

Reliability Considerations

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Some Thoughts

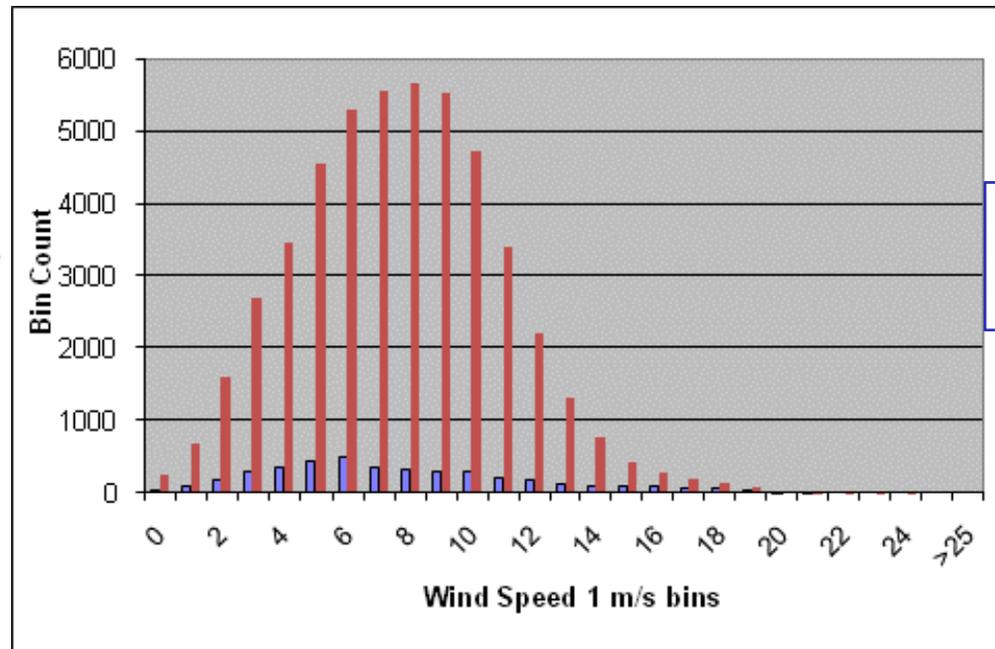
- Failures affect more than availability
 - *Plant production can often be improved*
- Condition monitoring is only in early stages of adoption
 - Lots of data being collected; but its not useful “information” as is
 - The **value** in doing more is not *YET* well accepted across our industry
- We can improve
 - Our understanding of performance and reliability
 - *What are the real driving factors?*
 - Our available means to impact the bottom line for existing and future farms

Some challenges:

- In-farm wind flow fields --- What is really going on inside the farm? Is it close to “design intent”?
 - Deep arrays
 - Flows, Loads, Stresses, Performance
 - Component Implications
- Condition Monitoring --- Using existing data...converting piles of scada data to *information* in the hands of operators; **AND** establishing a strong, accepted value proposition
- Information Sharing --- Data sets for benchmarking, comparison, planning and analysis

Non-Ideal Flow: Is it really significant?

- Performance tests only measure a few isolated turbines, meeting very specific flow conditions – the design intent operating case
 - Allowable points are filtered for turbulence, shear, terrain, obstacles, wakes etc

