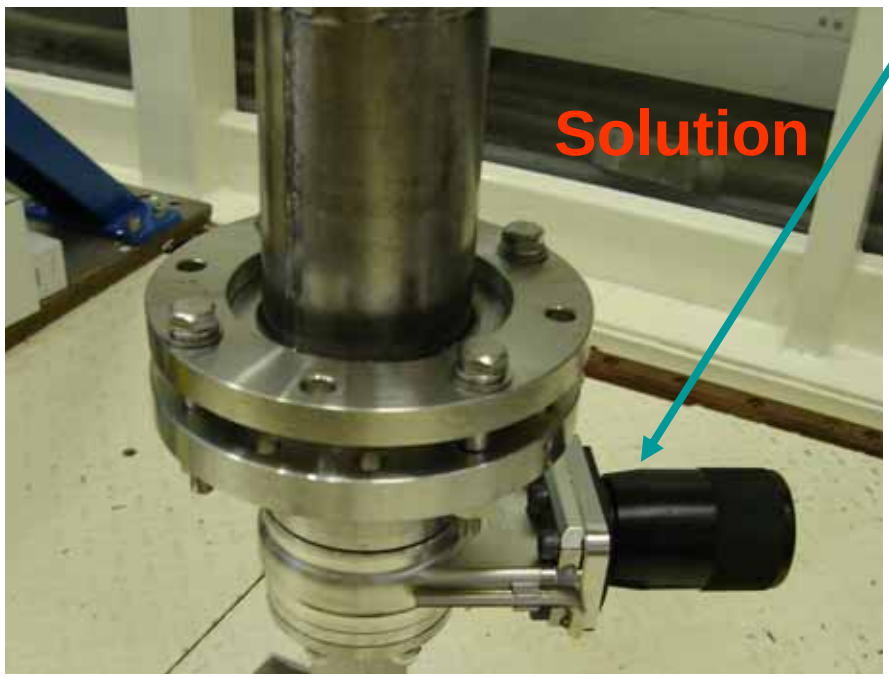
HPR clean-room problem at Nomura



HPR at Nomura is in clean-room (class 1000).
But the clean-room is not clean enough.

HPR clean-room problem at Nomura

After HPR, operator seals top and bottom flanges of cavity. Then KEK staff carry it to KEK for assembly in clean-room. But it seemed that, during this sealing operation, particles may go inside the cavity….



Valve is put on the bottom flange of cavity before HPR.

