

Wind Effects on Air Cooled Condensers – Mitigating high seasonal winds

Galebreaker Industrial – Jeff Ebert

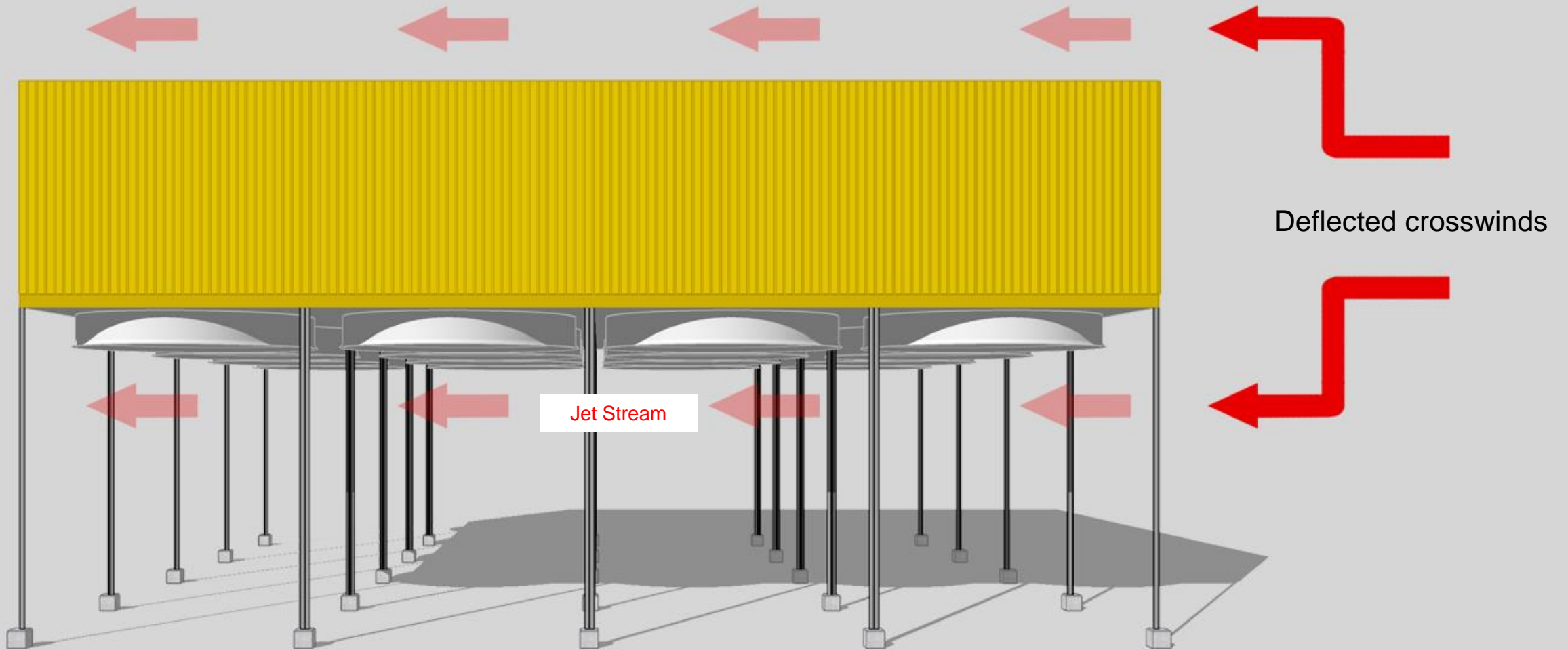


Presenter:

