

NDT standards and best practice guides

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Overview

- Focus on composite blades
- Initial literature review of DNV & GL WTB guidelines conducted for BINDT composites group in 2015
 - Documents searched for NDT/inspection
 - Updated list compiled
- Practical examples where NDT specifications and guidance would have helped
- Requirements guidelines, best practice

High level documentation

- Plenty of documents out there
 - Many standards mentioned at this workshop
- Role of inspection/NDT largely clear within those standards
- But
 - Level of detail does not cover specific applications methods, techniques, approaches










Updated documents

- Search “Renewables Certification” on DNVGL website
 - <https://www.dnvgl.com>

Renewables Certification Guidelines and Technical Notes

DNV GL developed guidelines and technical notes for the certification of wind turbines, wind farms and other renewables.

Key documents

-  DNVGL-SE-0073 Project certification of wind farms according to IEC 61400-22
-  DNVGL-SE-0074 Type and component certification of wind turbines according to IEC 61400-22
-  DNVGL-SE-0190 Project certification of wind power plants
-  DNVGL-SE-0263 Certification of lifetime extension of wind turbines
-  DNVGL-SE-0436 Shop approval in renewable energy
-  DNVGL-SE-0439 Certification of condition monitoring
-  DNVGL-SE-0441 Type and component certification of wind turbines
-  DNVGL-ST-0262 Lifetime extension of wind turbines
-  DNVGL-ST-0376 Rotor blades for wind turbines




- All are updated documents from original 2015 searches
- Keyword search:
 - NDT, inspection, surveillance

Notes on NDT in guidelines

- Inspection and surveillance used interchangeably sometimes inferring NDT as the technique
- NDT often mentioned in connection with welding
 - Not surprising as many standards exist that deal with weld inspection
 - Very few (arguably none) exist for composite inspection
- Implied use of NDT to support life extension
- Comprehensive guideline covering CMS but not NDT

IEC 61400:22 standard withdrawn

- Function moved to IECRE
- <http://www.iecre.org/documents/refdocs/>

-  od-551-14ed.1.0 Blades testing assessment – 2016 type certification
-  od-502ed.1.0 Project Certification Scheme
-  od-501-1ed.1.0 Conformity assessment and certification of Blade by RECB

- Opportunity here for specific NDT guidance operational documents ?

IEC 61400-23

61400-23 Full-scale structural testing of rotor blades.pdf

NDT mentioned in connection with testing blade is manufactured to required specs e.g.

“Non-destructive testing (NDT) techniques can, in some cases, be used to check that the blade is built in accordance with the design assumptions and to find manufacturing defects. NDT can be performed in connection with other tests. Some of the methods used are:

- measurements checking the geometry of the blade (e.g. dimensions, profile, etc.);*
- coin-tap;*
- acoustic transmission;*
- ultrasonic testing;*
- acoustic emission [9];*
- thermal imaging [10].”*

