The Barco Design Cycle

Sep. 16 2010

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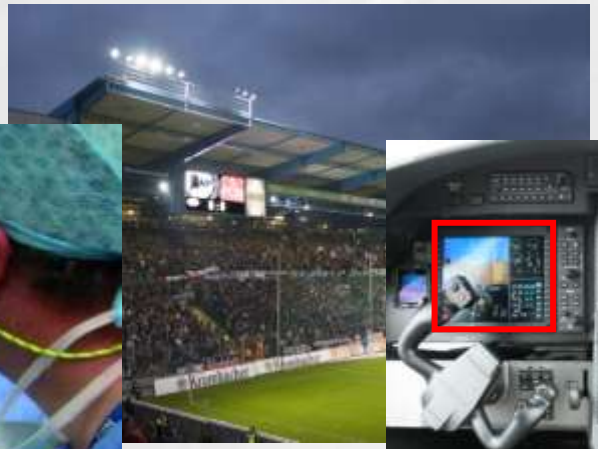
Agenda

- Environment of PBA’s for Barco Products
- Walk through the Design Process of Barco
- Practical Examples

PBA & Environment Overview

Environment :

Office	– controlled and known
Battleground	– severe and known
Hospital	– controlled and known
Outdoor	– severe and **unknown**
Airborn	– severe and known
…	



General Requirement :