Jeff Ebert – Galebreaker Industrial

- Wind Effects
- The Project
- Performance Evaluation
- Questions

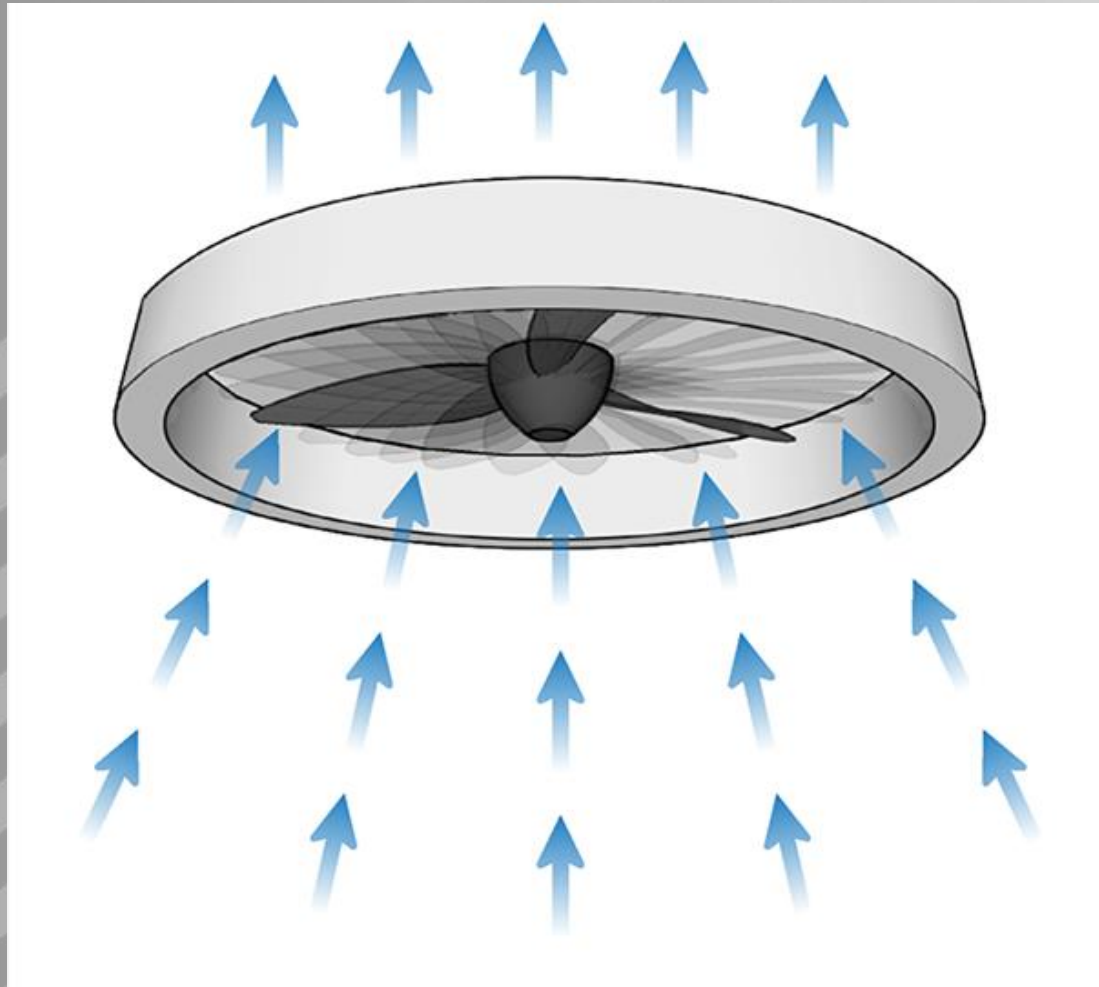




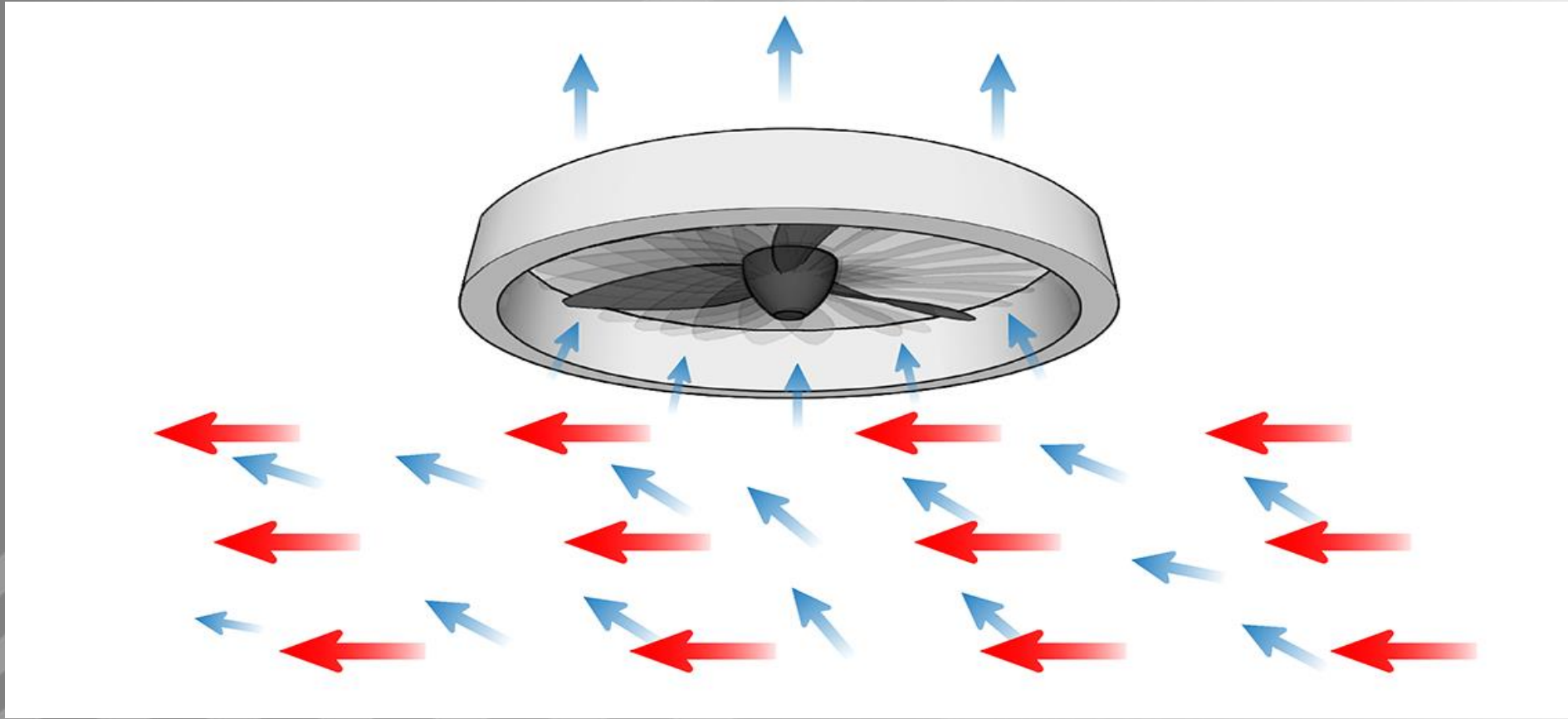
THE EFFECT OF CROSSWINDS

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A CLOSER LOOK BENEATH THE FANS NO CROSSWIND

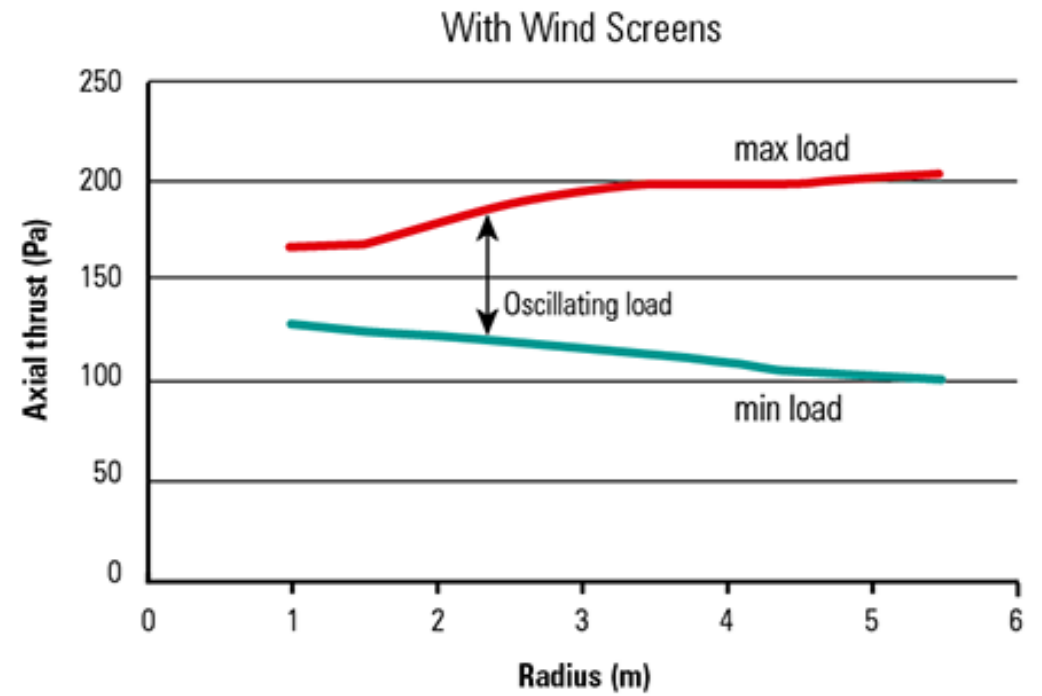
