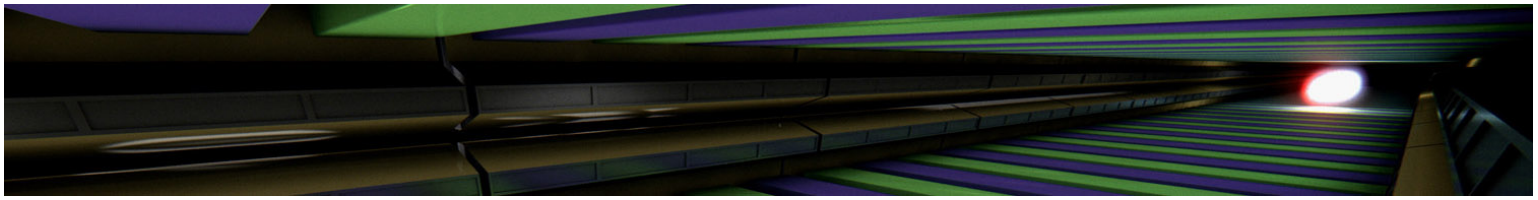


European XFEL procurement strategy – lessons learned

Detlef Reschke – DESY
(with J. Iversen, A. Matheisen, H. Weise)

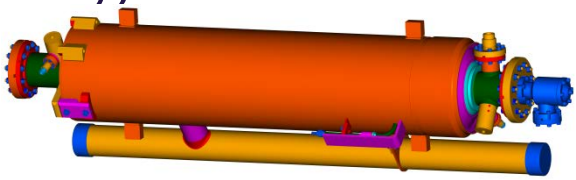
Cavity production: Preparation Phase

- Define final **cavity design**
  => TESLA design with minor design changes
- Establishing **surface treatment recipes**
  => based on app. 50 prototype cavities
- **Industrialization of main Electropolishing surface treatment**
  => set up of EP facilities at 2 companies
- Preparation of **detailed specifications**
  => mechanical fabrication, surface treatment, HT integration, transport concept
- Finalize a concept for **documentation and data transfer**
- Qualification + selection of **Nb / NbTi material vendors** in 3 steps
  => 2 new companies
- Concept for fulfilling **PED requirements**
- Establishing **“Long pulse” vertical acceptance test**
  => protect HOM feedthroughs
- Single-cell cavity R&D program (several aims)
- R&D on Large Grain Nb material

Courtesy W. Singer

Cavity production

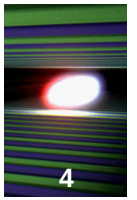
- Contract allocated to Research Instruments (RI, Germany) and E.Zanon (EZ, Italy) in **equal shares end 2010**:
  - 560 series cavities
  - 24 cavities w/o He-tank for QC and further R&D (EU funded: "ILC-HiGrade")
  - Option: 240 series cavity
    => Order allocated end 2012/beginning 2013 in **equal shares**



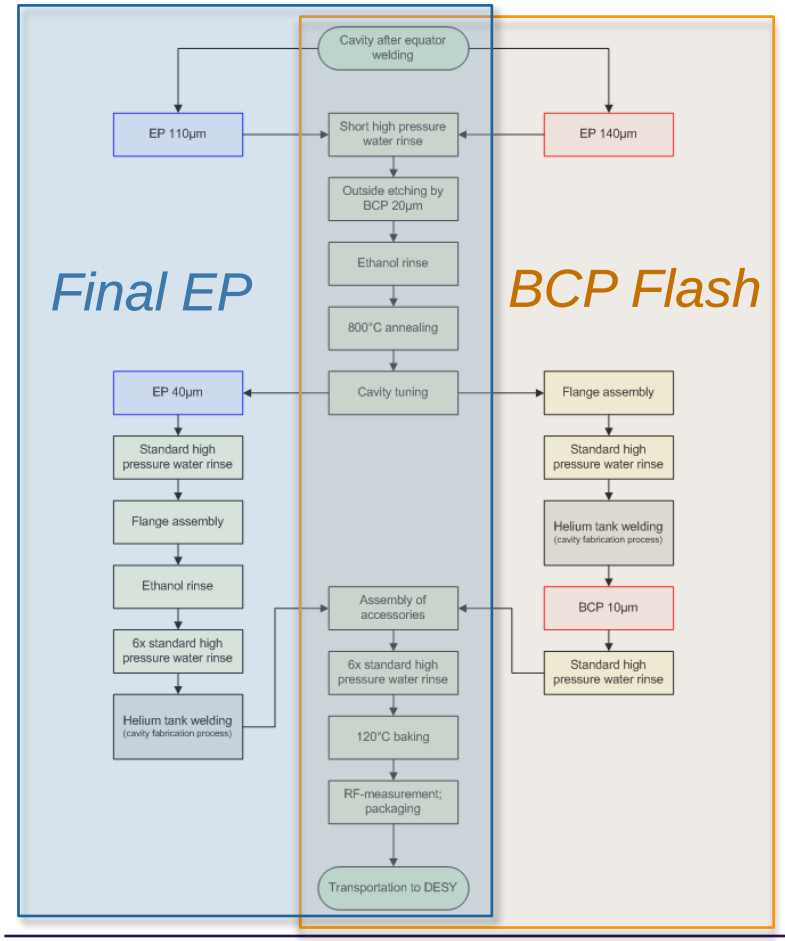
- **All Nb / NbTi material provided** by DESY (~ 24420 pieces)
  => includes ordering, PED-applicable QC + parts tracking, shipment