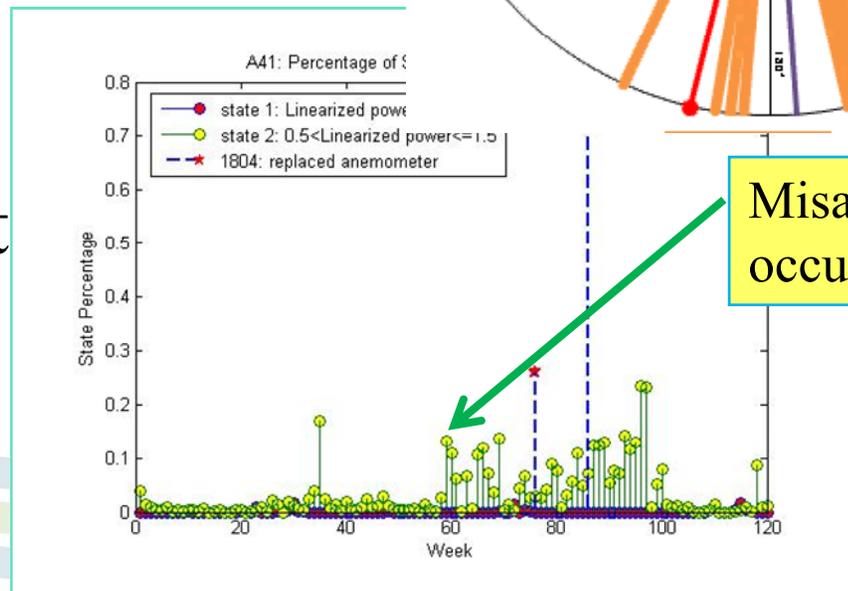
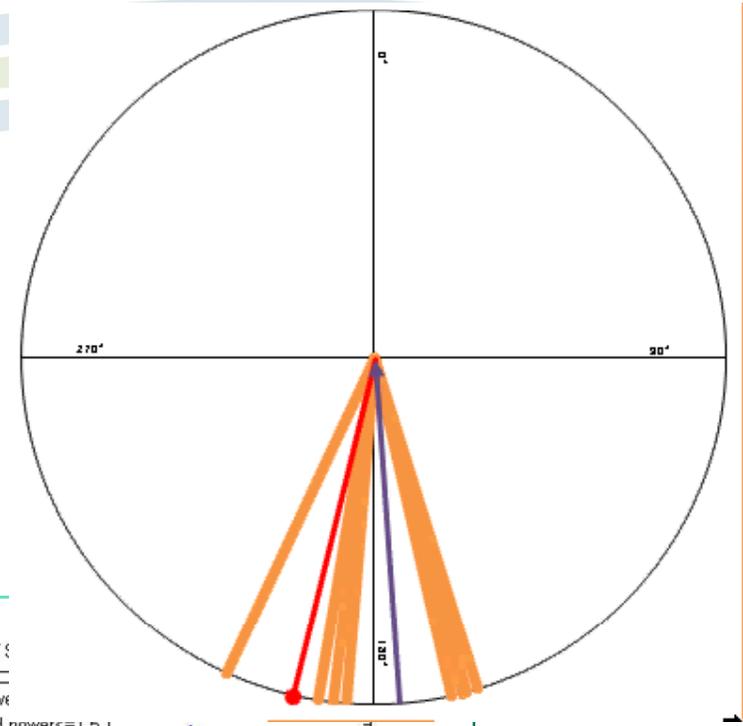