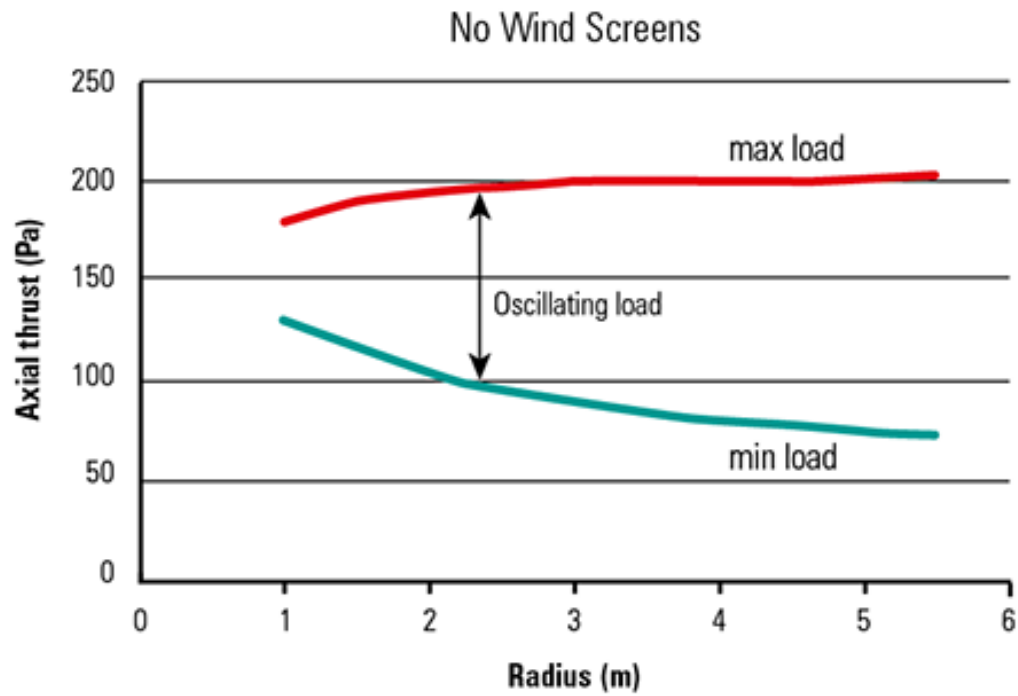


A CLOSER LOOK BENEATH THE FANS with CROSSWINDS

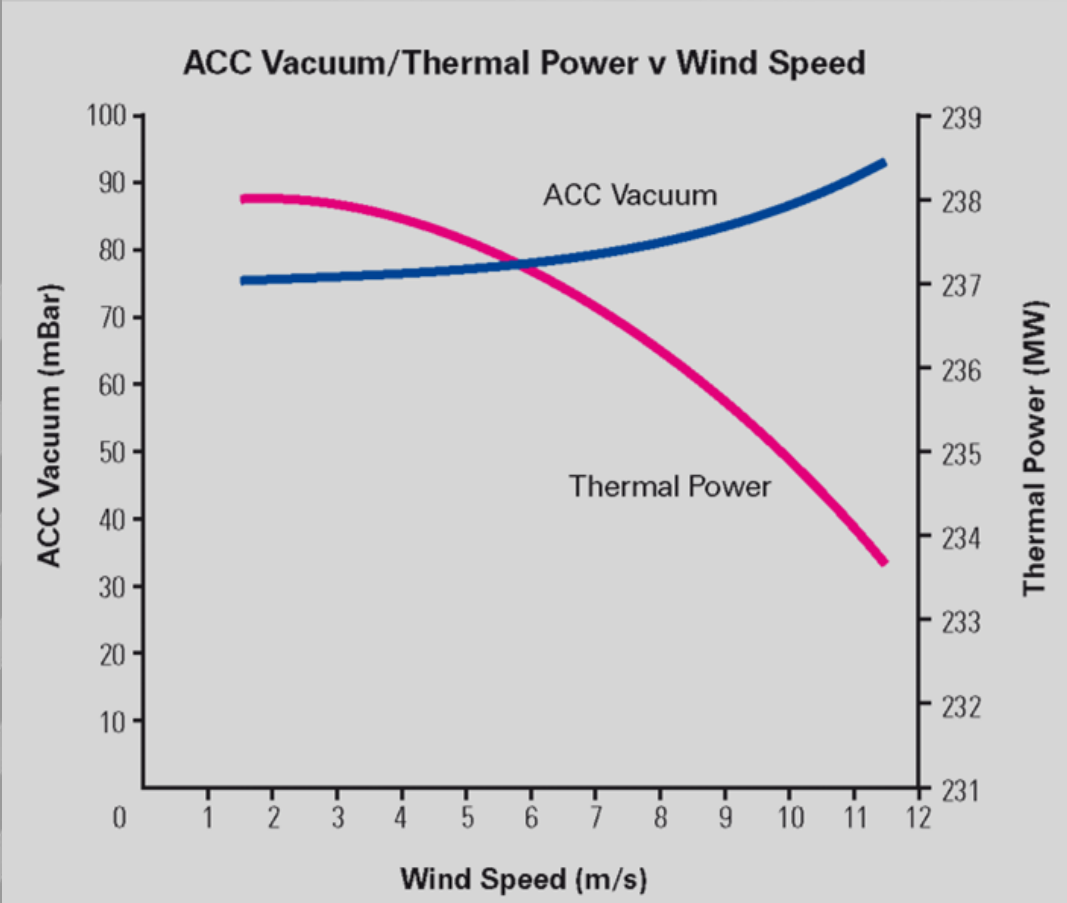
- Airflow reduces as wind speed fluctuates/increases
- Wind turbulence induces dynamic blade loading that cycles as the fan rotates, potentially causing blade stress and hardware fatigue.
- Prevailing wind direction and wind speed are seasonal.



