Synergistic Partnership of Standards and Design Process: But What’s Next

2015 Wind Energy Systems Engineering Workshop

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Standards History: Defining the Path to Turbine Reliability

- **The 1980's**
  - Altamont Pass, CA Kenetech 33-300kW 17m Rotor
  - 50kW

- **The 1990's**
  - Altamont Pass, CA Kenetech 56-100kW 17m Rotor
  - 130kW
  - Buffalo Ridge, MN Zond Z-750kW 46m Rotor
  - 300kW
  - 500kW

- **2000 & Beyond**
  - Arklow, Scotland GE 3.6MW 104m Rotor
  - 750kW
  - 2.5 MW
  - 1.5 MW
  - 3.6 MW
  - 5 MW
  - Medicine Bow, WY Clipper 2.5MW 93m Rotor

- **Suite of Standards**
  - Design Process
  - Testing
  - IEC Standards
  - IEA Guidelines
  - Irrational Exuberance

- **International Certification - IECRE**
Standards Successes / Failures

- Blades experience few failures (due to design process and testing required by IEC standards)
- Gears no longer fail (because of implementation of AGMA 6006 standard - DOE/NREL supported)
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Bearings still fail (Design Process?)
Some blade series failures (Mfg. QA?)
Still many gaps in the suite of standards
Standards needed to help End Users?
Certification not trusted by Owner/Operators (broader participation?)
What’s working

• Turbine design Framework
  – Fatigue?
  – Uncertainty?
• Coupled turbine aeroelastic analysis reasonable(?)
• Turbine test standards
  – Design support
  – Validation for End Users (?)
• Major component design
  – Blades
  – Drive Train
  – “Minor” components?

What’s Not

• Broad stakeholder engagement
• Need standards for:
  • facilitate wind plant design
  • Operations
  • Plant performance benchmarking
  • Integration requirements
• Wind specific component standards (“minor” components)
• Little formal collaboration between R&D and standards committees to solve technical challenges.
Possible TC88 New Framework

- Logical vertically organized groupings?
- Reduced scope standards for responsive revision time
- Managed & maintained by groups with common interest/expertise?
- Meeting broad industry sector needs (system compatibility framework)?
IEC leads international standards for wind plants.

- Multiple national standards.
- Multiple independent certification organization “rules”
- Harmonization is needed
What is needed from R&D

- More formal relationship that is informed by and informs standards.
- Broader stakeholder relevance
- Long-term (examples):
  - Accurate comprehensive flow understanding (inflow, plant and local atmospheric coupling)
  - Validated system design tools
  - Methods for quantifying uncertainties
  - Reference data sets
- Short-term (examples):
  - Robust fatigue design process
  - Reference models
  - System oriented design framework
  - More accurate wake models
  - Accurate benchmarking of performance
    - Turbines within a wind plant
    - Full wind plant (“wind plant Cp”)
Role of Standards and Certification in Wind Industry Maturation

• Public / investor confidence
  – Design safety requirements (implied reliability)
  – Credible performance verification
  – Permitting requirements clarity (international harmonization)
  – Credible community impact measures (noise)

• Technology development
  – Standardized (accurate / consistent) testing techniques
  – Defined design process
  – Design verification testing
  – Common definition of external conditions
  – Design goals (20 year life, redundant safety systems, etc)
  – Level playing field in international market
  – Common design vocabulary (design load cases, coordinate systems, safety factors, etc)