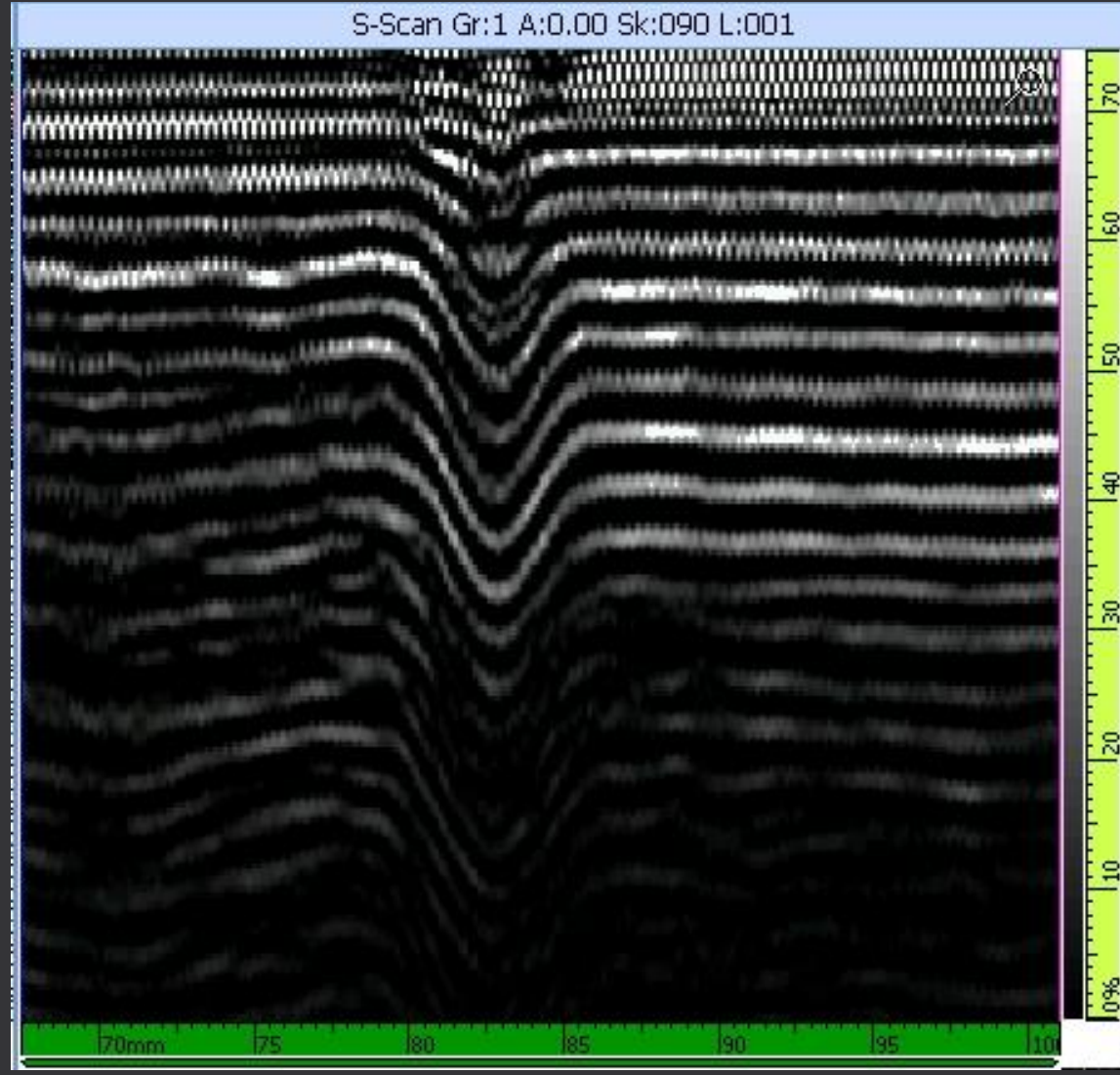
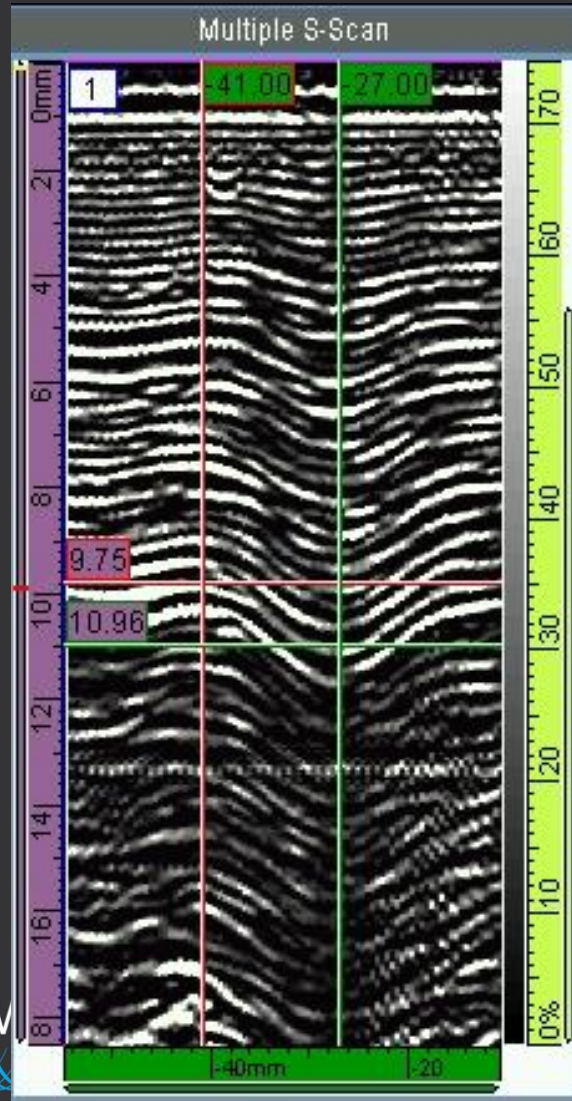
NDT examples where guidance would help

- These examples are ultrasonic EVALUATION techniques
- SHM and CMS methods are required to ensure that specific NDT techniques can be targeted
 - This is the NDT challenge !?
- Applying NDT alone is expensive, intensive, time consuming
 - Particularly when applied in-service