HOW WIND EFFECTS ACC PERFORMANCE



CFD ANALYSIS - DYNAMIC FAN BLADE LOADING



HOW WIND EFFECTS ACC PERFORMANCE

THE PROJECT



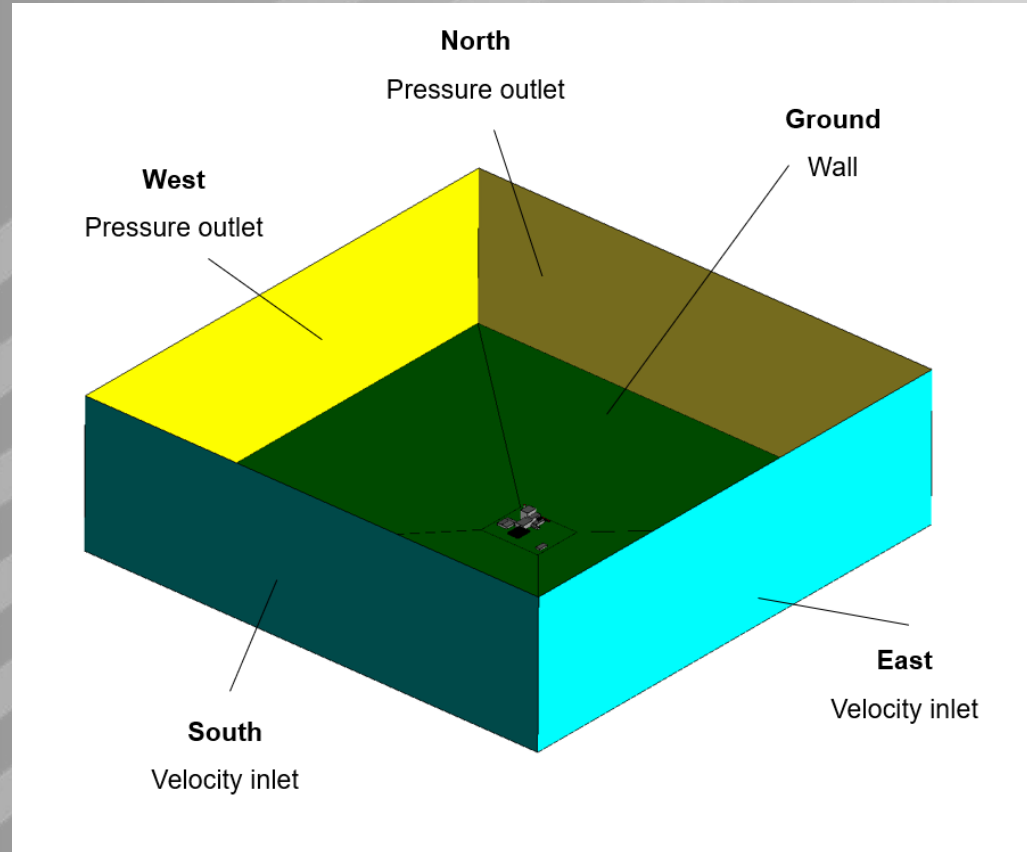
- 353 MW Gas Fired power plant in Saskatchewan Canada
- Online December 2019
- Contacted Galebreaker June 2020 regarding fan failures, performance loss during high winds

Project Scope

- Summer Winds 19 M/S vs 5 M/S
- CFD to model existing conditions, evaluate ACC windscreens
- Provide loads created by windscreens
- Provide debris screens for ACHE with doors
- Design, manufacture, deliver to site.
- Provide Field Tech Rep
- Performance Evaluation

