



WIND EFFECTS ON AIR-COOLED CONDENSERS

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ABOUT **GALEBREAKER**

- More than 35 years' experience with the elements
- Wind Screen solutions all over the world
- Power, petro-chemical, industrial, agricultural and off-shore
- Market leader
- Specialists in fabric design
- 40,000 sq ft factory



HOW WIND EFFECTS ACC PERFORMANCE

Thermal Performance

- Increases in back pressure
- Loss of steam turbine output
- Loss of MW output

Mechanical Load/Stress

- Fans & fan blades
- Motors & gearboxes

Fouling

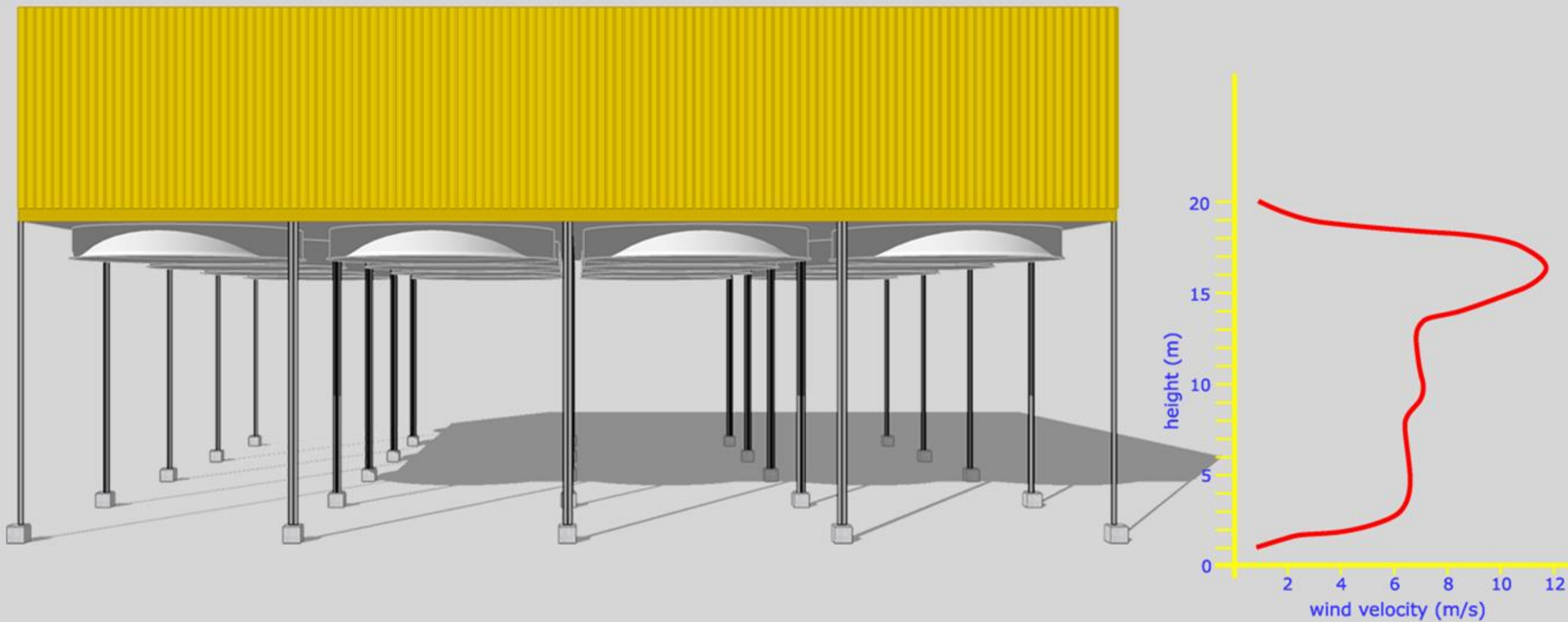
- Debris
- Leaves
- Airborne Seeds



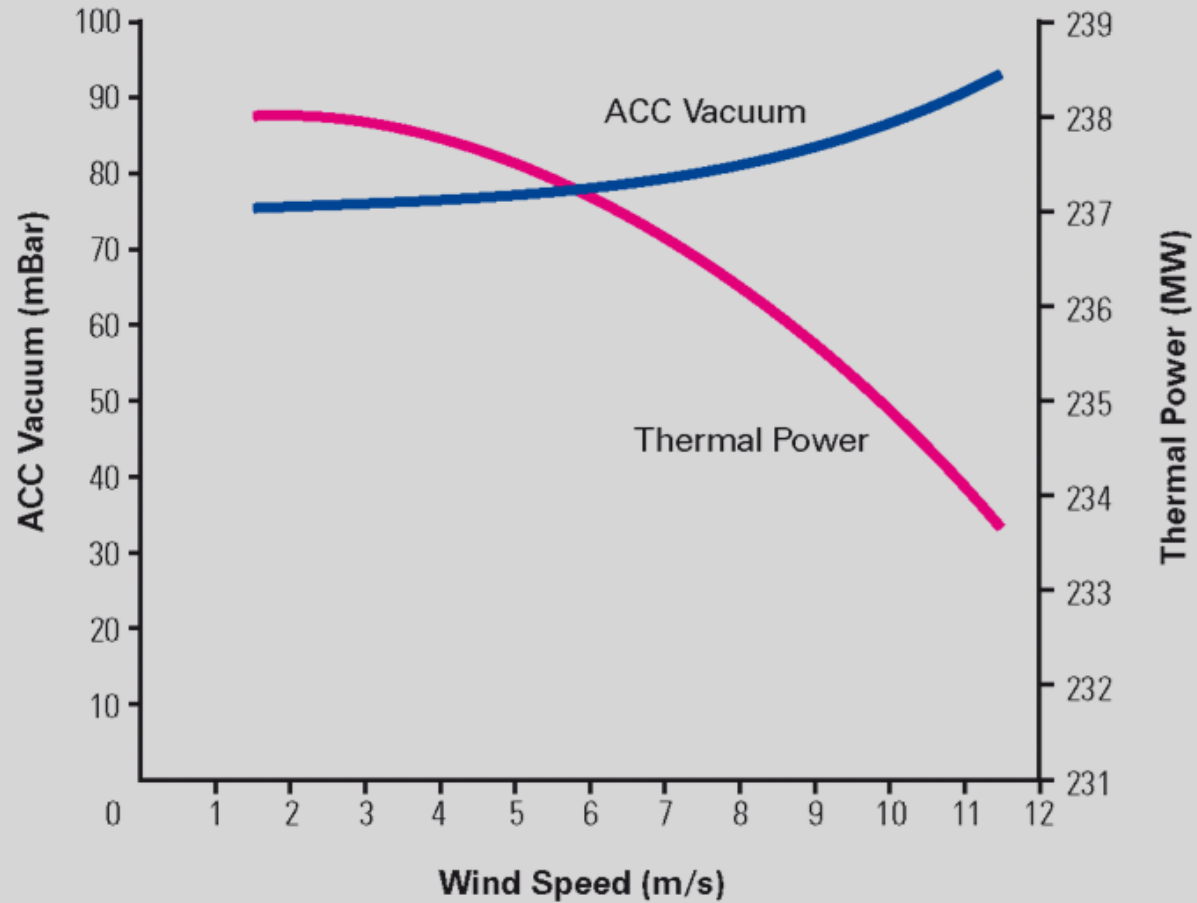
Galebreaker[®]

