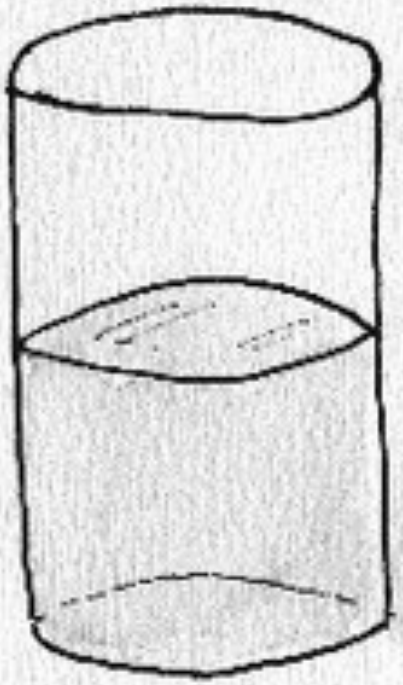
QC/QA Procedures Preparation for BPAC

F.Forti, INFN and University of Pisa

T.Higuchi, IPMU, Tokyo

Outline

- QC and QA are different things
- Review process
- QC/QA on parts
- QC/QA during assembly
- QC/QA during shipping
- Examples from Atlas and CMS



Optimist:
Glass half-full

Pessimist:
Glass half-empty

QCG

Physicist:

$$\frac{1}{\sqrt{2}}\left(\psi_{full} - \psi_{empty}\right)$$

TOM

Quality Control and Assurance are different things, although strongly linked.

- Quality control:
  - an aggregate of activities (as **design analysis** and inspection for defects) designed to **ensure adequate quality** especially in manufactured products → **Design** a process so that the products have adequate quality.
- Quality assurance:
  - a program for the systematic **monitoring** and **evaluation** of the various aspects of a project, service, or facility to ensure that standards of quality are being met → **Monitor** a process to verify that products have adequate quality.

How is quality obtained

- Quality control must be an integral part of the production process
- Quality assurance is essential to ensure that quality control is effective
- Production processes are defined, documented, tested, verified and then carried on consistently
- No change in process is allowed without proper verification

Production Readiness Review process

- The review process is formed by two steps
  - Internal site qualification review
  - BPAC SVD production readiness review
- The review must help (force) the group to
  - Design stable and reliable procedures
  - Document the procedures and the QC/QA
  - Organize the manpower and schedule
- It is not an event, it is a work method
  - The BPAC wants to see the detailed choices, but mostly wants to be reassured that we know what we are doing.

$$\frac{1}{\sqrt{2}}(\psi_{\mathrm{full}} - \psi_{\mathrm{empty}})$$

QC/QA on parts

- Parts are produced by external companies
  - Often the details of the production technique is not accessible
- But some elements are still indespensable:
  - Full, documented, technical specifications
  - The quality control plan at the company
  - An approved quality assurance and testing program
  - We cannot trust the companies statements without proper verification
- No change in process is allowed without proper verification

Are we OK on parts ?

$$\frac{1}{2}\psi_{\mathrm{empty}}$$

- Not really.
- Some of the issues:
  - Lack of proper technical specifications and sufficient detail on the quality assurance program of some key elements (HPK sensors). Hopefully not a problem.
  - Change in company for the production of PAs; not fully documented QA and testing program. This resulted in a crisis (resolved).
  - Lack of proper quality assurance and testing program for the PA0; unverified change in the production procedures. This is resulting in a crisis.
- We need to improve the method with which we produce parts
- Many parts are produced and OK

$$\frac{1}{2}\psi_{\mathrm{full}}$$

QC/QA during assembly

- Main object of the Site qualification review
- Elements (all must be properly documented)
  - Environment and equipment
  - Assembly procedures (traceable through DB)
  - Manpower
  - Schedule
- No change in process is allowed without proper verification
  - It is hard to predict what consequences even a small change can have
    - It can break things
    - It can make things difficult or impossible to use in successive steps

Are we OK on assembly ?

$$\frac{1}{2}\psi_{\mathrm{empty}}$$

- Not really.
- Some of the issues:
  - Final assembly procedures are not fully tested yet
  - Not all final jigs are produced and tested
  - A fully functional module has not been produced yet.
  - Documentation, DB tracking, procedure optimization need to be completed
- We are confident we will get there, but more work is needed
  - The qualification review will be useful to move in the right direction

$$\frac{1}{2}\psi_{\mathrm{full}}$$

QC/QA during shipping

- Not fully defined yet
- Need to work out a full plan including:
  - Shock protection
  - Conservation of mechanical accuracy
  - Vibration protection
  - Humidity and temperature variations protection
- So far mostly worried about the transport jigs, but not about the containers and protective equipment
- Potential for damage is high, possible consequences can be severe.