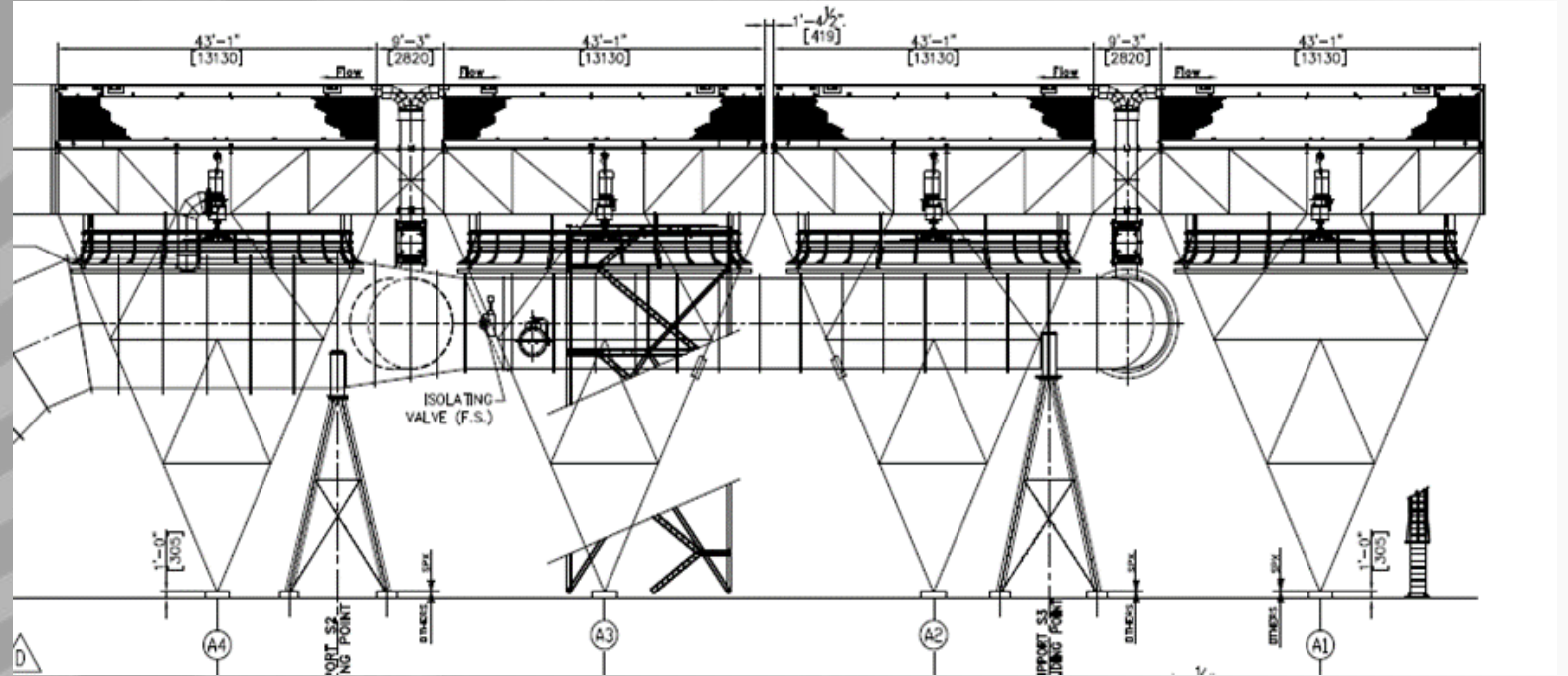


INNOVATIVE STRUCTURE ACC



MODELING AREA (1KM X 1KM X 600M)

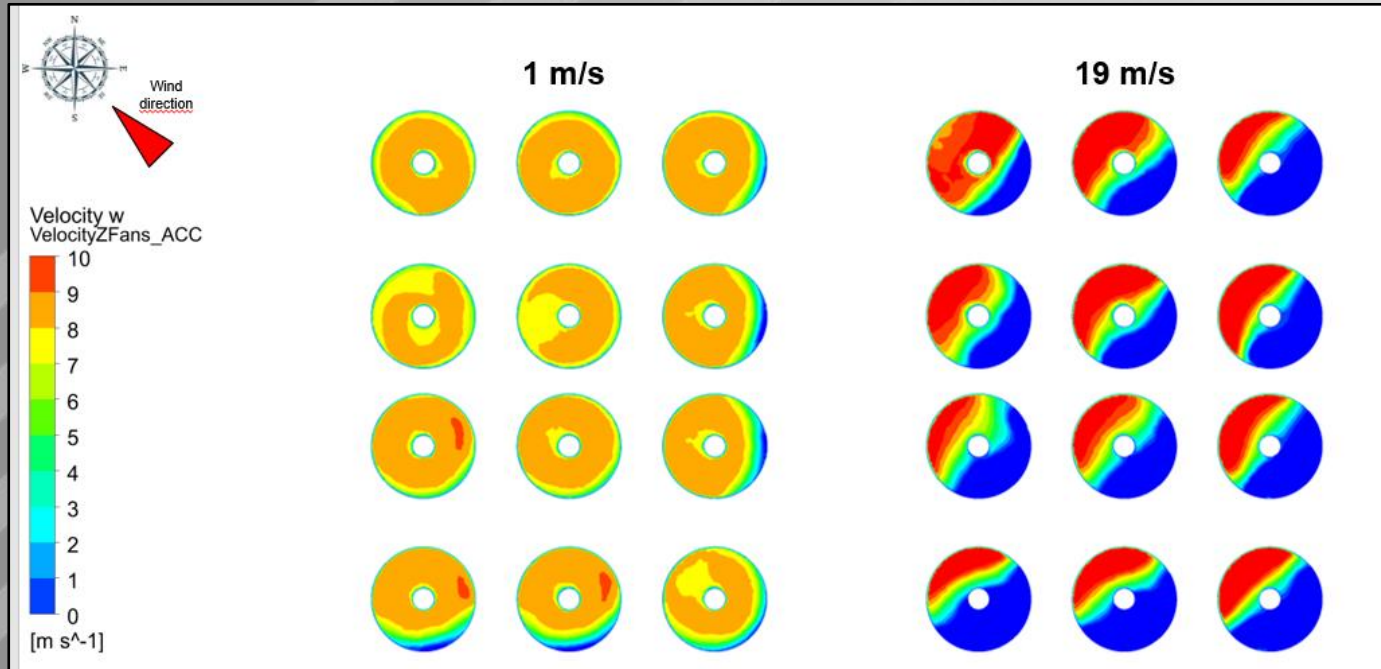
- SW wind predominant, coincident with 19m/s wind speed.
- Vary windscreen configuration
- Vary windscreen height and solidity
- Many iterations with Perimeter and Cruciform windscreens



INNOVATIVE STRUCTURE ACC

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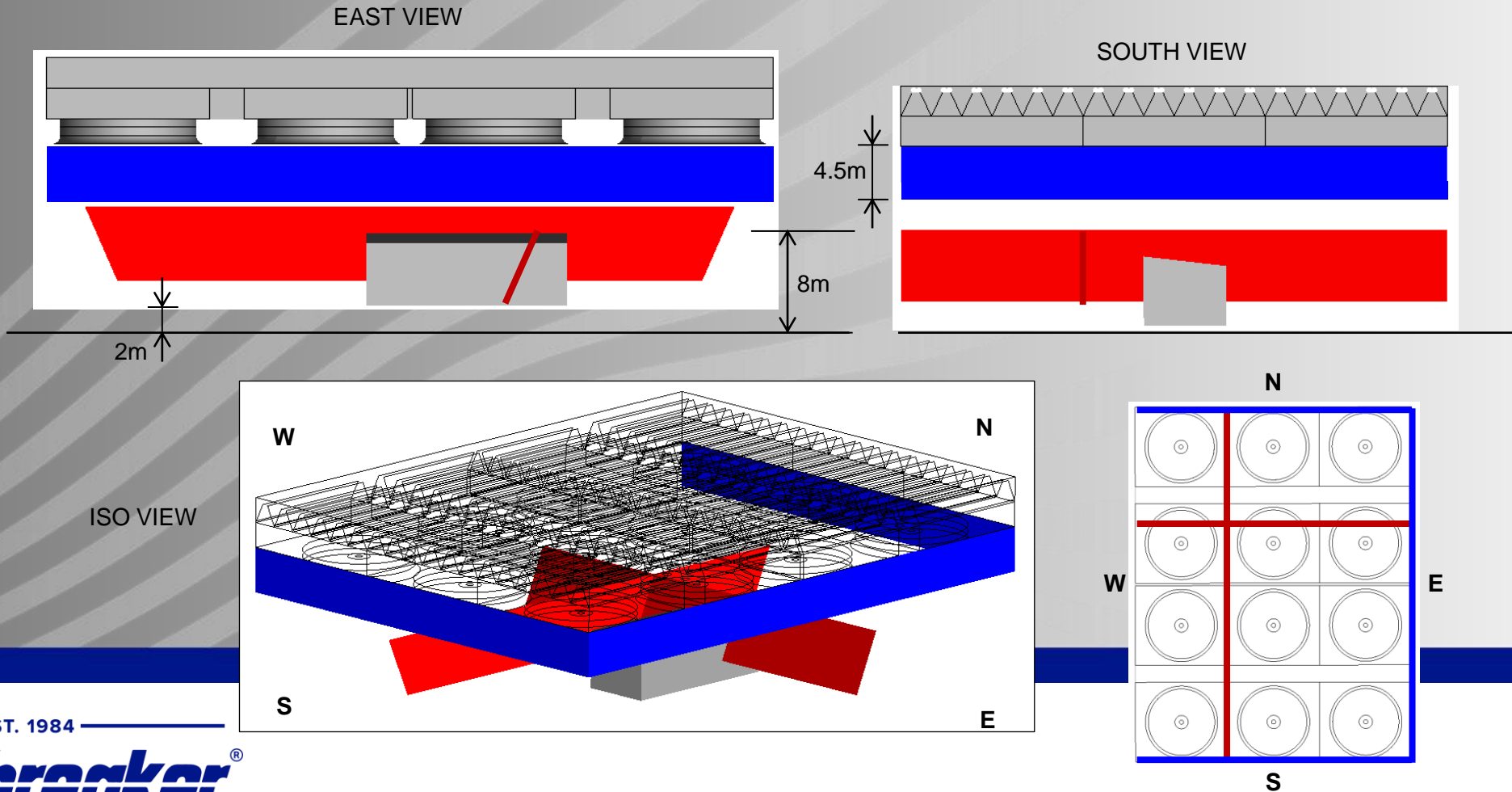