— INDUSTRIAL —

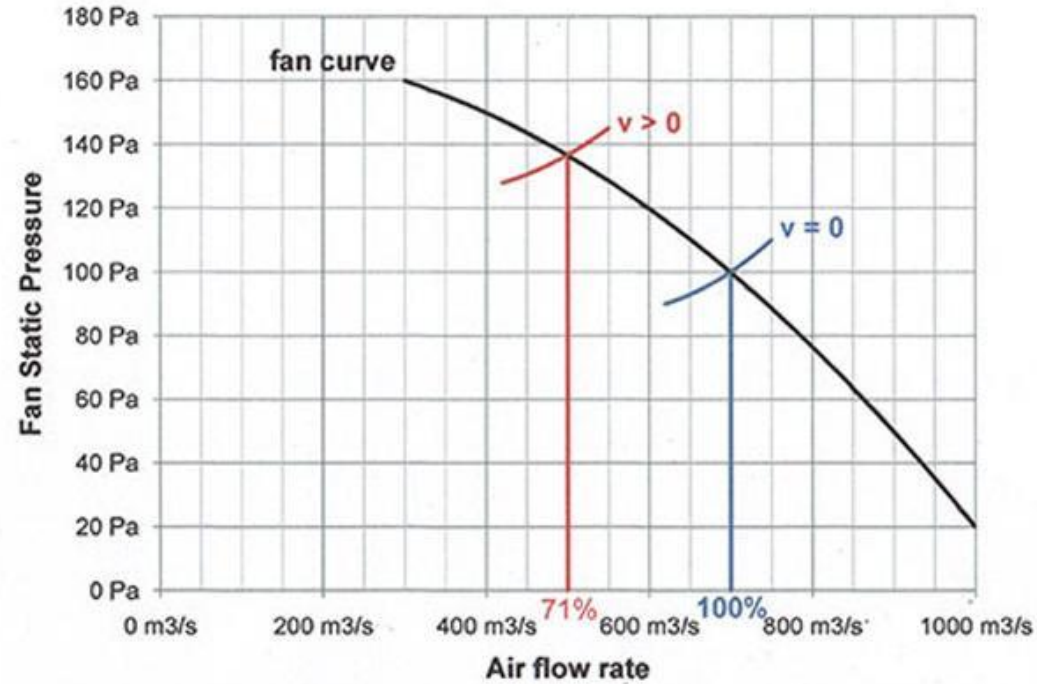
Your Guard Against the Elements



ACC Vacuum/Thermal Power v Wind Speed



Aerodynamic impact of wind on fan operation



If v_{wind} increases \rightarrow static pressure increases \rightarrow reduced air flow