- Order placed following **"Build-to-Print" strategy**:
  - Production has to follow specifications precisely
    => close supervision by expert team + frequent visits + regular reporting
    (no resident expert at vendor)
  - **No performance guarantee** by vendors

Cavity Surface Preparation



- **Two schemes** for the final surface treatment:
  - **E. Zanon:** **Final 10µm BCP** (“BCP Flash”)
  - **Research Instr.:** **Final 40µm EP**



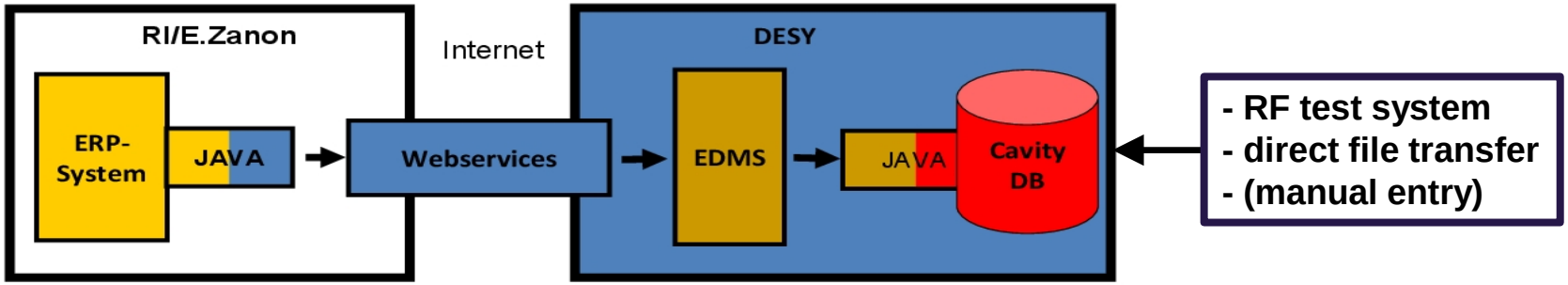
Successful mechanical production and surface preparation at both vendors!

No performance guarantee resulted in DESY taking responsibility for:

- the risk of unexpected low gradient or field emission
- **retreatment**
  (good cooperation/agreements with both vendors)

Quality Management + Documentation

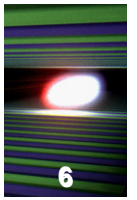
- Key technical documents: **Technical Specifications + Change Reports**
- Quality Process based on **Quality Control Plan** (also for PED) including:
  - Vendor internal QA, QM system
  - Microsoft Project Plan for tracking of progress + schedule
  - **Non Conformity Reports NCR**:
    Documentation of all NC's including a proposal for correction procedure
  - Stepwise release of production (**Acceptance Levels** 1, 2, 3)
- All production documents (specifications, protocols, PED data, etc.) recorded electronically in **data management system (EDMS)**
- Data analysis in **cavity data base**



- **Request Tracked e-mail** communication ("tickets")