High Reliability @ lowest Cost

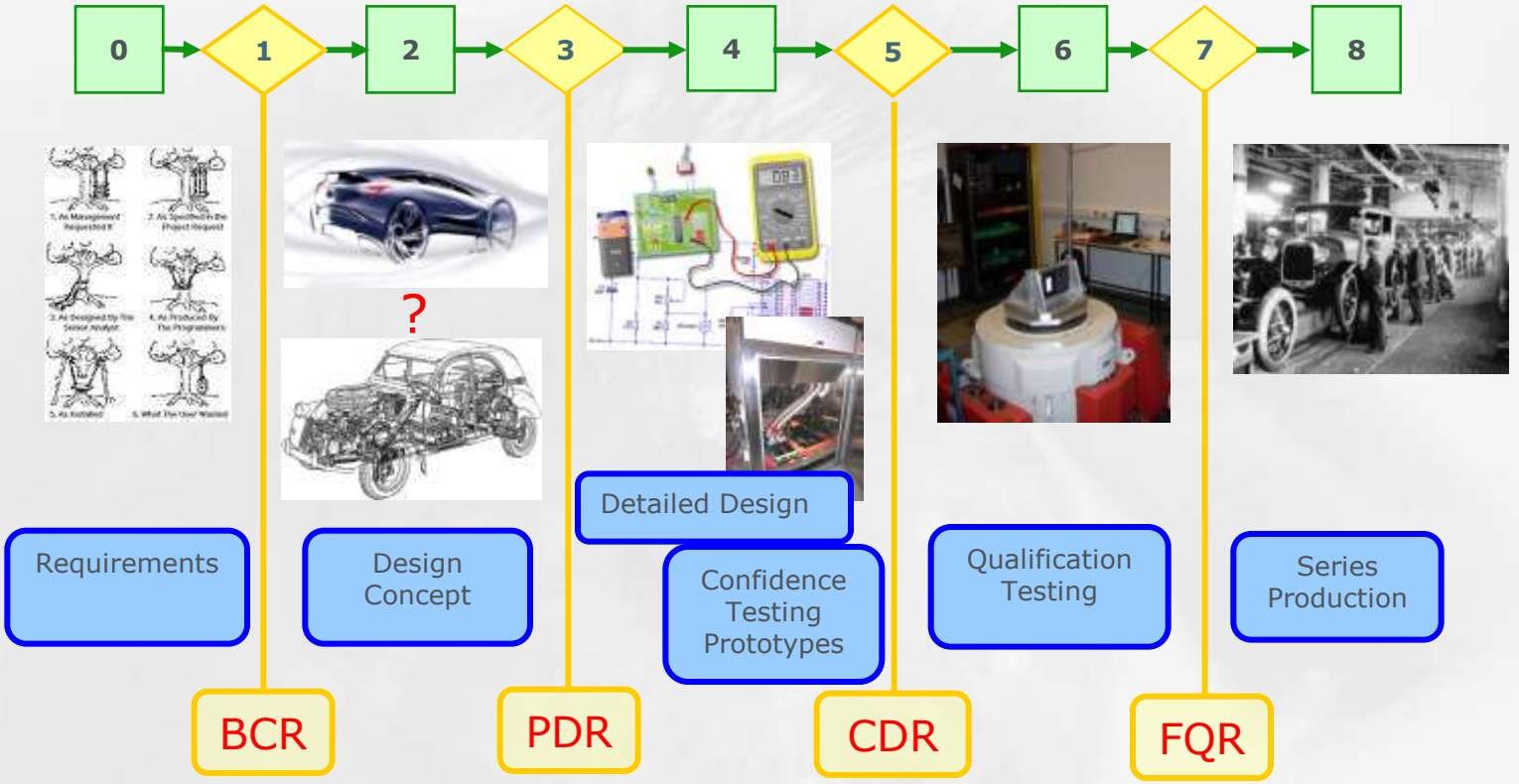
First Time Right

PBA &
Environment Overview

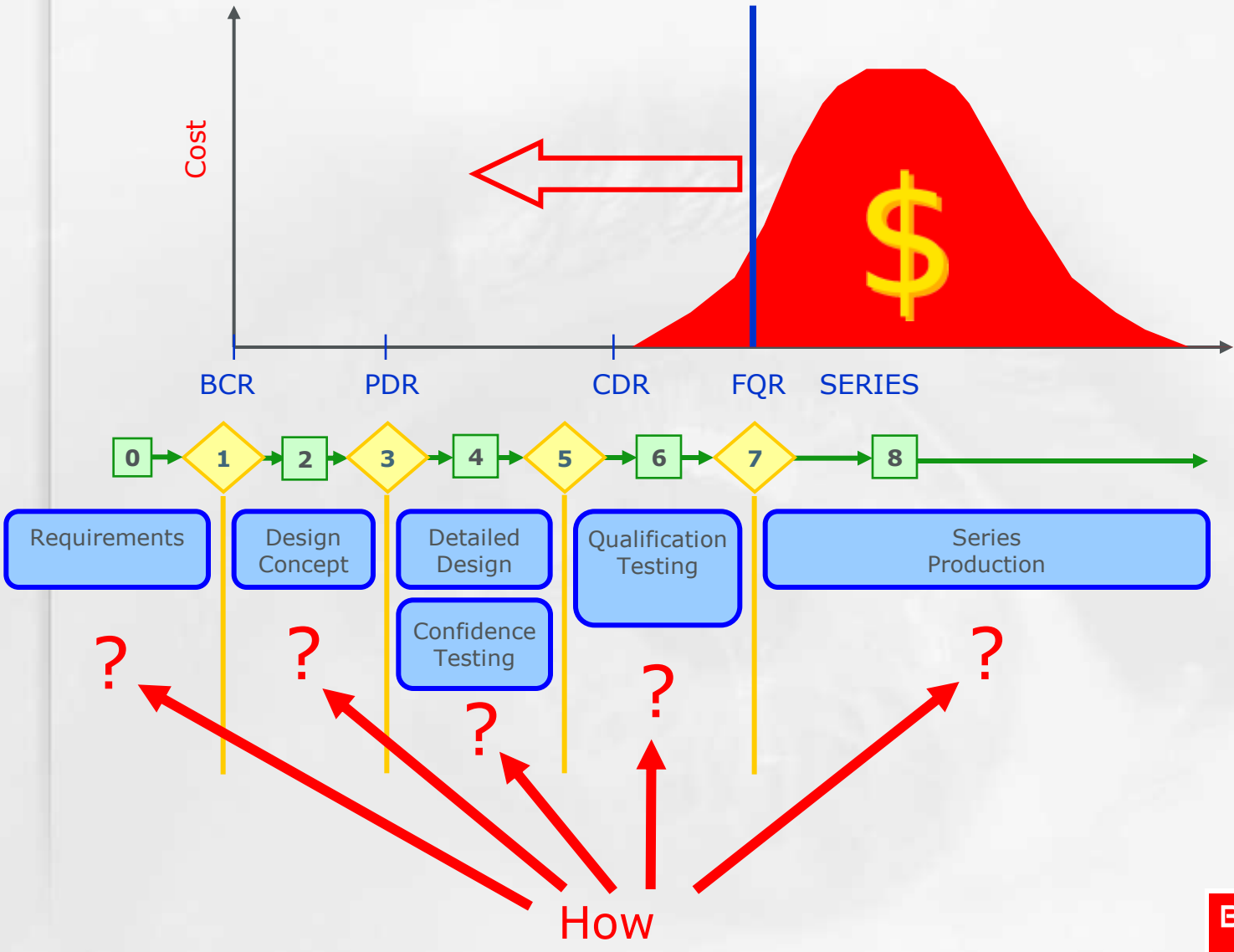
Environment :

EMC	Radiated, Conducted - Emission, Susceptibility,...
Mechanical	Vibration, Shock, ...
Climatic	Temp, Vibration, Hum, Solar, Salt,...
Product Safety	CEBEC, KEMA, UL, ETL,...
Green	RoHS, WEEE, Eco Design, ...

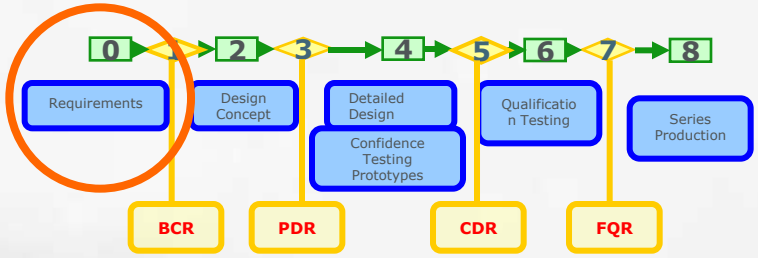
Base Process (Product Life Cycle, PLC)



Base Process



Requirements



Requirements @ Product level

- Able to sell in different countries
- Reliable product (MTBF 40.000h)
- Outdoor Product
- ...