Red = Observed
Blue = Allowed

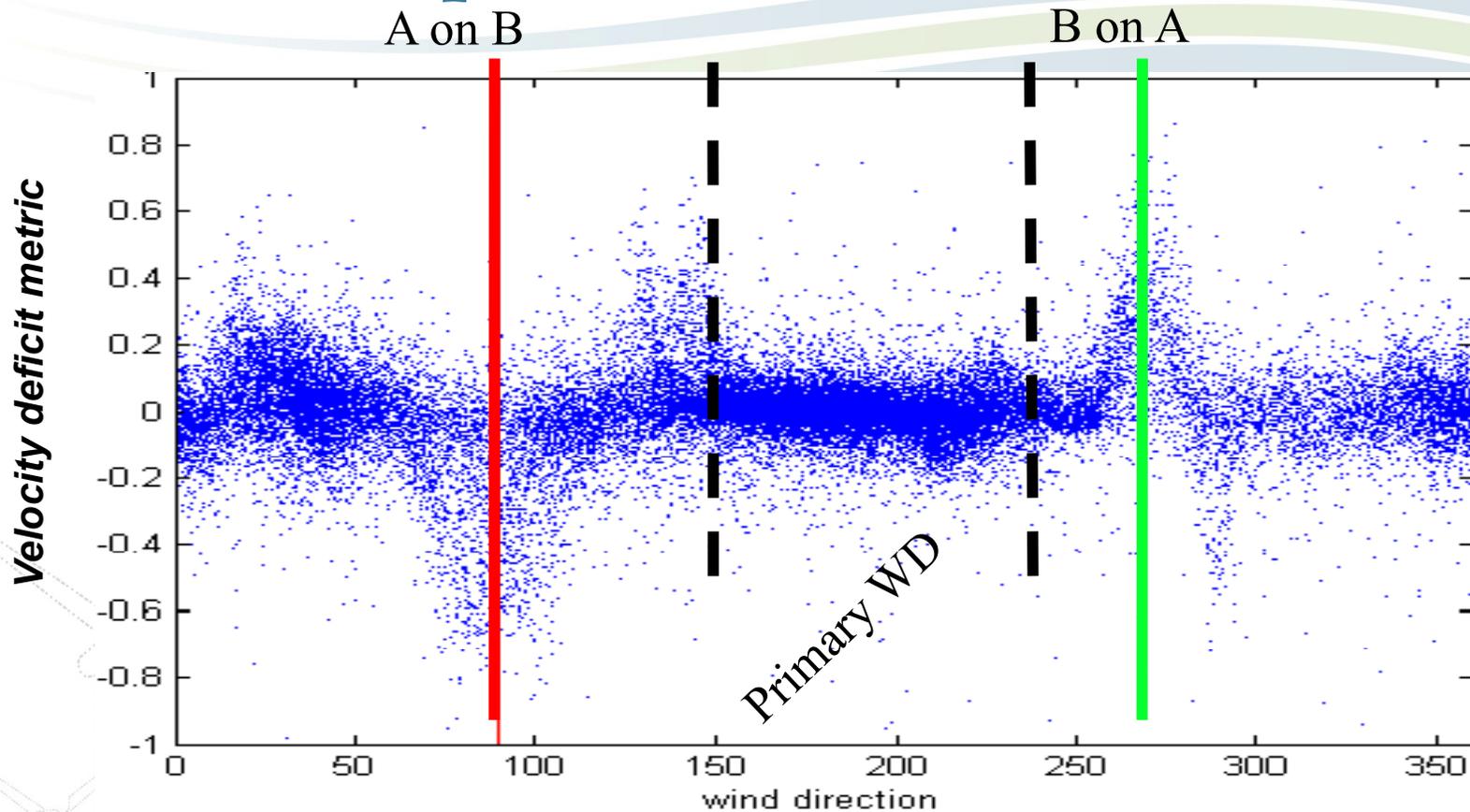
Very large percentages (>90%) of the observed wind conditions may not meet the filter ...How do they really impact the turbine?

Automated tools can detect abnormal conditions

- Directional shifts and similar faults can be detected with simple automated tools
- Issues can impact performance and reliability



Normal conditions may be complex functions



“Normal” may be site specific and complex,
but not impossible to analyze and understand
=> *Automation is essential to accessing “information”*

If it was your brand new car... AWS Truewind

- Would you go seriously off-roading, outside “design intent”? **And be surprised if something breaks?**



- Would you run a long time with bad plugs, a dirty air filter, in city traffic **and expect good gas mileage?**
- Would you be happy if no one gave feedback to “Consumer Reports” and JD Powers? **And wonder why you can’t gauge reliability and repair intervals?**

As an industry we can improve in all of these areas

Areas for industry consideration

- **In Farm Operations**
 - Data on actual flow and load conditions in “deep arrays”
- **Failure detection: Plant performance, underperformance, and failure prediction**
 - Increase use of existing data
 - Analytical methods development
 - Gaining acceptance for value of condition monitoring
- **Benchmarking and information sharing**
 - A means to improve overall industry performance

Collaboration and information sharing will help us advance more rapidly in all of these areas

A final thought

- How are you gauging your overall plant performance?