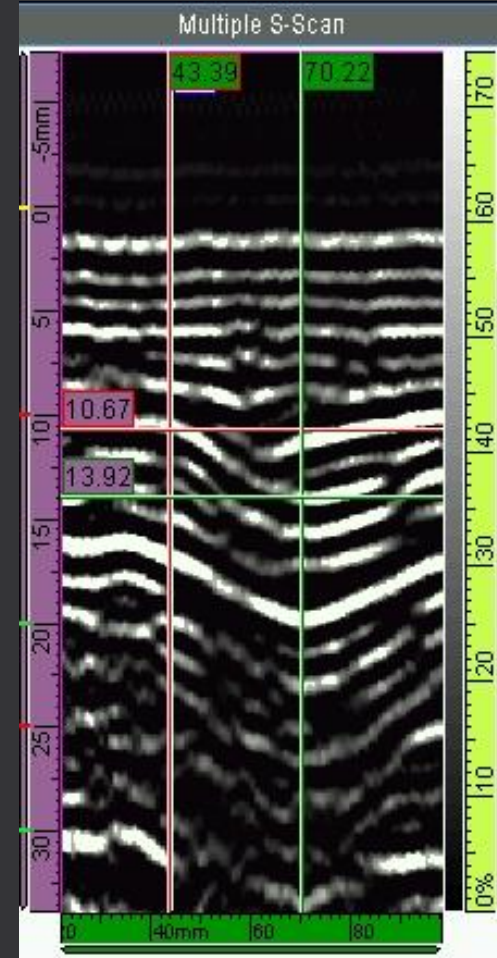
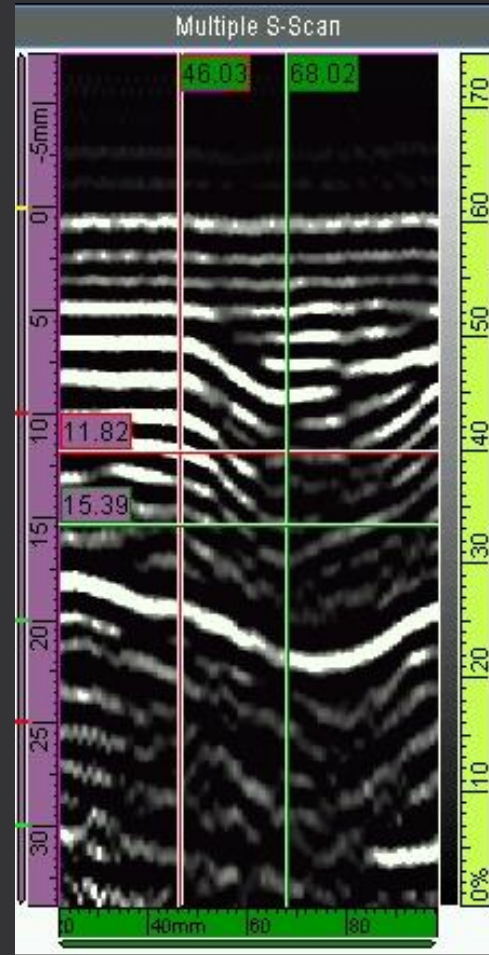
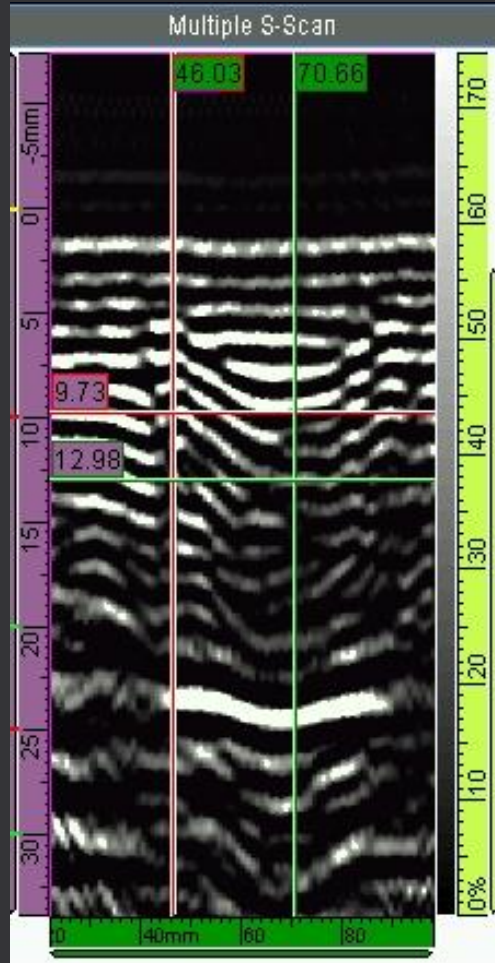
Case study 1 – wrinkles