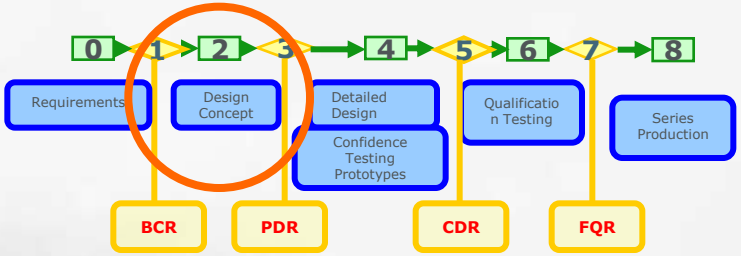
Specifications @ Product level

- min. & max. ambient temperature
  - DC (+10°C ... +35°C)
  - DEF (-40°C ... +71°C)
- user profile
  - number of on/off cycles a day
- Vibration, Shock, Dust, ...
- Humidity, Salt mist, ...
- Green (RoHS,...)
- EMC, Product Safety
- ...

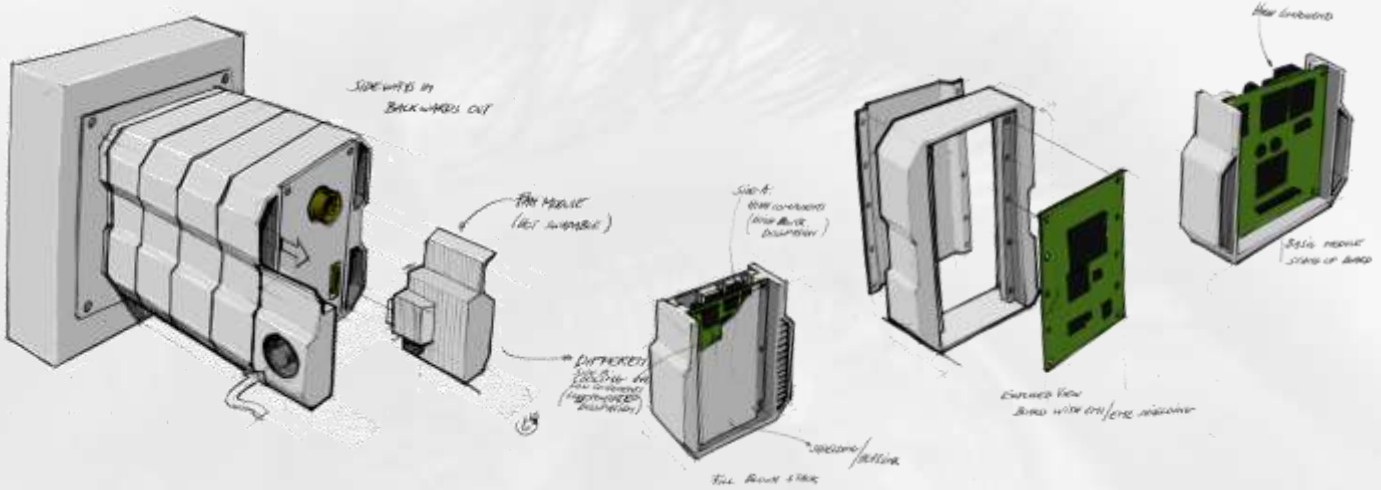
Specifications @ PBA level

- min. & max. ambient temperature
  - DC (+10°C ... +50°C)
- user profile
  - number of on/off cycles a day
- Humidity, Salt mist, ...
- Mechanical Fixation
- Green (RoHS,...)
- ...

Design Concept

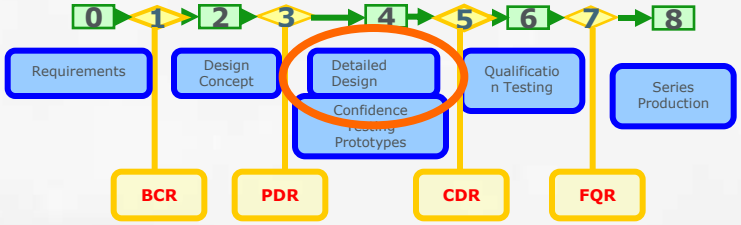


- Concept Review



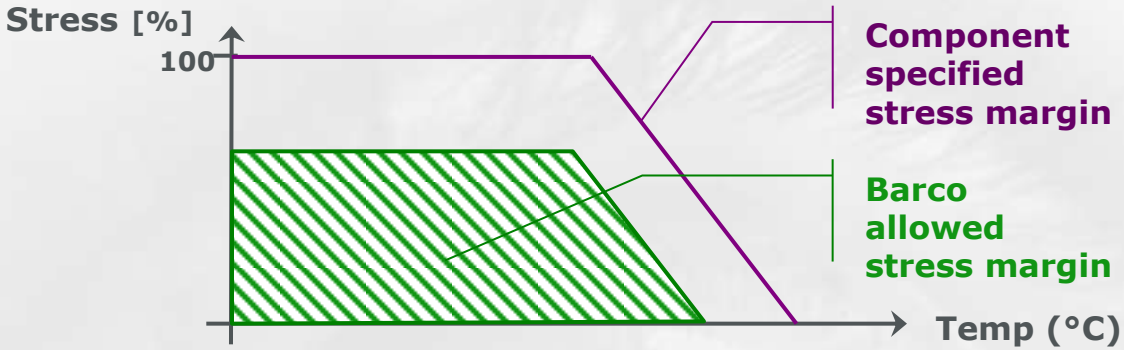
- High level Thermal Simulation
- Cost estimation
- Planning estimation