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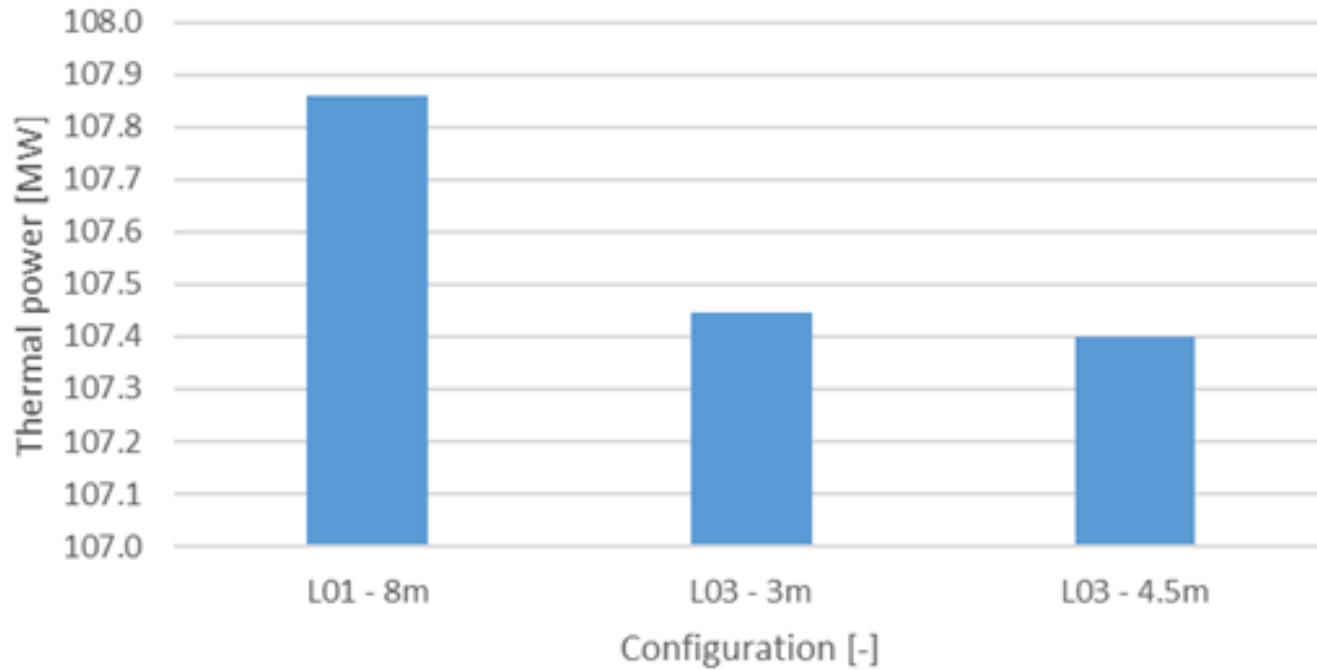
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WINDSCREENS CONFIGURATIONS

Layout L03 4.5m – Cruciform height=8m Solidity=75%, Perimeter height=4.5m Solidity=60%



19 m/s



L03-4.5m, 60% solidity is considered the best for its beneficial impact in terms of fan blade loading and cost.

+31.93%

+31.43%

+31.37%

EFFECTIVENESS

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Project Execution

- Material delivered in October 2022
- Some structural reinforcement required
- Installation April 2023
- 3 weeks duration
- Performance Evaluation after a year



