BINDT Workshop – 27th Feb 2018

NDT Requirements for High Performance Yachts

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The America’s Cup

- The world’s oldest international sporting trophy and the pinnacle of sailing technology
- The America’s Cup was first offered as the Hundred Pound Cup in 1851 for a race around the Isle of Wight
- The Cup was won by the schooner ‘America’ from New York - who beat a fleet of British boats around the Island and it subsequently became known as the America’s Cup
- American teams representing the New York Yacht Club successfully defended all challenges for 132 years - the longest winning streak in sport - until an Australian team won in 1983
- The Cup has been held in eight global locations - Cowes, New York / Newport, Fremantle, San Diego, Auckland, Valencia, San Francisco, Bermuda
- Emirates Team NZ are the current holders of the America’s Cup
AC35 Class

- 50 foot foiling catamaran with “wing sail”
- Overall dimensions specified in class rule
- Technical freedom – hydrofoil design, control systems, wing structure, aerodynamics
- “Flying surfaces” will be hydraulically actuated with power from 4 sailors
- Capable of speeds up to 85 km/h
- No fly by wire, the helmsman is constantly in the control loop
- All the power generation must be human
AC35 Technical Team

50 Technical Staff including

- Designers and Naval Architects
- Performance Prediction and Data Analytics
- Fluid Dynamists and CFD Engineers
- Structural and Composite Engineers
- Mechanical, Hydraulic and Electrical Design
The Challenge

- A ‘Moon Shot’. We have one chance to get it right!
- This is a “technical race”
- Leading edge advanced technology
- Tremendous time pressures
- Limited opportunity to physically test
- Regulation constraints
- Safety critical
The Challenge

- A large variety of prototype composite parts
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- from sandwich 50gsm plies over 28kg/m3 Nomex
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  - to 70mm solid carbon foils
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  - to 70mm solid carbon foils
  - via cored and solid composite assemblies
Structures – the simulated world
Structures – the real world
Structures – the real world
NDT use in the America’s Cup world

- **Design Phase**
  - Characterize designed defect sizes
  - Calibration of NDT equipment reading at coupon level
  - Setting acceptance criterias

- **Manufacturing Phase**
  - Manufacturing process sign off
  - Measurement of defects for further FEA analysis
  - Support during the proof loading/acceptance structural testing

- **Service Phase**
  - Health monitoring of structural components
  - Assessments of damage areas
  - Sign off of repairs
NDT toolbox

• **Ultrasonic equipment**
  • A-scan and phase array scan
  • Primary NDT tool for spotting defects requiring further analysis
  • Referenced phase array scan created for service phase monitoring

• **AE equipment**
  • Use as support during the proof loading/acceptance structural testing

• **Thermography**
  • Part of the tool box for final acceptance at the end of the manufacturing phase

• **Tomography**
  • Part of the tool box for final acceptance at the end of the manufacturing phase
  • Results used as support for UT A-scan
NDT toolbox – defect characterization
Structural testing

• **Coupon level**
  • Characterize materials
  • Material properties/allowables
  • Quality checks
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• **Substructure level**
  • Manufacturing/processing methods
  • Analysis correlation
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  - Instrumentation calibration
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  - Performance correlation
  - Instrumentation calibration
- **Assembly level**
  - Proof loading
  - Systems testing
What's Next - AC36

- 2021, New Zealand
- 75 foot foiling Monohull
- More restrictions on physical testing - Further emphasis on simulation
LRBAR NDT collaborator

• Pierrepont Analysis Ltd (UK)

• Vetorix Engineering (IT)

• Pancom Ltd (UK)
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