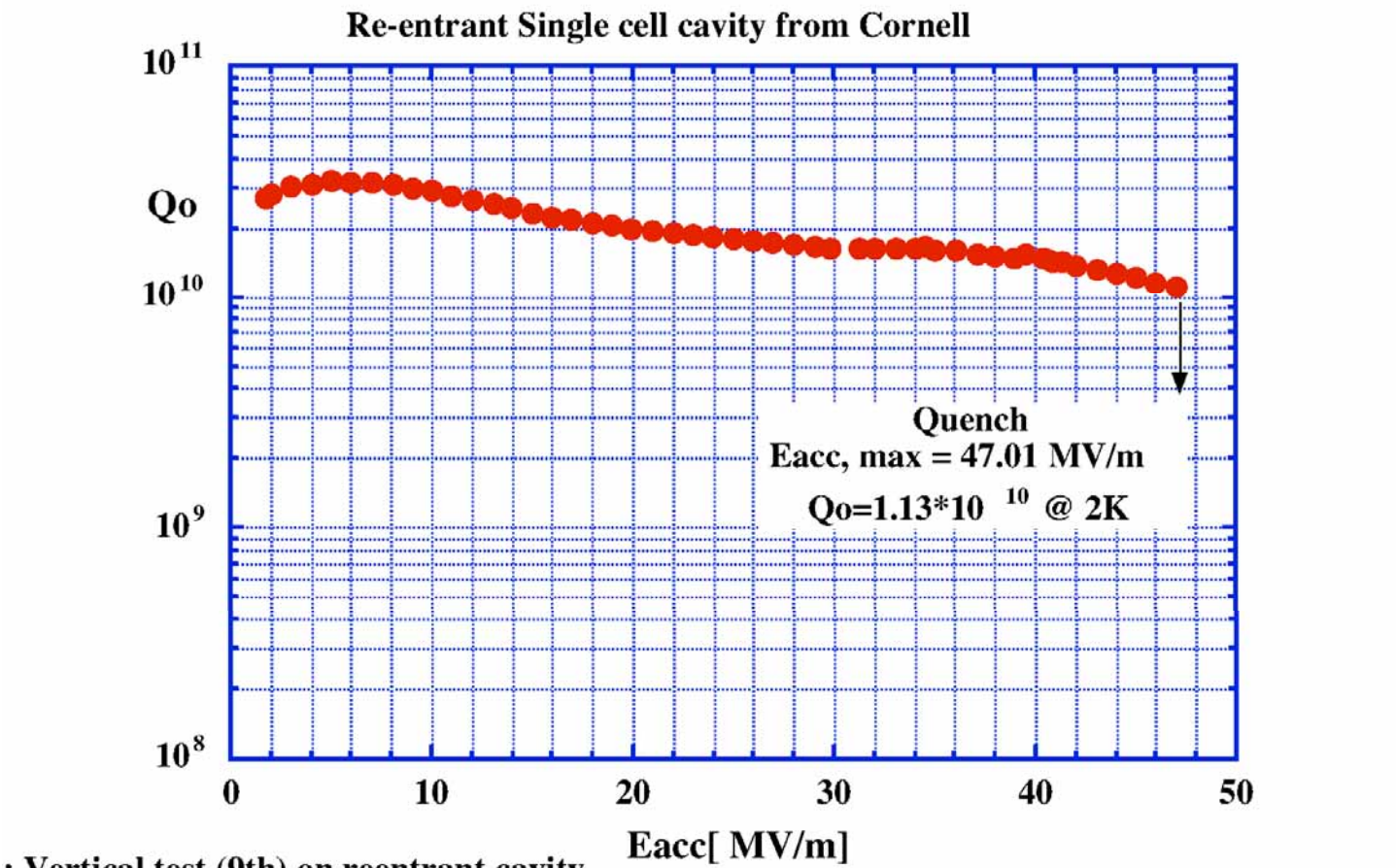
↓

After setting the valve and starting HPR, operator goes out the clean-room. No operator in the clean-room during HPR.

↓