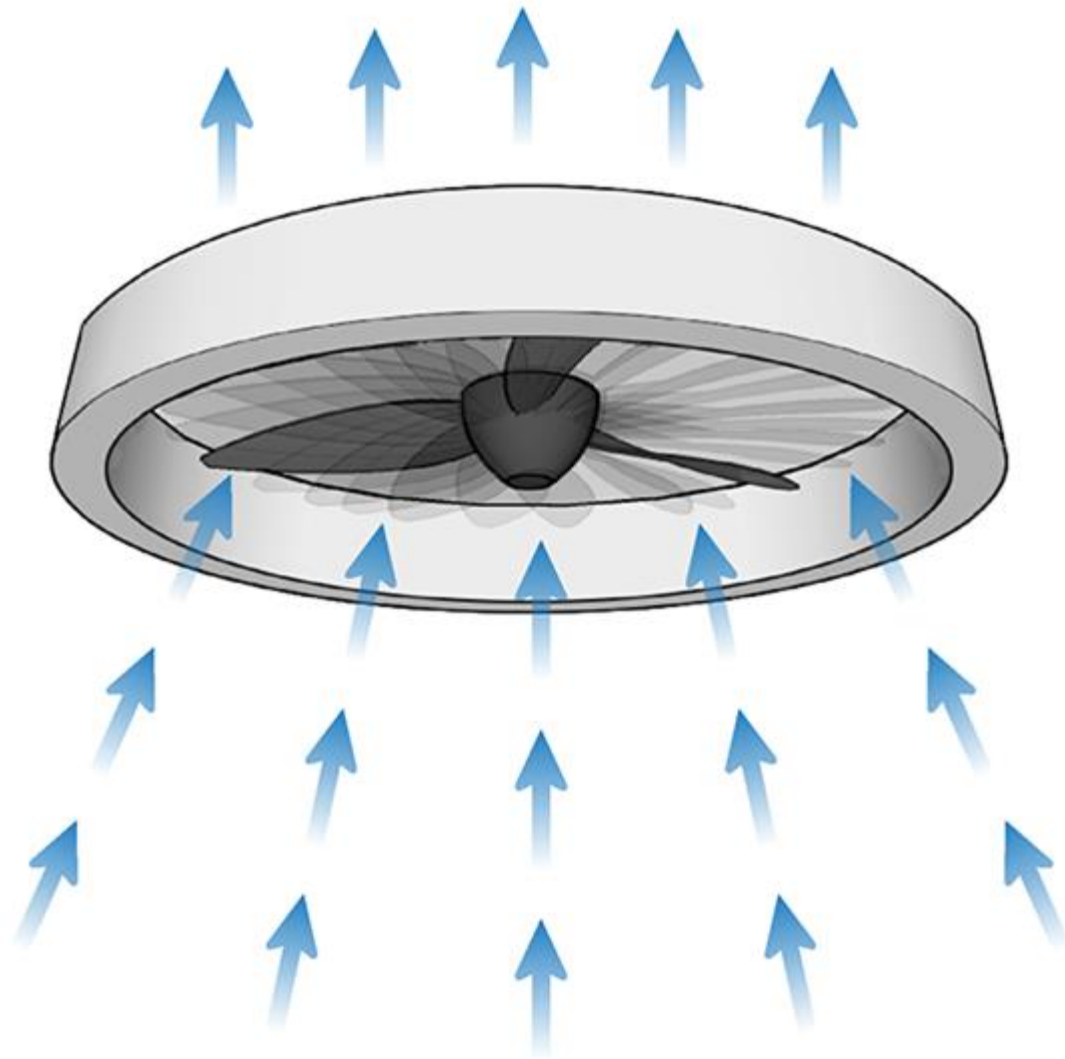
HOW WIND EFFECTS ACC PERFORMANCE

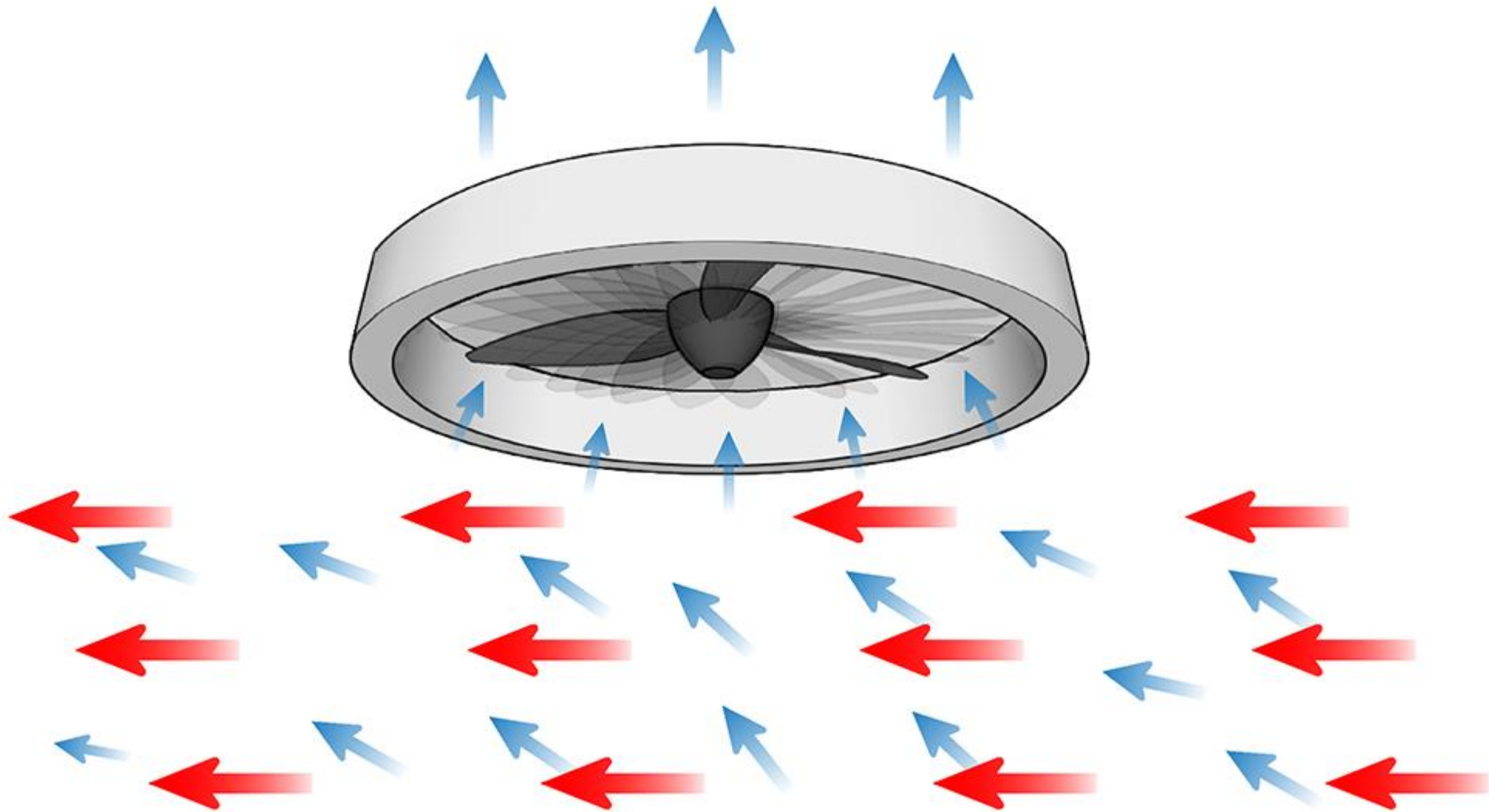
- Airflow reduces as a wind speed varies.
- Wind turbulence induces a dynamic blade loading that cycles as the fan rotates.
- Blade stress is created.
- Cycling loads induced on the blade hardware can cause fatigue failures

Wind is:

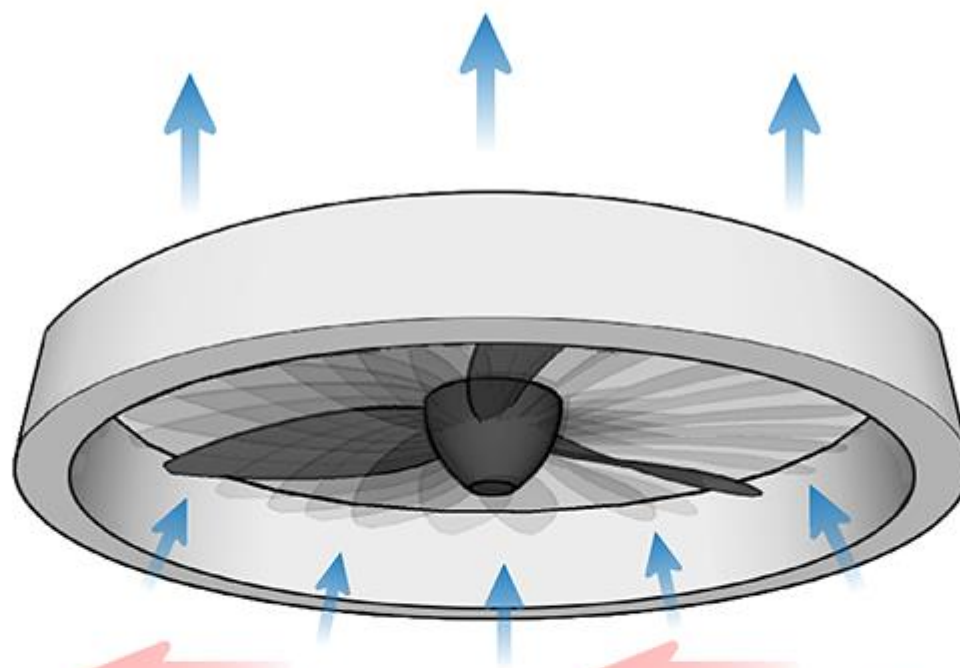
- Unpredictable and powerful.
- Prevailing wind direction may not represent the highest wind speeds.







Static pressure increase =
airflow reduction – GEA



20% airflow reduction =
33% back pressure increase
– Conco Services

5m/s = 30% airflow reduction
– Cofimco

Dynamic blade loading and
vibration - Howden

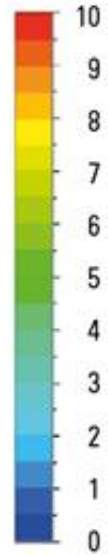
Fan & mechanical damage –
PS Colorado

GALEBREAKER WIND SCREEN SOLUTIONS

- Bespoke fixed and retractable solutions
- Tailor made fixings, fabrics and materials
- Site specific CFD modelling
- Configurations to suit site requirements
- Wind loading calculations
- Installation services
- Improving thermal performance
- Reducing mechanical stress

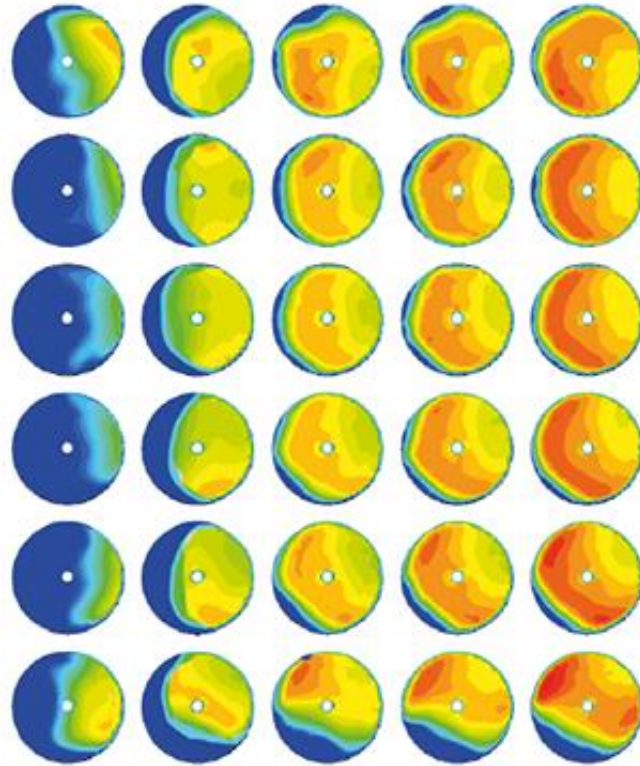


Vertical Velocity
(wind speed 10mph)

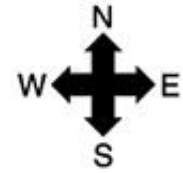
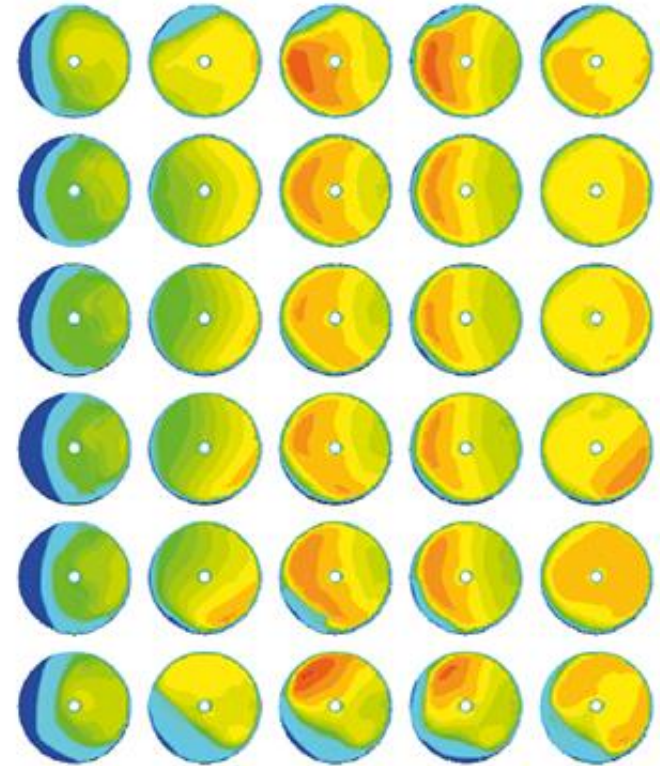