ATLAS IBL Wirebond corrosion

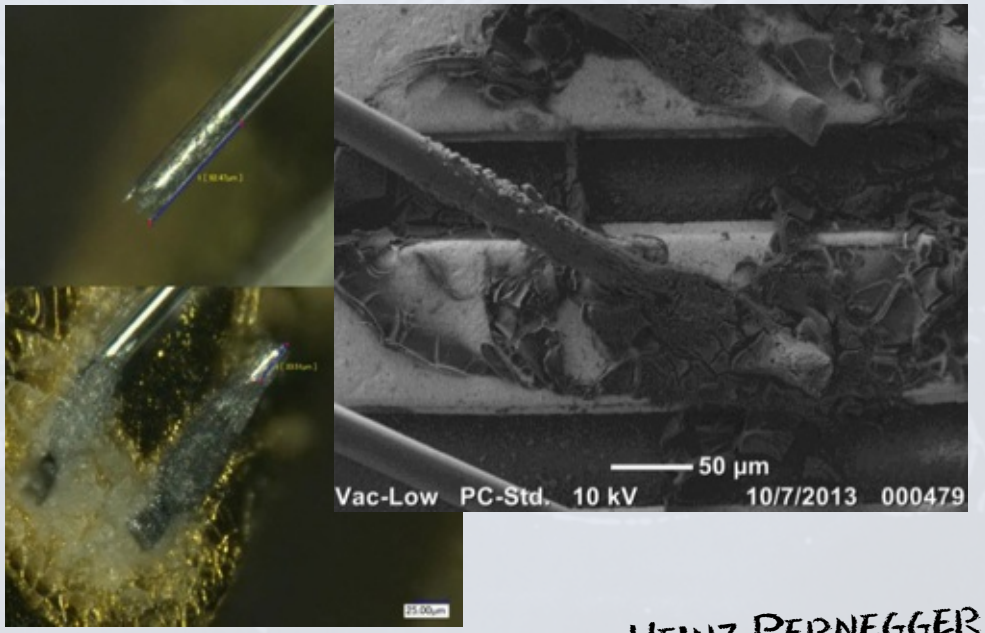
- Mid-way during production discovered corrosion of wire bonds
  - 2 staves exposed to accidental severe condensation during a test
  - Observed corroded wire bonds, detailed inspection of all staves
  - Reworked of all staves which were produced so-far (replace corroded wires and clean affected areas)

The corrosion can be reproduced even on bare cleaned flex with the drop of DI water
Flex for different vendors tested – many show similar issues
EDS/XPS/FBI analysis showed:

- Halogen (Cl or F) associated with the corrosion product (residue)
- No surface halogen contamination measured on cleaned samples

One over two techniques showed significant Fluorine into the gold layer (7nm)
Where the Cl and F could come from?
Surface migration, cover layer, gold metallisation?

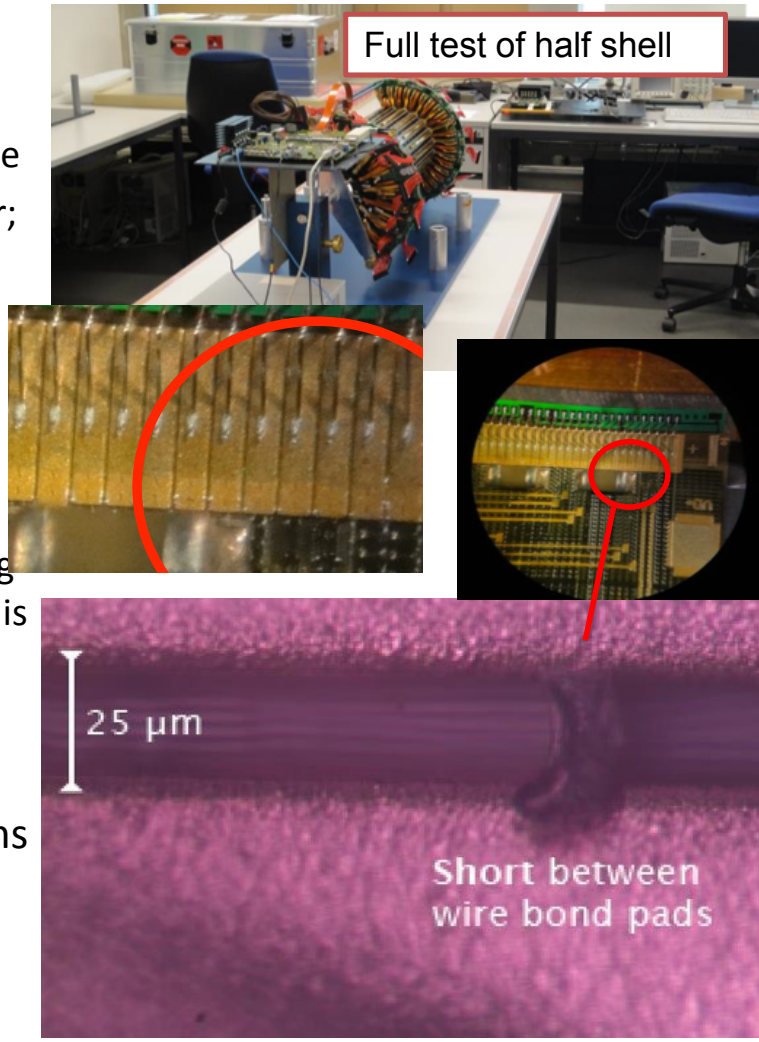
- Must avoid condensation at all cost!



HEINZ PERNEGGER

CMS Pixels Dendrites

- Discovery:
  - ~25% (47/192) of BPIX modules in one half-shell were found unresponsive at final checkout, 2 weeks before insertion date
  - The half-shell was transported to PSI for diagnosis and repair; the other three have been re-checked and are working fine
- The problem:
  - Ohmic shorts between wire-bond pads on the High Density Interconnect (HDI). Most of the shorts look like “dendrites”
- Repair:
  - The shorts can be removed in a controlled way thus repairing the module - “scratching”. Also, production of new modules is underway, allowing to completely replace modules with multiple shorts. **Layers 1 and 2 repairs are almost finished**
- Prevention:
  - Chemical analysis is underway; investigating conditions that create the shorts, and longevity of repair
- A plan has been developed to advance other tasks and install the pixel detector in December/January. **No significant change to overall CMS schedule.**



Conclusion and outlook

- SVD is nearing the stage of being ready to start production
- Significant progress at all sites, but additional work is needed to fully satisfy all requirements
- Recent crisis on QA of PA0 indicates our procedures need to be improved
  - Try to minimize schedule impact
- Underline to the BPAC the process and the method (ψ_{full}) rather than the final procedure that still require work (ψ_{empty})