- NDT requested by blade manufacturer
- Clear-ish specification on wrinkles 😊
 - Limited modelling/design/mechanical data to guide 😞
- Full access to manufacturer L3 😊
- Full access to NDT procedures 😊
 - But no existing techniques relating to wrinkles 😞
- Aerospace phased array qualification approach followed
 - Low severity measurement possible 😊
 - Material variation a problem on this product 😞
 - But not on test coupons 😊?
 - High severity wrinkles a problem cannot measure but can detect 😊😞

Phased array image (Aero)

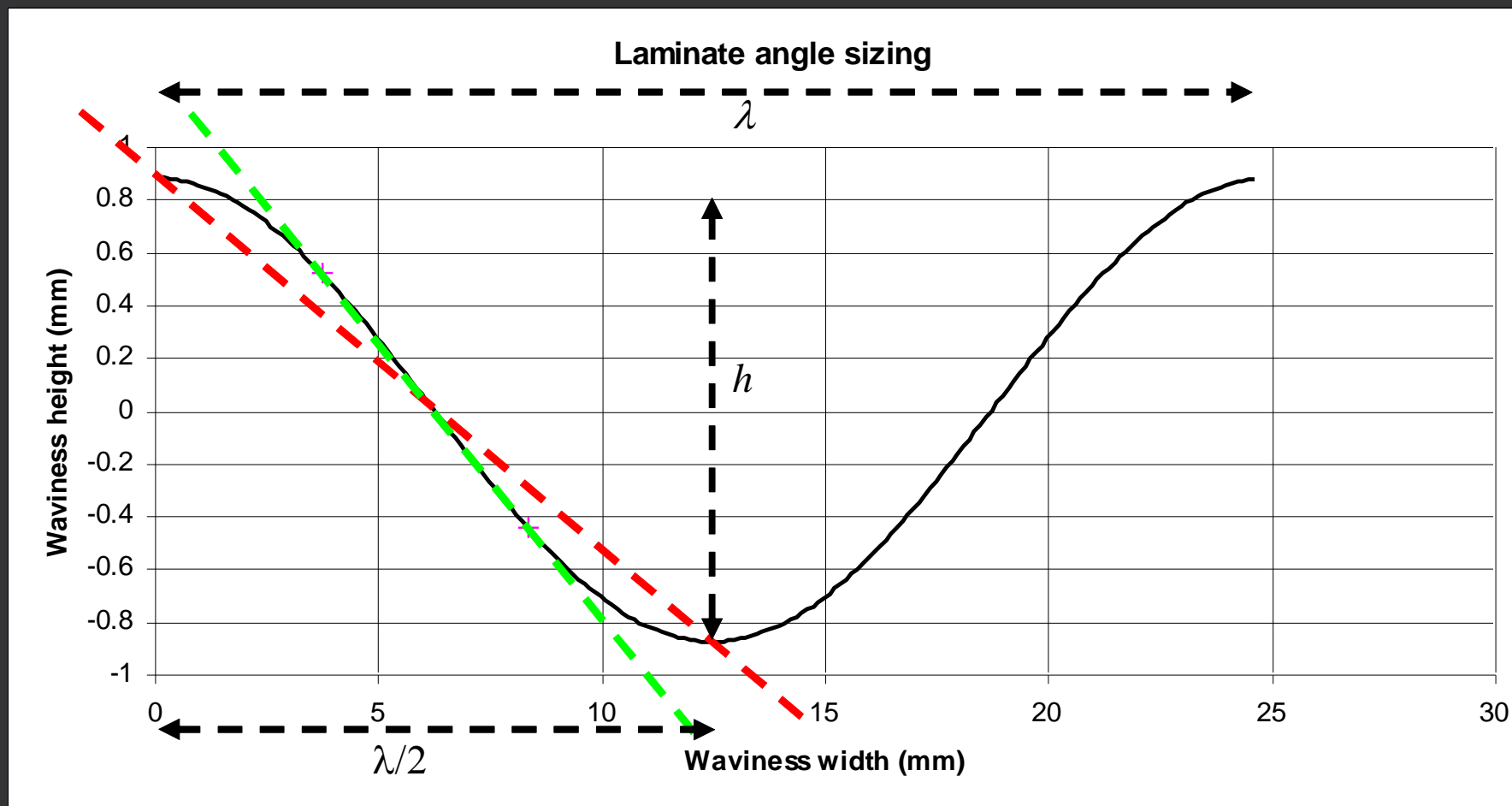


Phased array image (WTB)