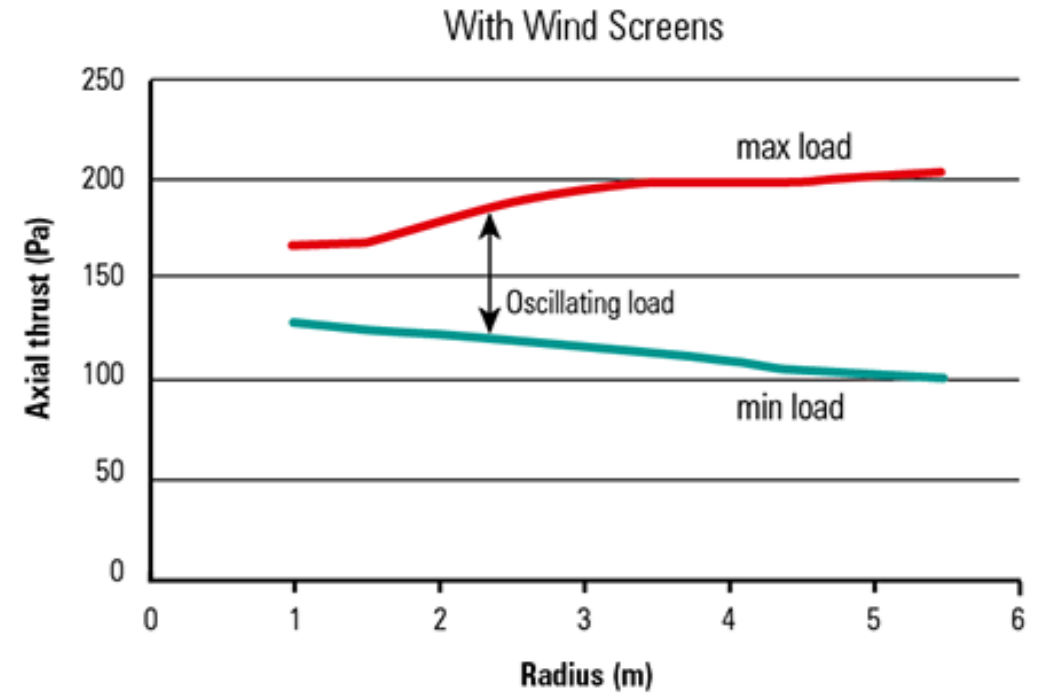
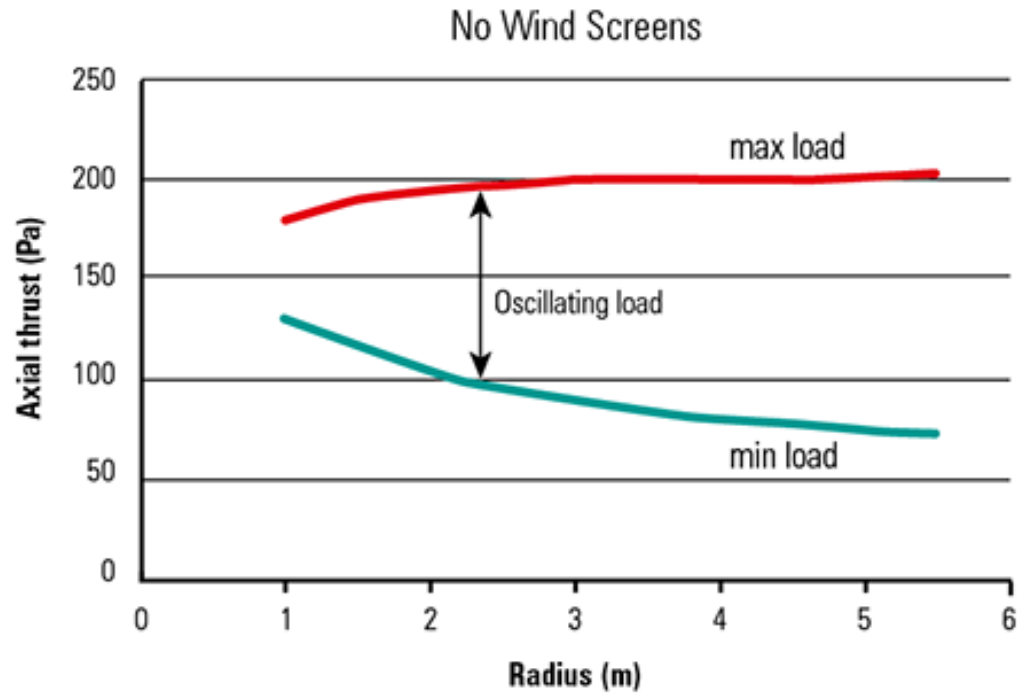
Air Velocity through
the Fans (m/s)