Courtesy W. Singer

Lessons Learned

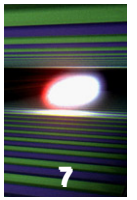


- **Concept of Preparation Phase successful**
  - Pre-Qualification of cavity vendors and Nb/NbTi suppliers important
  - Surface treatment recipes worked well

- **Communication with cavity vendors and notified body of upmost importance**
  - Trustful cooperation from tendering until (beyond) last cavity extremely helpful incl. solving problems together
  - Frequent meetings + visits; request tracked e-mails; good balance between personal contact and well-defined documentation; ...
  - Rough estimate: team of about 20 colleagues (INFN Milano + DESY)

- **Specification successful => make it precise wrt. to critical values and tolerances, but keep the infrastructure as generic as possible**
  - Few mechanical tolerances to tight (inner cell shape)
  - RGA spec for m>50 to tight (modified on request from 1:1000 to 1:300)

Lessons Learned II

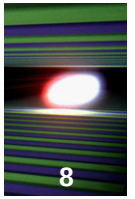


- **Effort of documentation and data transfer underestimated**
  - Started late and not enough man power available
  - Post-documentation required a lot of additional effort

- **Provision of “Cavity Tuning Machine” and “HaZeMeMa” by DESY**
  - Successful, but labor-intensive (now used for LCLS2, Mesa, Tarla cavities)

- **Pores in longitudinally welded Ti “2-phase pipe” caused significant rework**
  - Lonigitudinally welded pipes fulfilled Spec + PED, but during orbital weld pores “widened up” => out of PED => *surprise, surprise …*
  - Solution: Rework with seamless pipes