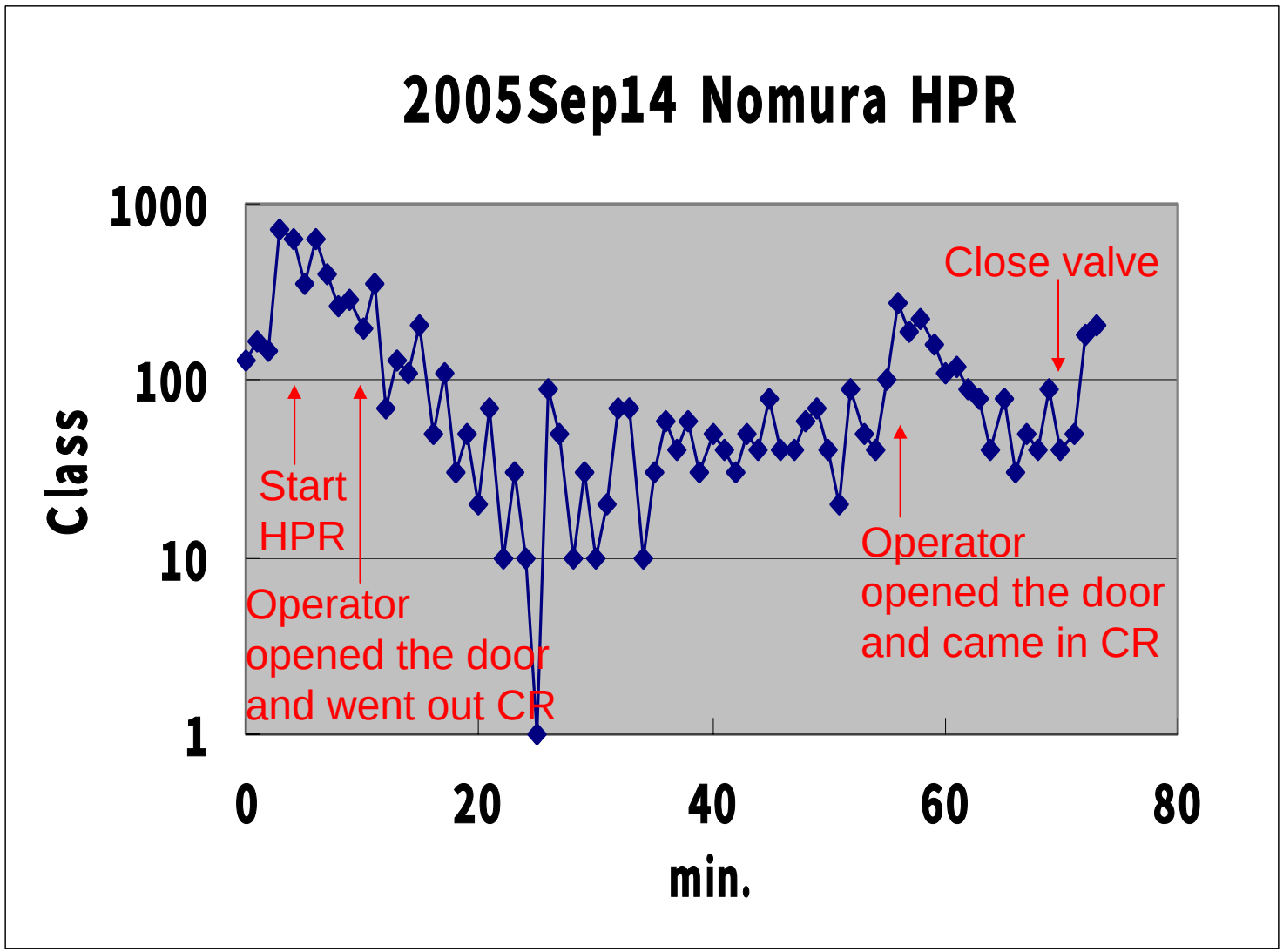
15 min. before the end of HPR, operator comes in the clean-room again to sit inside the CR. Then, operator closes calve at the end of HPR. => carry to KEK.