Detailed Design



- **Reduce stress of components**

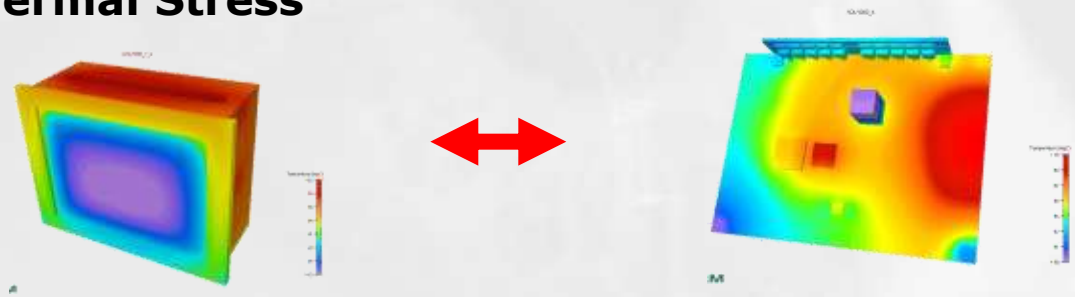
1. Voltage, Current and Power Stress



Tools : Barco Derating Rules

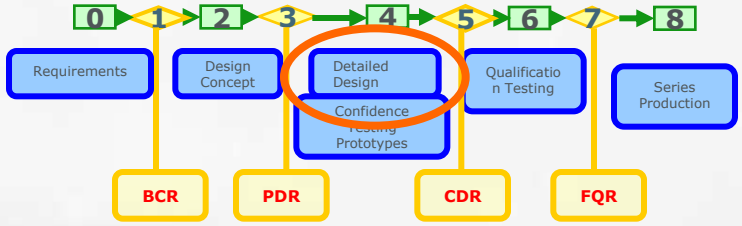
Electronic Simulation

2. Thermal Stress



Tool : High Level Thermal simulations

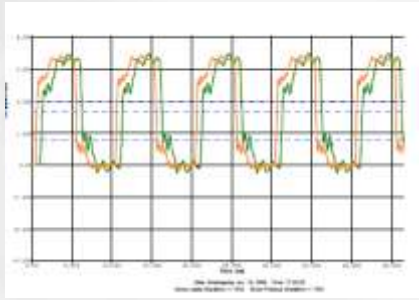
Detailed Design



One component is neglected… PCB itself

How to measure the PCB design quality

- PCB laminate selection ***-> guidance needed***
- Via Cracking (on/off cycles) ***-> tool needed***
- Delamination ***-> tool needed***
- Signal Integrity -> tool available
- Power Integrity ***-> tool needed***
  - Current carying capability
  - Max Voltage



- Layout "Design Rules" need commonly accepted design rules ***-> guidance needed***