Additional slides



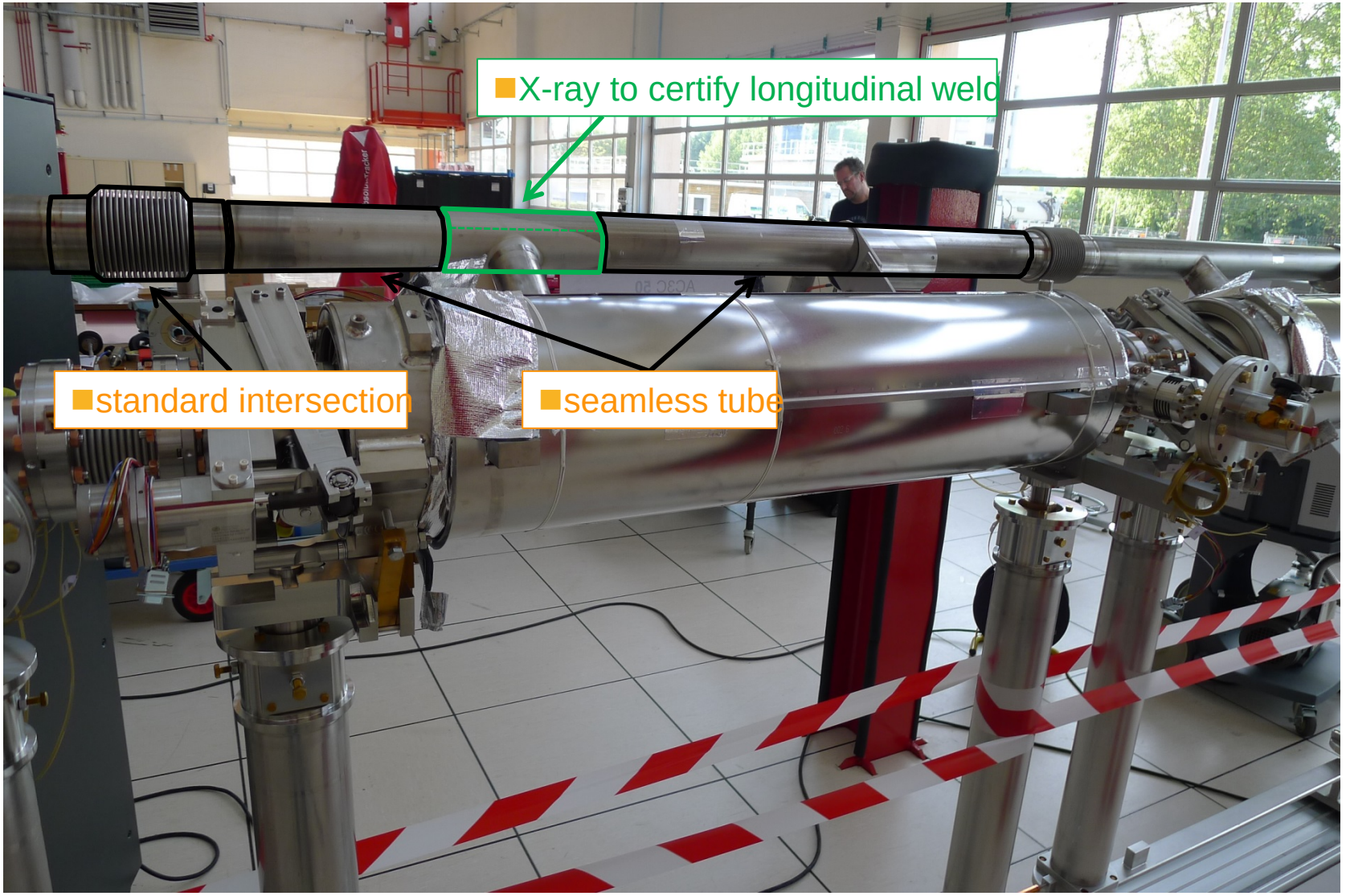
Transportation + Incoming Inspection

- **Transportation:**
  - "Cavity ready for test" requires well-defined transport concept
  - Transport under vacuum
    => avoid particle transport
  - Dedicated boxes for horizontal transport by truck (Vendor => DESY => Saclay)
  - **No performance degradation observed**

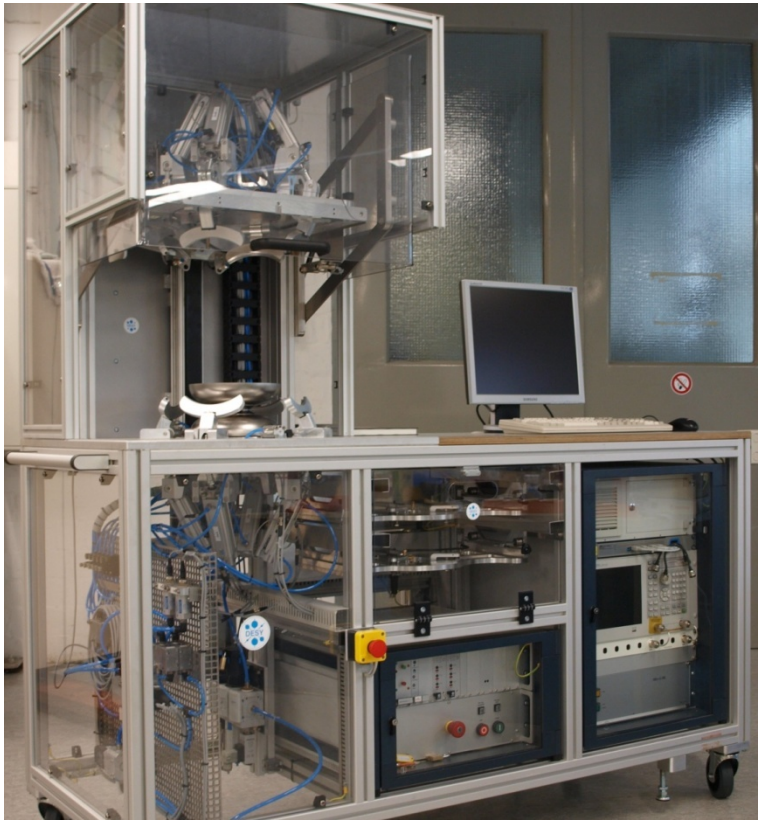
- **Incoming inspection at DESY**
  - Basic mechanical, electrical, RF checks + final vacuum leak check before test
  - Idea: Check for damages during transport
  - Found:
    - Assembly errors + contaminations
    - Mechanical + electrical damages
    - Few leaks

    => 54 Cv's back to vendor
  - **Incoming Inspection is mandatory**

2-Phase Line (Service Pipe) Repair Work



RF Measurement and Field Flatness Tuning using DESY-provided Tools



- Both machines ready to be used at the companies (CE certified).
- Machines can be operated by Non-RF-Experts.
- **Considerably shorter measurement / tuning time.**
- Automation and documentation guaranteed.