INNOVATIVE STRUCTURE ACC



MANUFACTURING PROCESS



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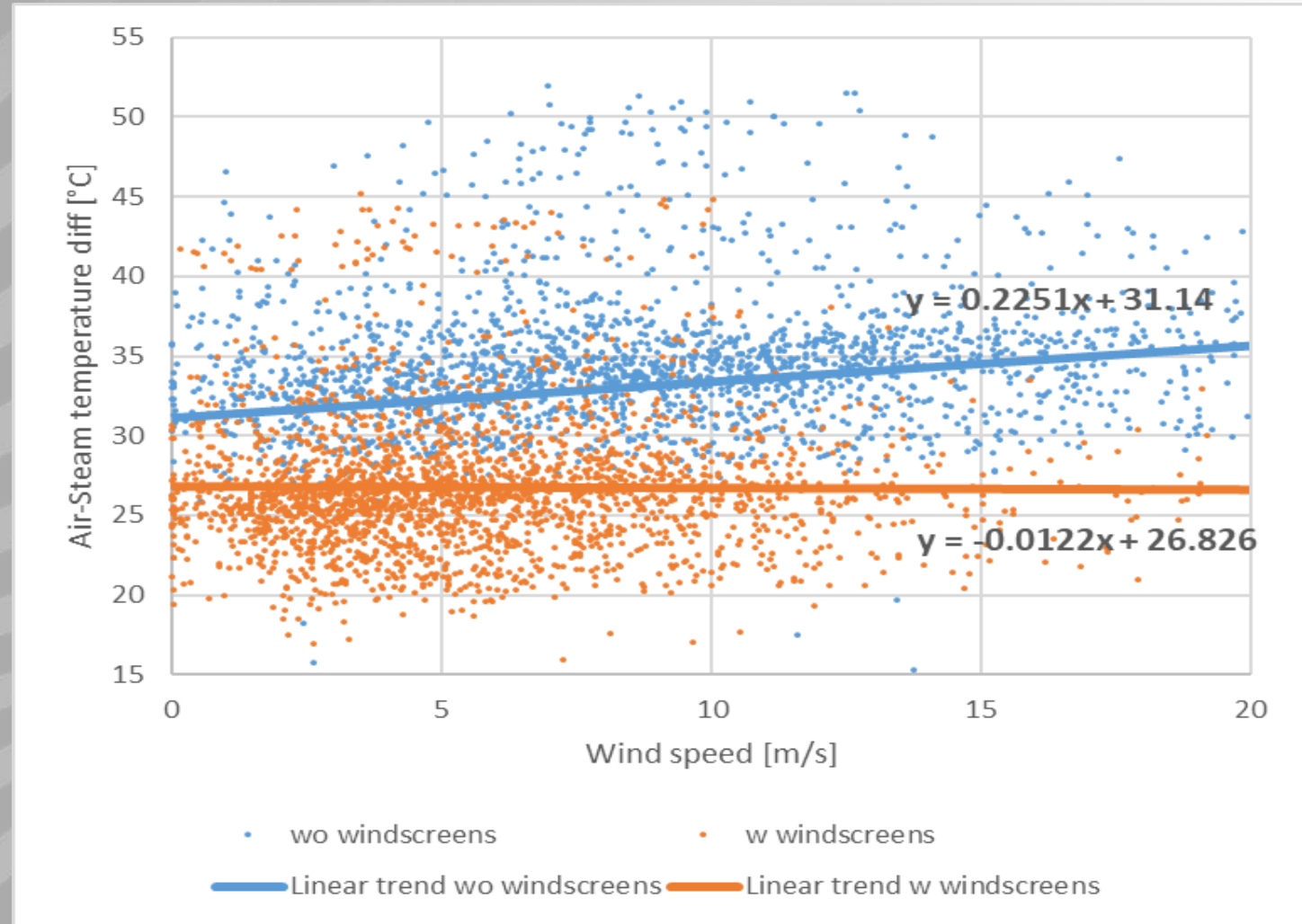
Performance after Windscreen Installation

PI Data

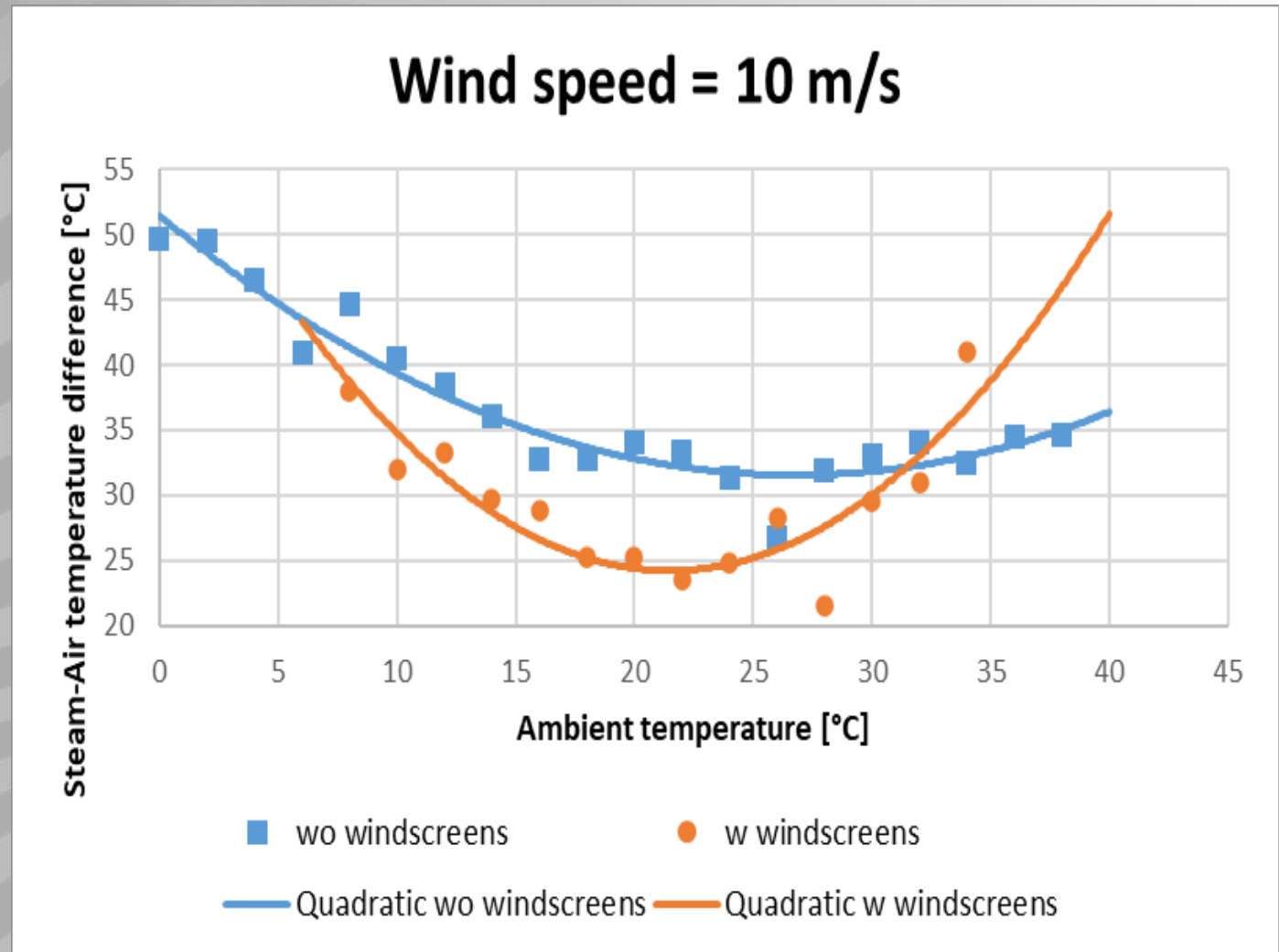
- Two sets of summer data have been shared:
 - Before windscreen installation: 2021-05-15 / 2021-08-20
 - After windscreen installation: 2023-05-15 / 2023-08-20
- Shared PI Data contains hourly-average for wind speed, direction, ambient air temp, ACC steam temp and more....
- VFD's were retrofitted to the ACC in 2022 so a new variable. Use summer conditions.