At PBA level

BOM ***-> guidance & tool needed***

Vibration & Shock behaviour ***-> tool needed***

- Number & location of fixation points
- Where to put components

Green (RoHS) ->tool available

Prototype Phase

- Manufacturability Review

Address manufacturability issues during design

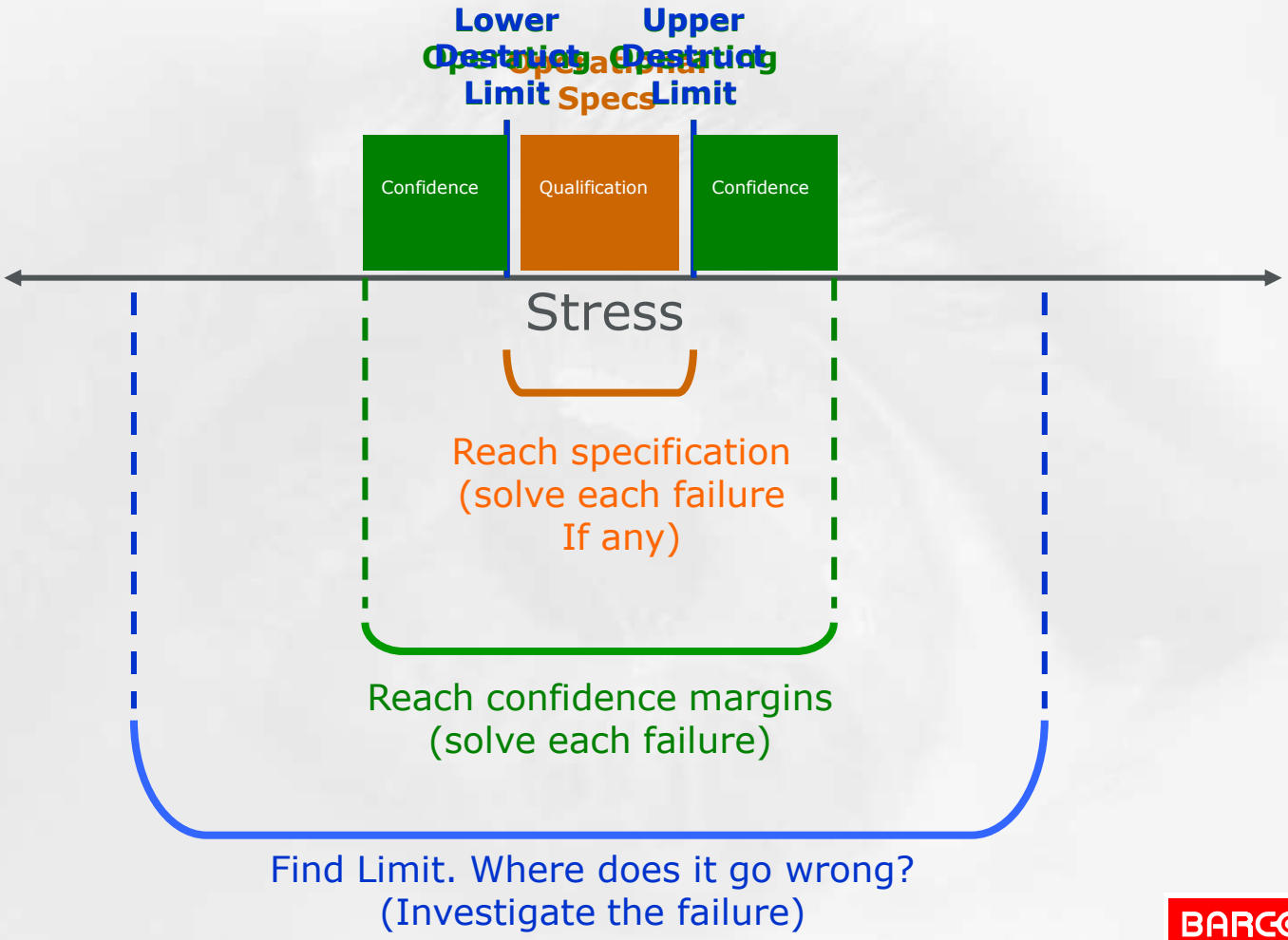
Confidence testing

- Confidence testing has following goals:

1. **Verification of previous design stage (detailed design)**
   - Technical Risk List is strongly reduced
2. **Early detection of weaknesses in the design and increase Robustness for:**
   - Operational usage (functional properties)
   - Environmental usage
   - Component variation
3. **Have a smooth (one-time pass) qualification flow**

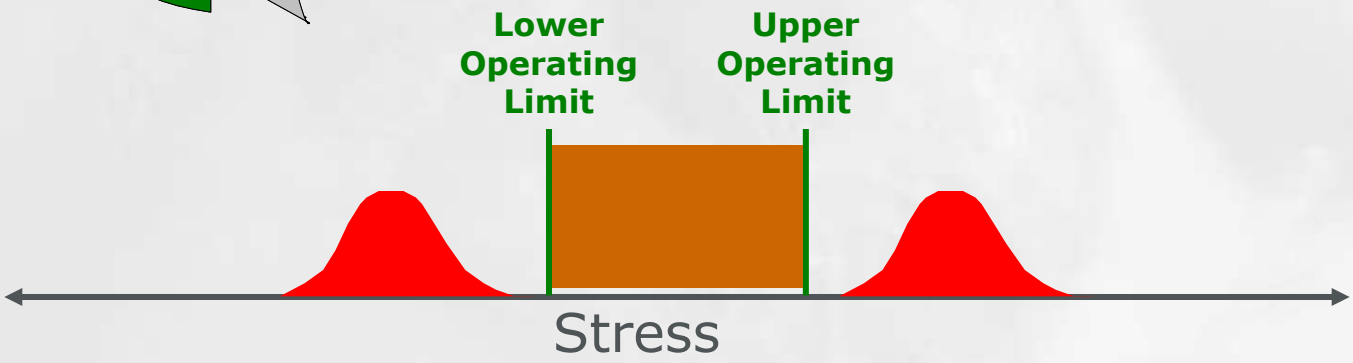
Confidence testing increases design robustness