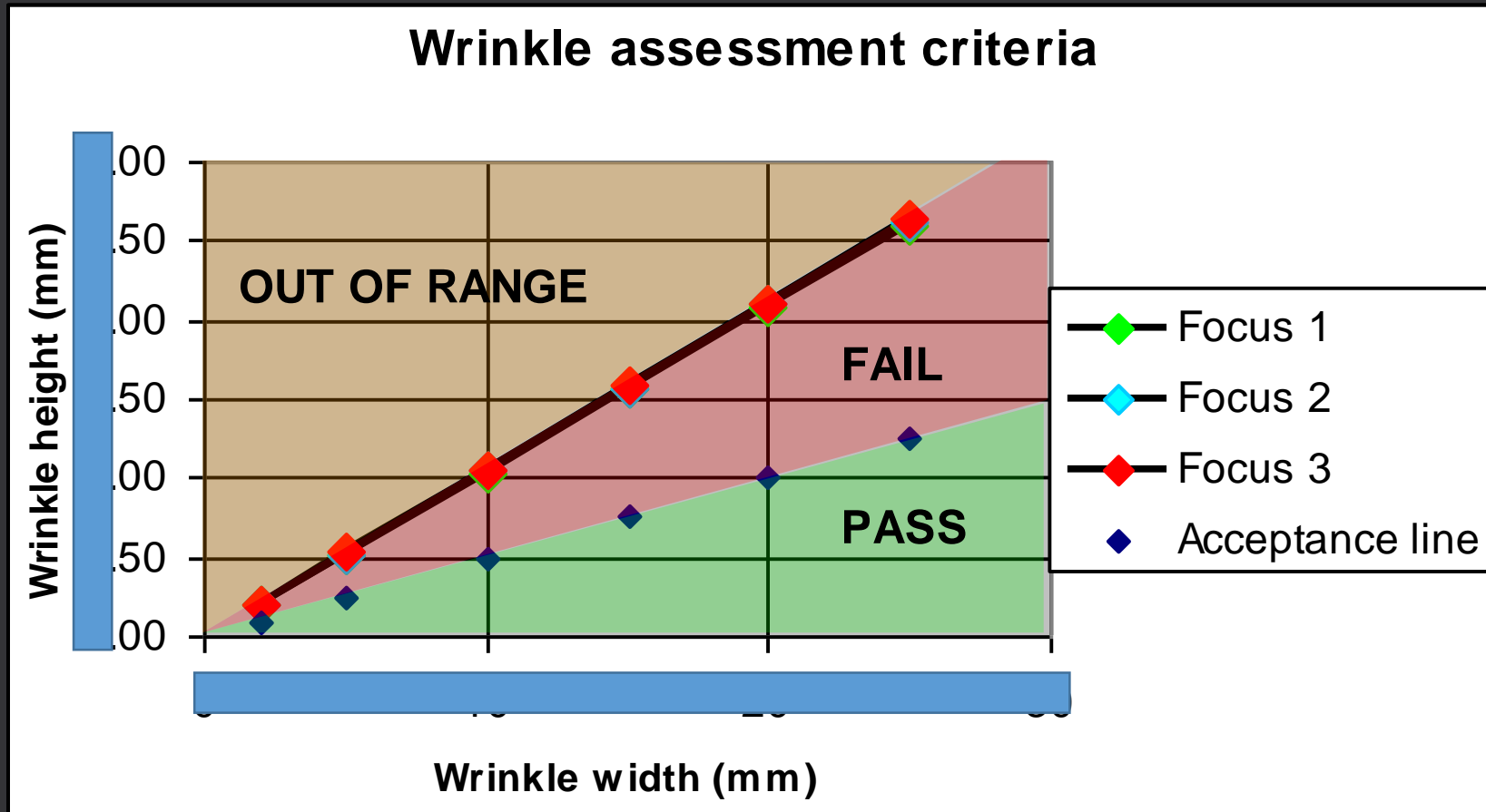


Workshop on NDT and SHM
requirements for wind turbines