- No significant differences in gross power registered between 2021 and 2023 (demand?)
- Lesser wind speed during the summer compared to prior years
- The ACC performance (global Heat Transfer Coefficient UA) can be estimated looking at the temperature difference between air and steam

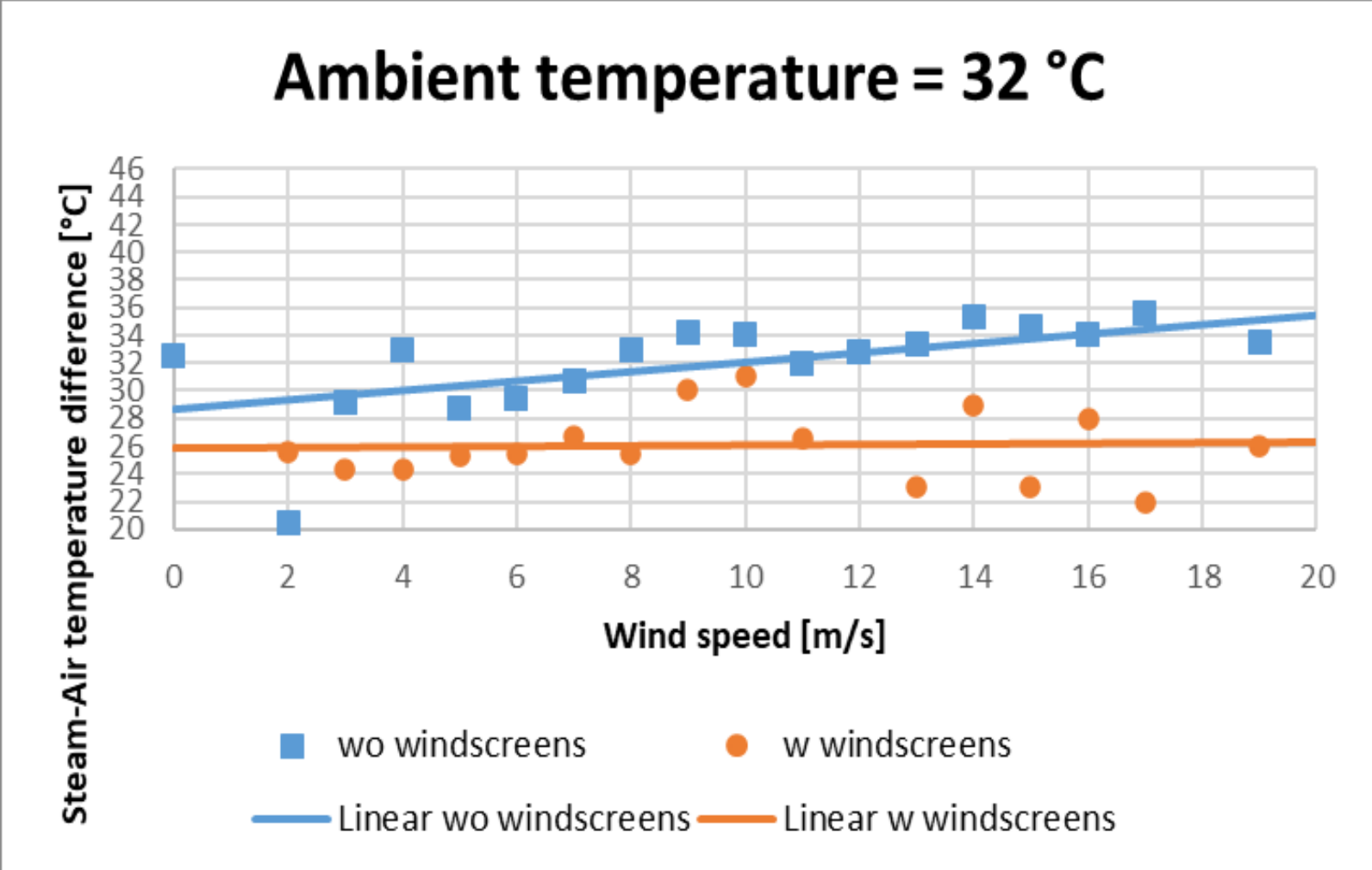
- Computing the difference between steam and ambient temperature it is clear how the ACC was more efficient in summer 2023 rather than in 2021
- Despite the high scattering, the linear trend lines show:
 - Lower absolute temperature difference (26.8 °C vs 31.1 °C)
 - Higher insensitivity to wind speed (slightly negative vs 0.225 °C/(m/s))



- Filtering the data for similar wind speed and ambient temperature it is possible to make a more quantitative comparison
- The improvement thanks to the windscreens is appreciable in terms of reduced temperature difference between steam and air
- The fitting is less effective at high ambient temperature and high wind due to the reduced number of samples



- Filtering the data for similar summer wind speed and ambient temperature it is possible to make a more quantitative comparison
- Both at cold, mild and hot temperature the windscreens reduce the temperature difference between air and steam (higher cooling efficiency) and reduce the sensitivity to wind speed



Conclusions

- The analysis of PI Data before and after the installation of windscreens demonstrate that:
- The CFD model of the ACC thermal power is a good tool to simulate/estimate improvements with windscreens
- The windscreens improved ACC thermal power at a variety of wind speeds and ambient temperatures.

PERFORMANCE EVALUATION AFTER WINDSCREENS



Thank You

Questions?

Galebreaker Industrial: galebreaker.com/industrial
Ergon Research: ergonresearch.it/