No Wind Screens

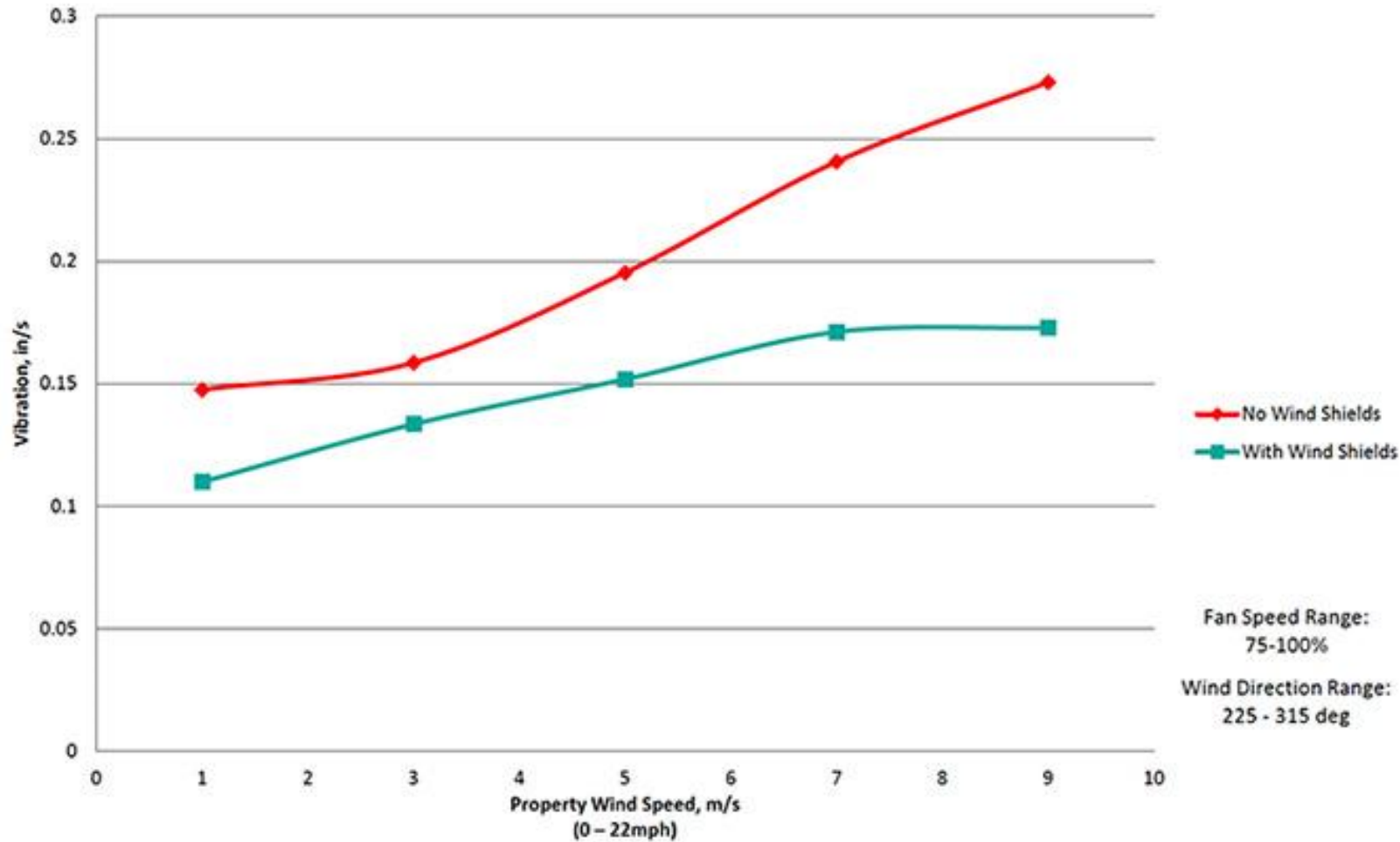


With Wind Screens



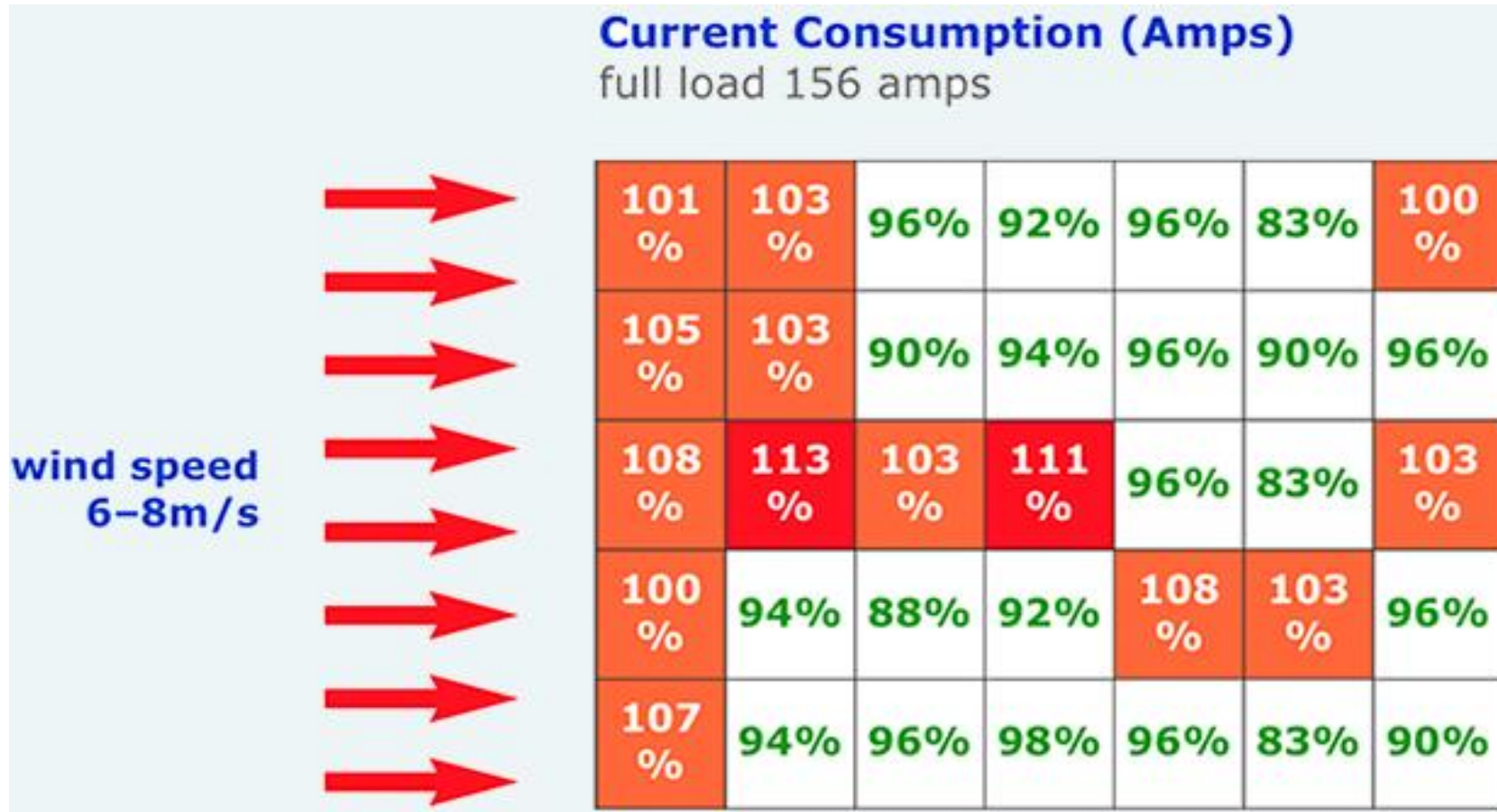


FAN VIBRATION MEASUREMENTS



* 260 MW, 10 cell (5x2)