Blyth Feb 2019

Waviness description



Acceptance criteria



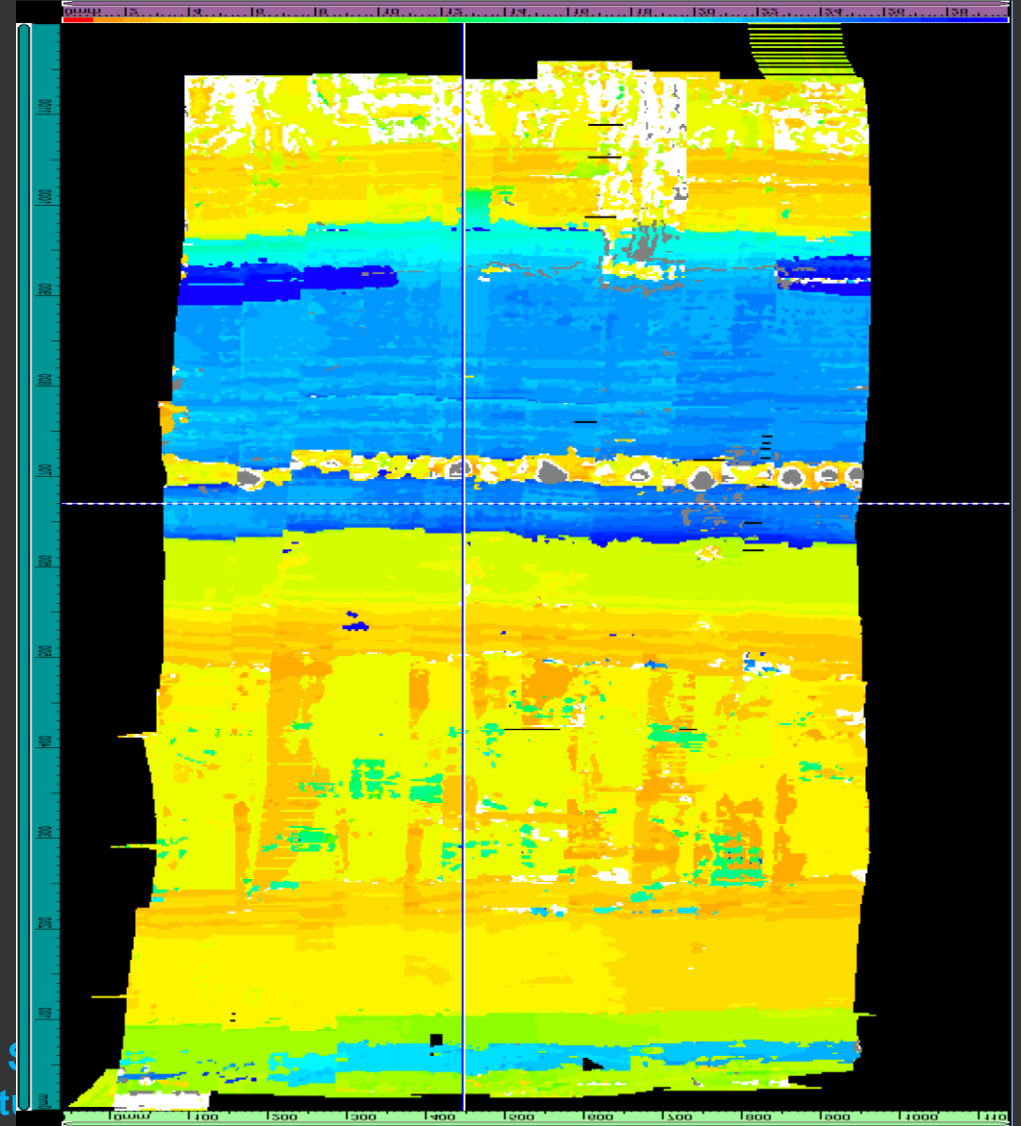
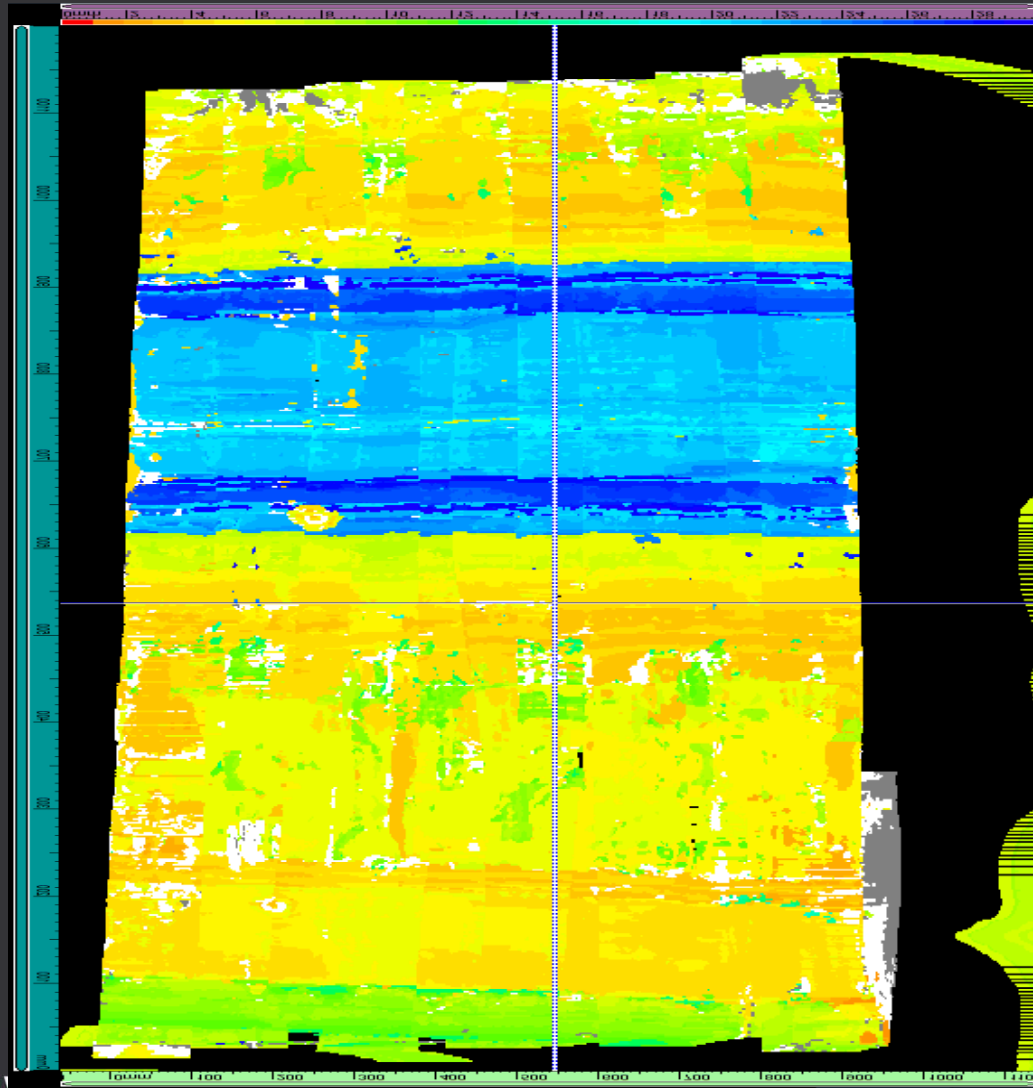
Case study 2 – bonding