Confidence testing



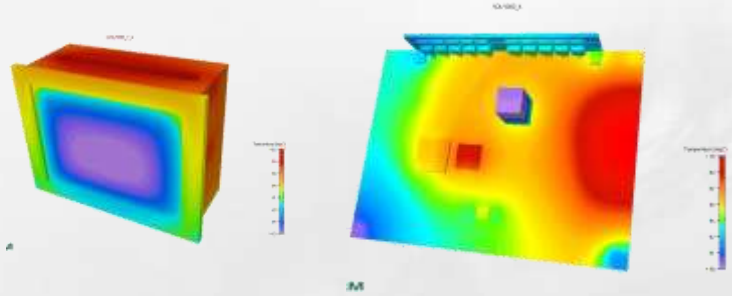
Confidence testing

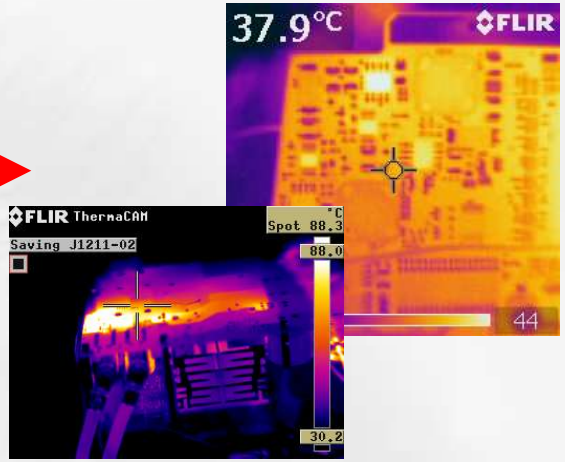
- Increase Design Margin



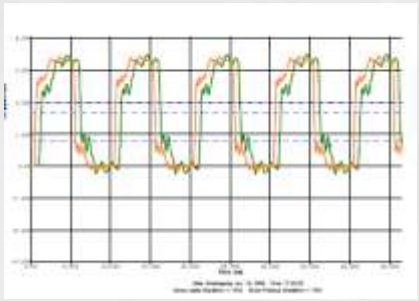
Confidence testing

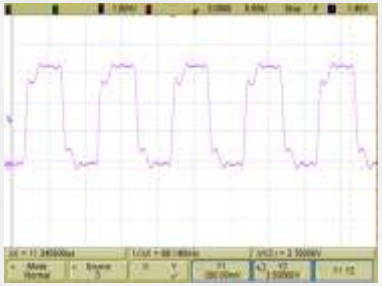
Thermal Design Verification





Signal Integrity Verification



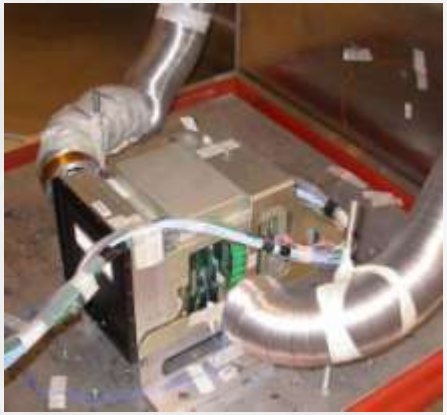


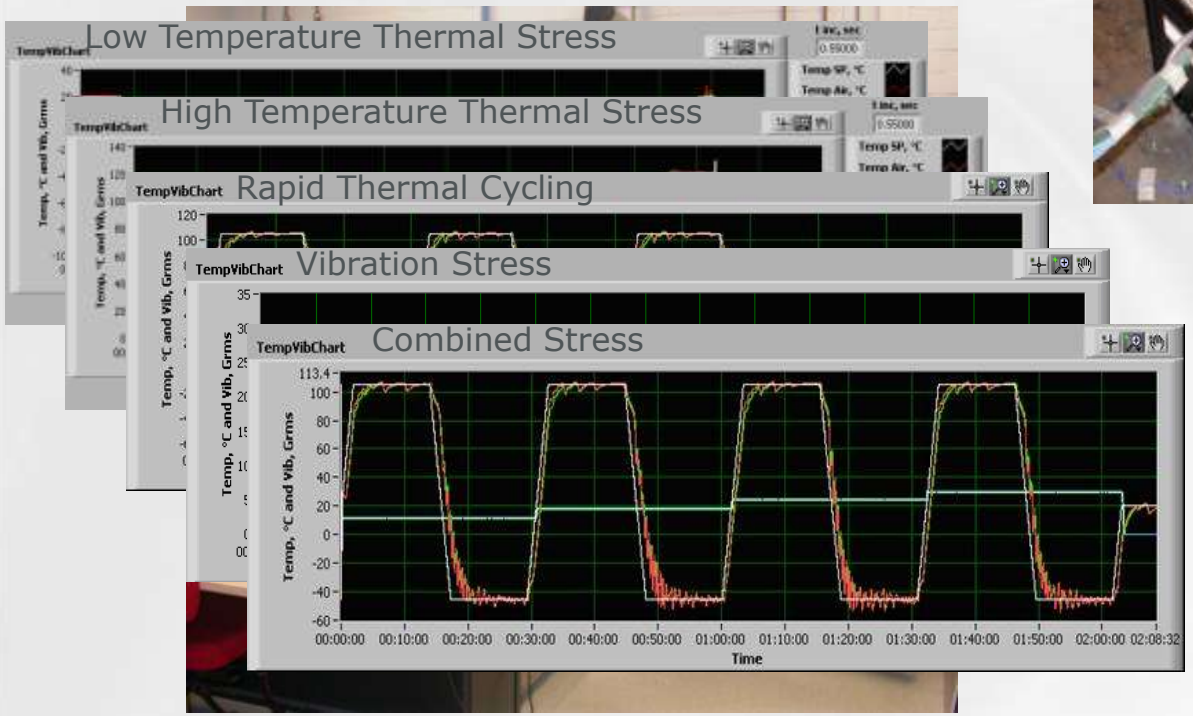
validate Early simulations & design assumptions