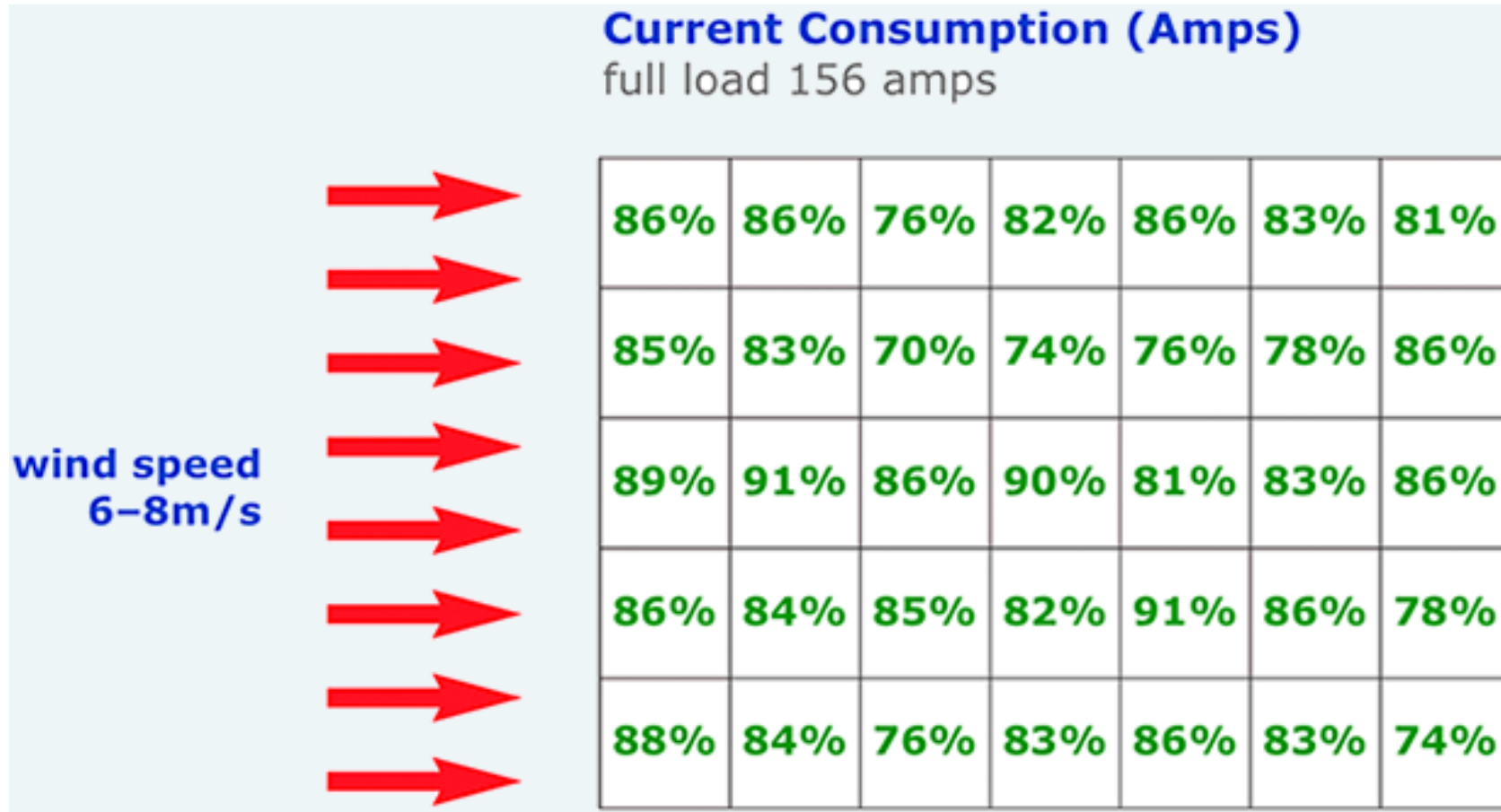
Before Galebreaker Wind Screen Installation



Engineers estimated losses of up to 60 MW in high wind speed conditions.

* 903 MW, 35 cell (7x5)

After Galebreaker Wind Screens and VSD Motors



Conclusions

1. Windy conditions were contributing to motor overload and motor trips
2. Motor overload was leading to electrical infrastructure damage.
3. ACC Performance improvement – re-gain of 75% of performance loss.

Source: Industrial Energy Surveys Ltd.

* 903 MW, 35 cell (7x5)







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Perimeter Screens Reduces Blade Stress



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**Cruciform Screen for Improved Thermal
Performance**



INSTALLATION

- Galebreaker can either fully fit or supervise an installation
- Panels can be moved or relocated
- Typical fixed Wind Screen installations take approximately 2 weeks
- Installations can take place with the ACC still running (may require individual fans to be turned off)



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Your Guard Against the Elements

- Review of Previous ACCUG Presentations
- Above Design Inlet Wind Velocities Reduce Heat Rejection Capabilities
- Mechanical Equipment Reliability Is Affected
- Seasonal Wind Effects; Although Short In Duration, Are Costly (max \$/MW Hr)
- Wind screens Work
- Are There Other Approaches to Mitigating Wind effects?