RE single-cell cavity achieved 47 MV/m on 30 July 2005.



: Vertical test (9th) on reentrant cavity
Re-annealed (750^{O}C,3hr) +EP(30μm)+HPR(Nomura, ultra-pure water)+Bake(120^{O}C, 48hr)

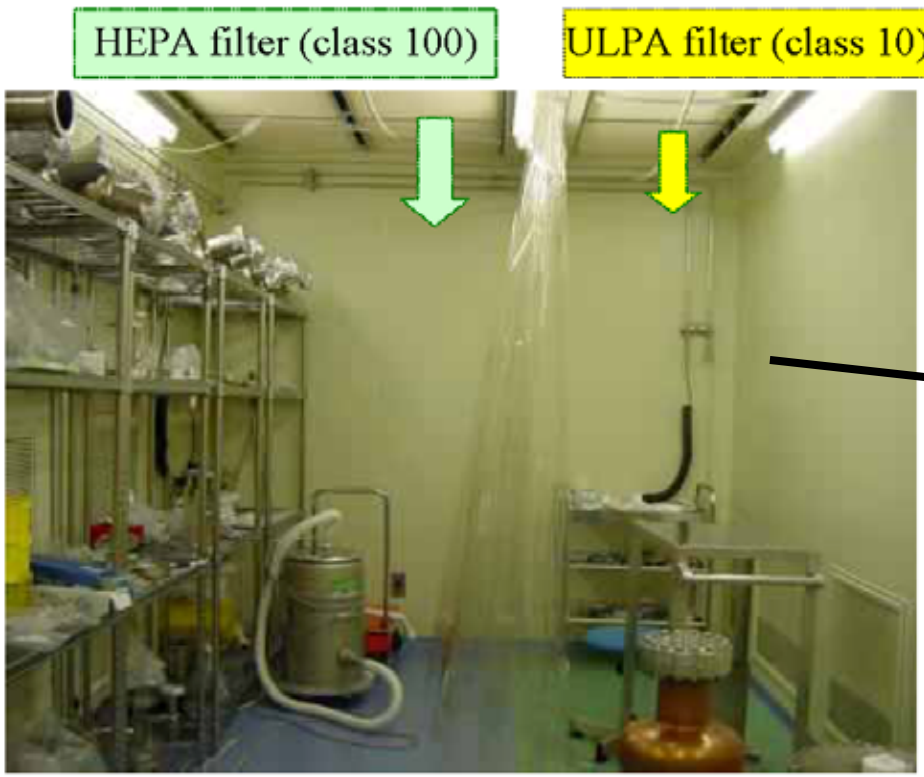
RE cavity HPR at Nomura



Class = # of particles (>0.5 um) per CF

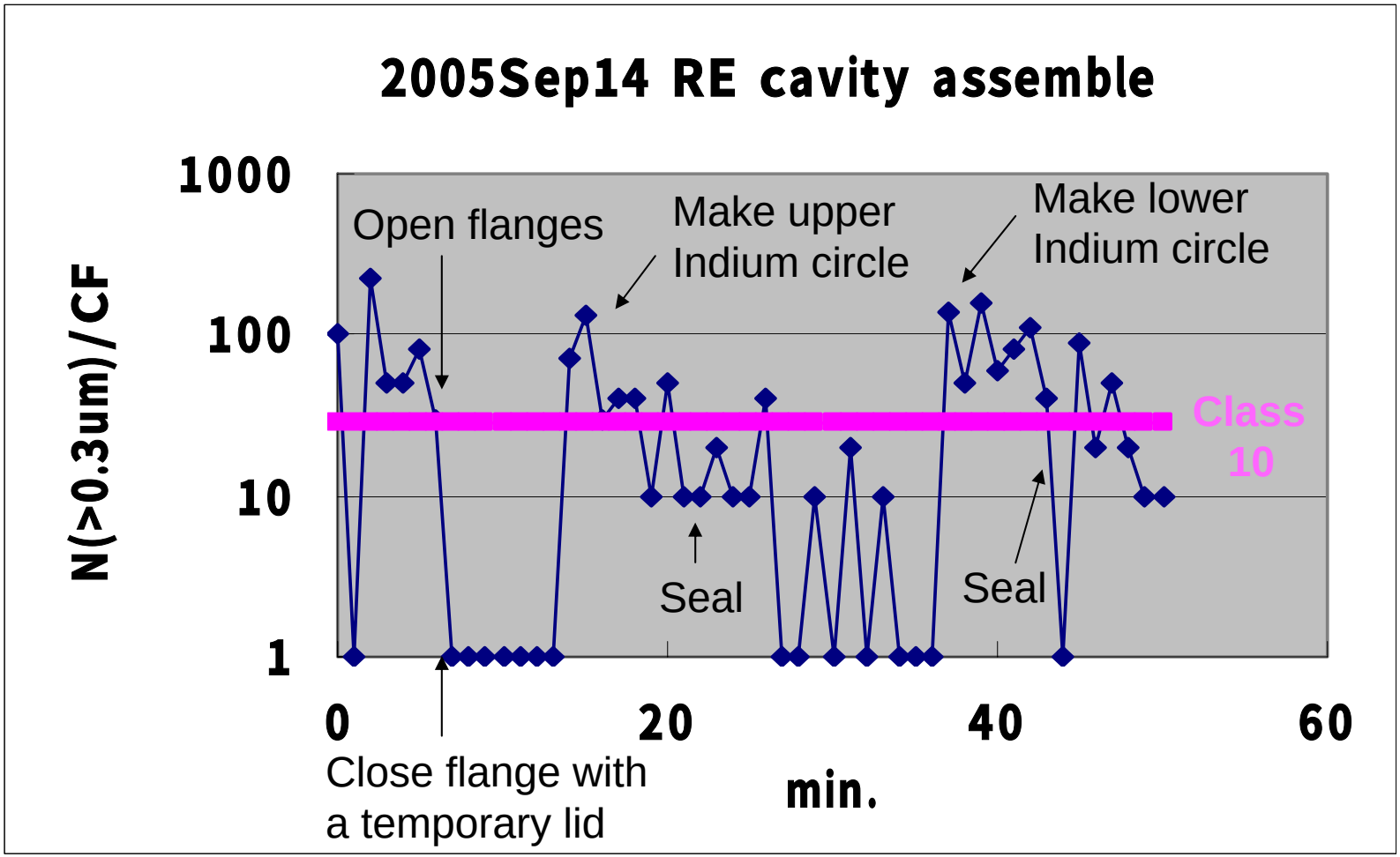
Assembly of cavity in clean-room at KEK

**After HPR at Nomura (UPW),
KEK staff carries cavity to KEK
for assembly in clean-room.**



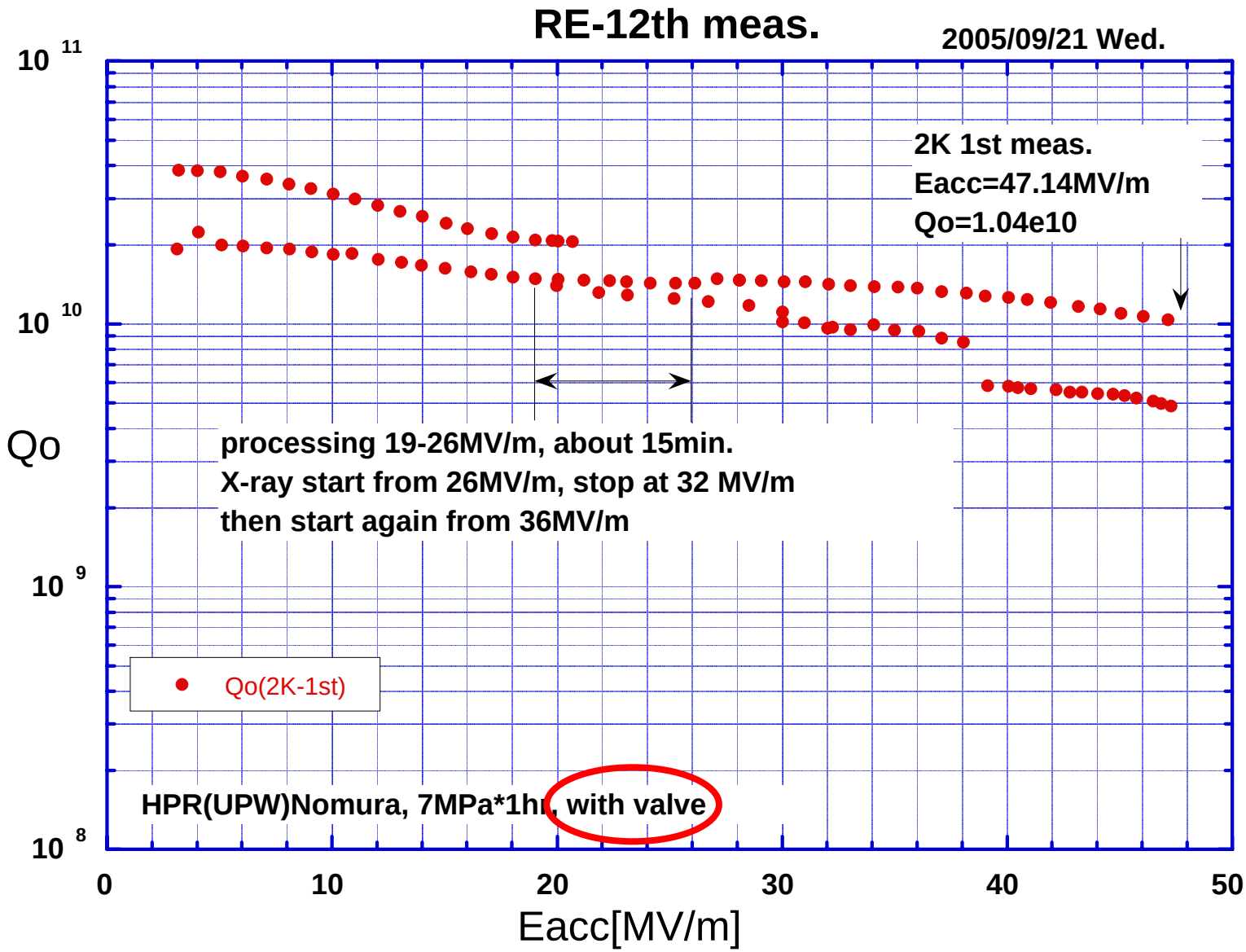
Clean-room at KEK

RE cavity assemble at KEK



28 particles (>0.3um) / CF = class 10

RE cavity performance with HPR @ Nomura (on 14 Sept.) and assembly @ KEK (on 14 Sept.)



Clean-room in KEK

- We cleaned up the clean-room at KEK (swept wall, floor, curtain…etc)
- Compared the cleanness of CR before/after the cleaning of CR by particle counter.
- It seems that cleaning CR does not affect so much in cavity performance.
- Operator's moving & acting calmly during assembly is most effective to avoid particle's going inside cavity.
- Also, cleaning CR-wear seems a bit effective.

Summary

- Oil-contamination in HPR water @ KEK caused field emission.
- Oil-free compressor was bought, and water-tank and pipes were cleaned up.
- But, default HPR = HPR at Nomura (UPW).
- Cable problem was solved by changing cable.
- CR for HPR @ Nomura is not clean enough. => caused field emission.
- Valve operation during HPR @ Nomura solved the field emission problem.
- Assembly in CR @ KEK: Operator's moving & acting calmly is most effective.