- NDT requested by wind farm operator
- No access to blade drawings 😞
- No access to NDT procedure used to manufacture blade 😞
- No specific guidelines on qualifying techniques 😞
- Some information on defect acceptance criteria 😊
- Good access to failed blades 😊
- Willingness to validate inspections 😊

Visual inspection: Root section (R16)

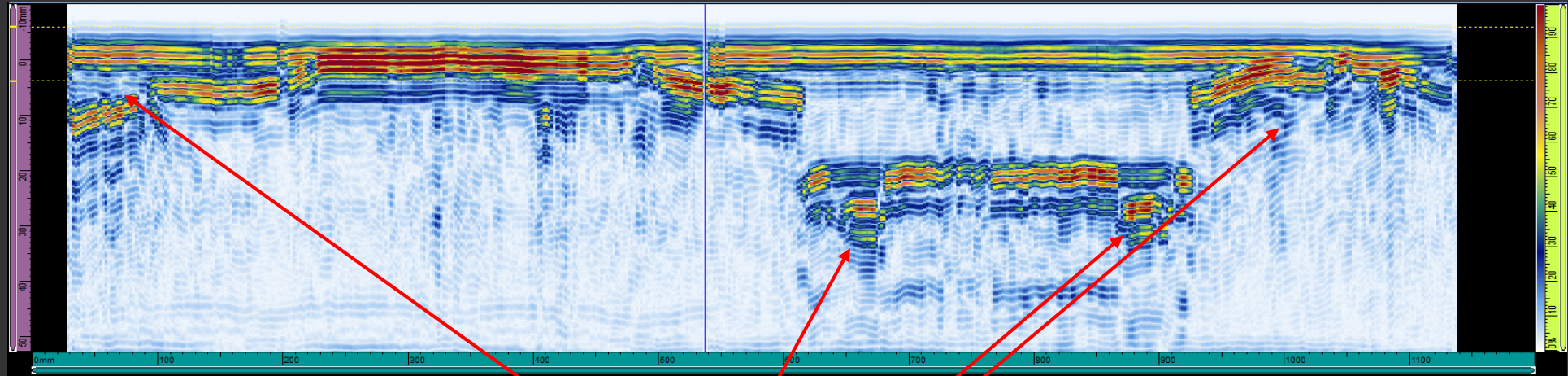


Large area C-scan result



Localised PA B-scan result

Root section (R16) pressure side: Cross-section view

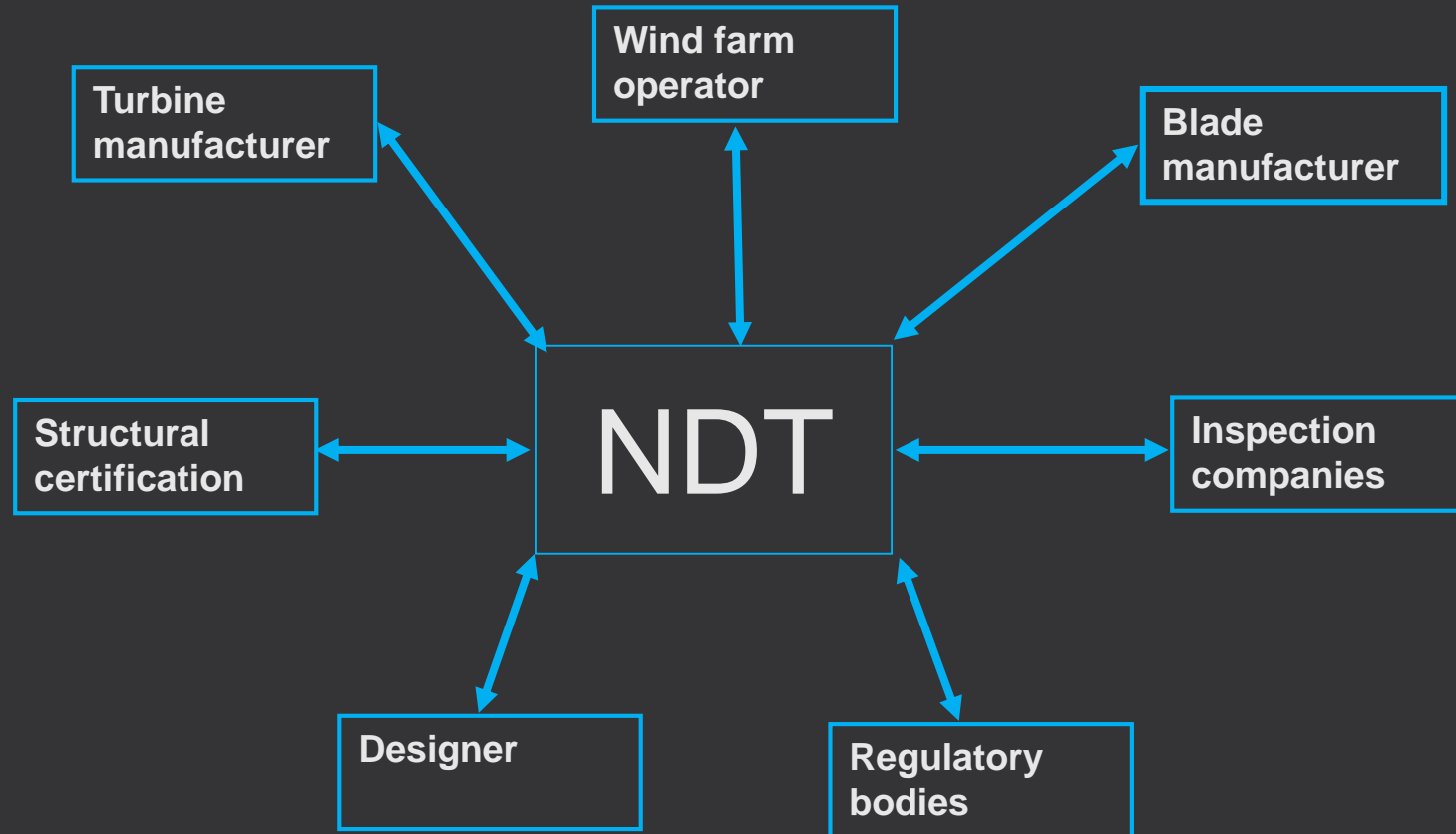


- Trailing edge laminate
- Trailing edge web bonding
- Leading edge web bonding
- Leading edge laminate

Testing at 65 m



We should talk more often !!



What is needed?

- Studies on combining SHM/CMS (detection/screening) and NDT (evaluation/measurement)
- Specific guidance on
 - NDT Technique development
 - Effect of defect studies (aid acceptance criteria reporting)
 - Qualification of inspection methods
 - Validation on structures
- Better linking/data exchange between
 - Manufacturer (production – stress/design)
 - Operators
 - NDT providers