BARCO
Visibly yours

Confidence testing

- HALT (High Accelerated Life Test)
  - Find weakest points (temperature & vibration)
  - Find Operational and destructive limits (temperature & vibration)





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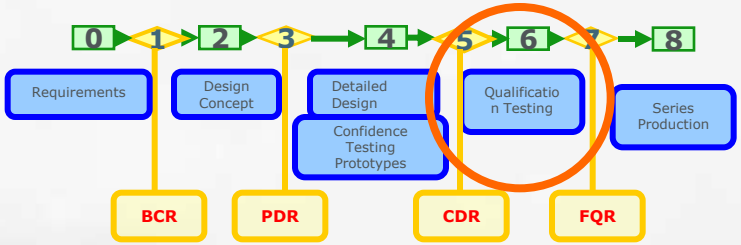
Qualification testing



- Qualification testing

  First implement lessons learned from previous confidence tests and analyses before CDR

Qualification should be a walk in the park!

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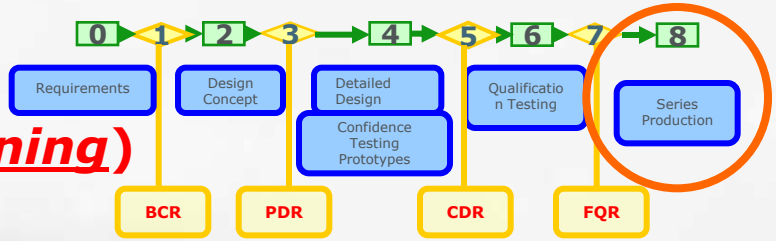
Production (*Environmental Stress Screening*)



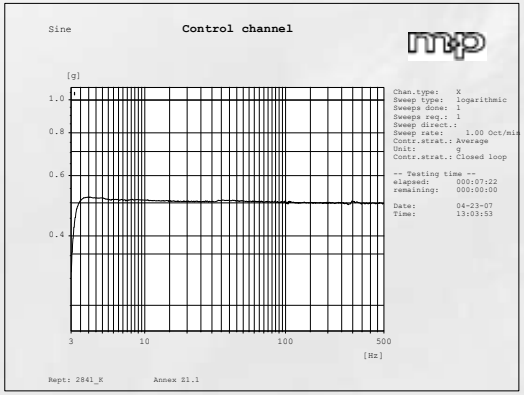
ESS is a way to split the good from the "weak" ones

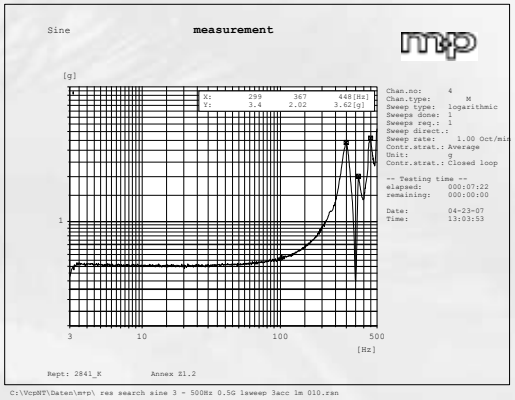
- **Current ESS method:**
  - Temperature stress …"Burn-in"
  - Vibration stress
- **Other method :**
  - Highly Accelerated Stress Screening (HASS)

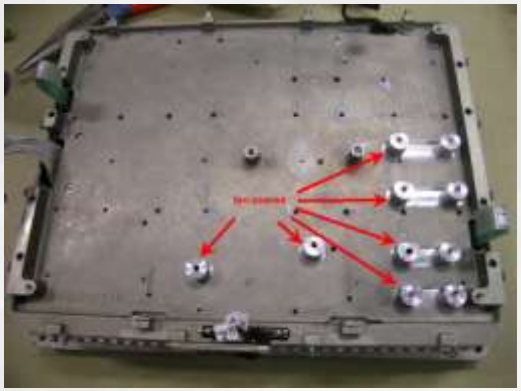
Practical examples (1)