Other Designs and Industries Using Air Cooled Equipment

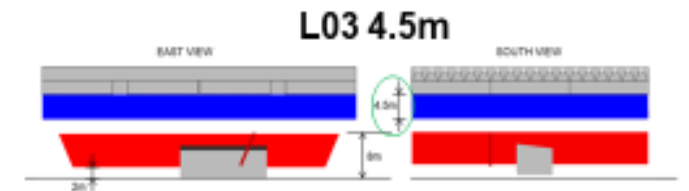
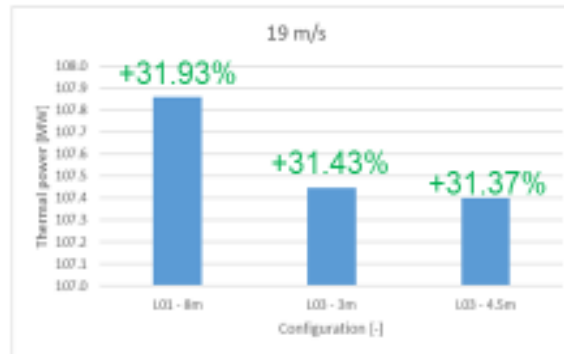
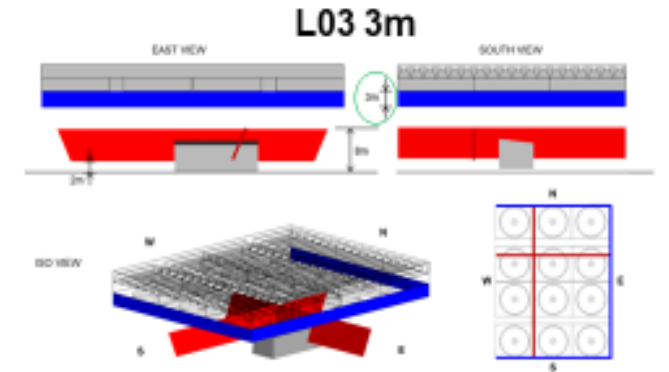
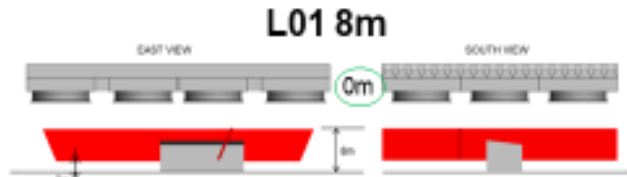
- Our first Sloped Structure ACC
- Seasonal Winds 19 M/S (highest we've seen)
- Fan Blade Stress Problems
- Substantial Thermal Performance Problems
- Perimeter and Cruciform Windscreens to be Installed



Results @19 m/s

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- Seasonal Winds 19 M/S (highest we've seen)
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- Substantial Thermal Performance Problems
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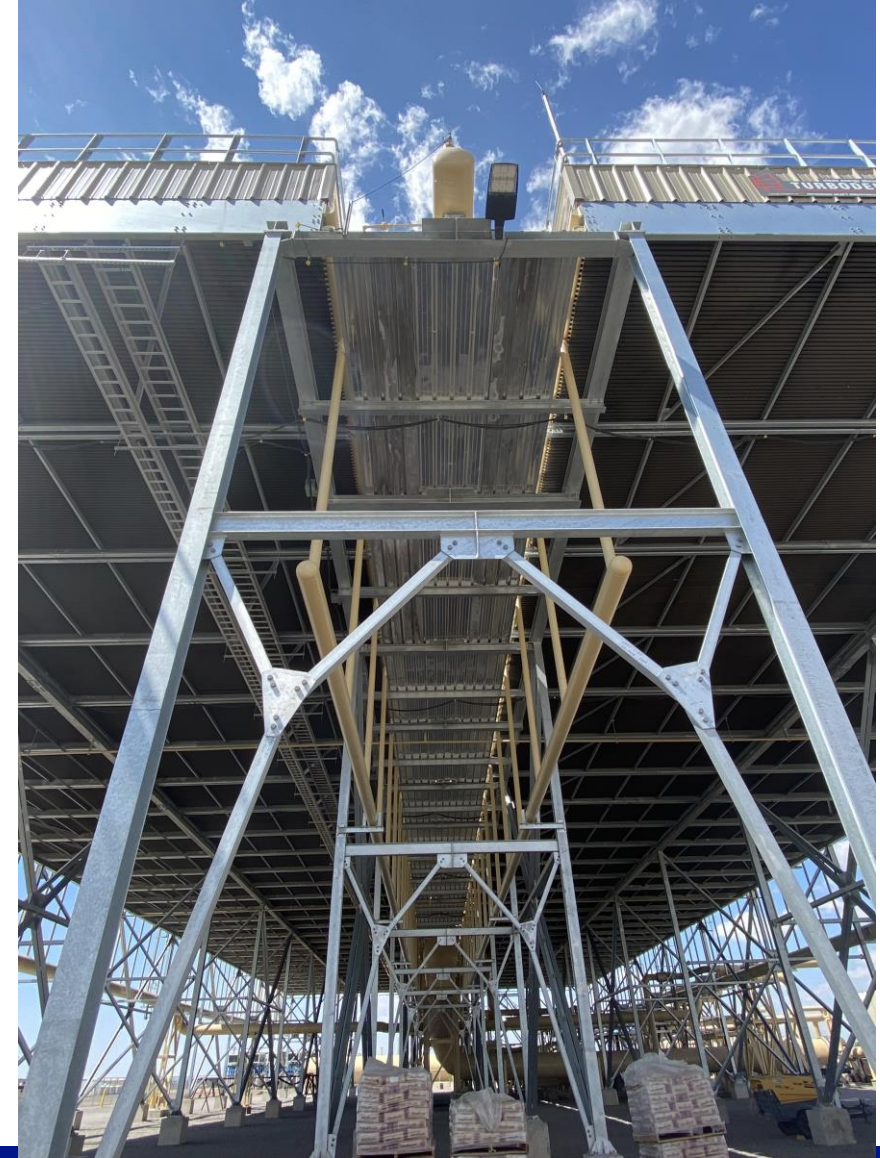
- Windscreens perimeter sensitivity (3m vs 4.5m). Perimeter solidity=50% (M50)



- In terms of thermal power:
 - All layouts show almost the same performance increase respect to L00
 - L03 – 4.5m is considered the best for its beneficial impact in terms of fan blade loading

Source - ERGON

- Consistent high winds over 6 M/S
- Substantial imbalance of airflow, windward side
- Recirculation and backflow
- Substantial thermal performance reduction
- Cruciform wind screens regain 70% of wind losses



- Monster ACHE
- 7 M/S seasonal winds
- Costly seasonal production losses caused by recirculation, hot air migration and air flow reduction
- Full length cruciform wind screens
- Shown is one of many trains





Thank You !

Questions?

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