1. Mechanical fixation of PBA

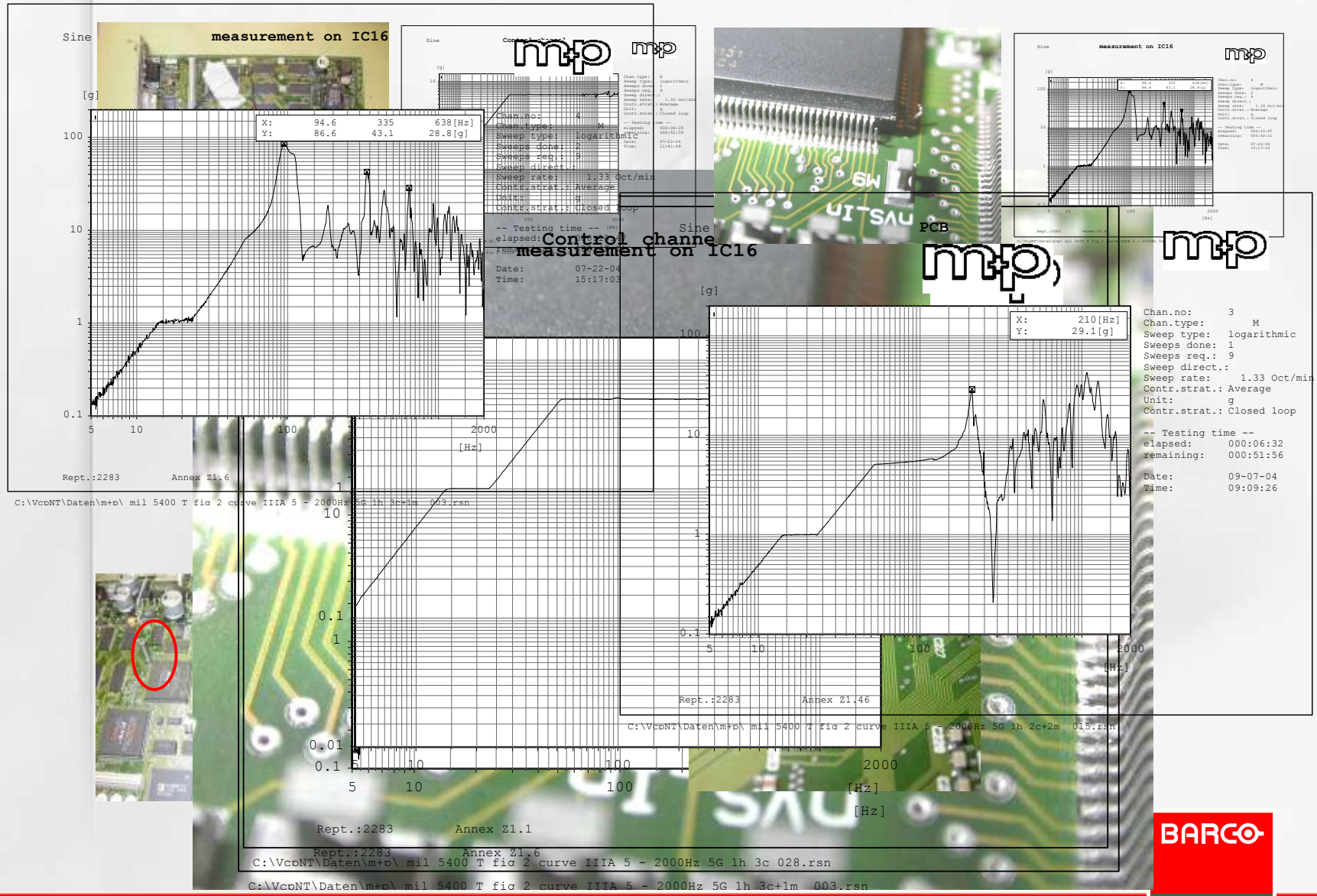
- **Solder joint failure in HALT testing**







Practical examples (2)



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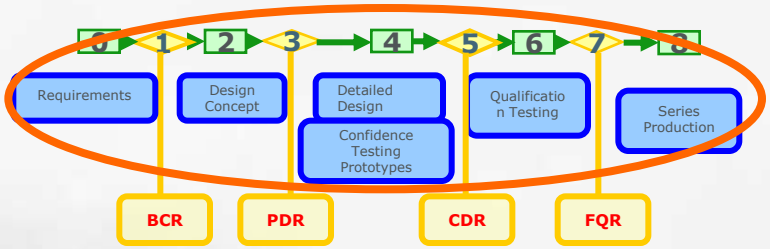
Overall Design Process



- Quality / Reliability

  - **has to be build-in**
  - **Is <u>not</u> "something" you add afterwards**
    - Proper Component selection
    - PCB design
      - How to get an idea of the PCB design quality
        - » Via Cracking ***<u>-> tool needed</u>***
        - » Signal Integrity -> tool available
        - » Power Intergrity ***<u>-> tool needed</u>***
          Current carying capability
          Max Voltage
        - » Vibration & Shock behaviour ***<u>-> tool needed</u>***
          Number & location of fixation points
          Where to put components
      - Need commonly accepted Layout Design Rules
      - Purchase can order independent
    - PBA design
      - Interaction PCB <–> Components
      - Environment
  - **Designing a high level qualitative PBA isIs a multi-disciplinary exercise**
    - Helicopter view is very important
    - Based on knowledge, scientific bacakground

Conclusion

- **Designing a high level qualitative and reliable PBA is a multi-disciplinary exercise**
  - Helicopter view is very important
  - Based on knowledge, scientific background is needed

  GOAL: come to common design rules that are easily applicable

  EDM is a big help

END of presentation