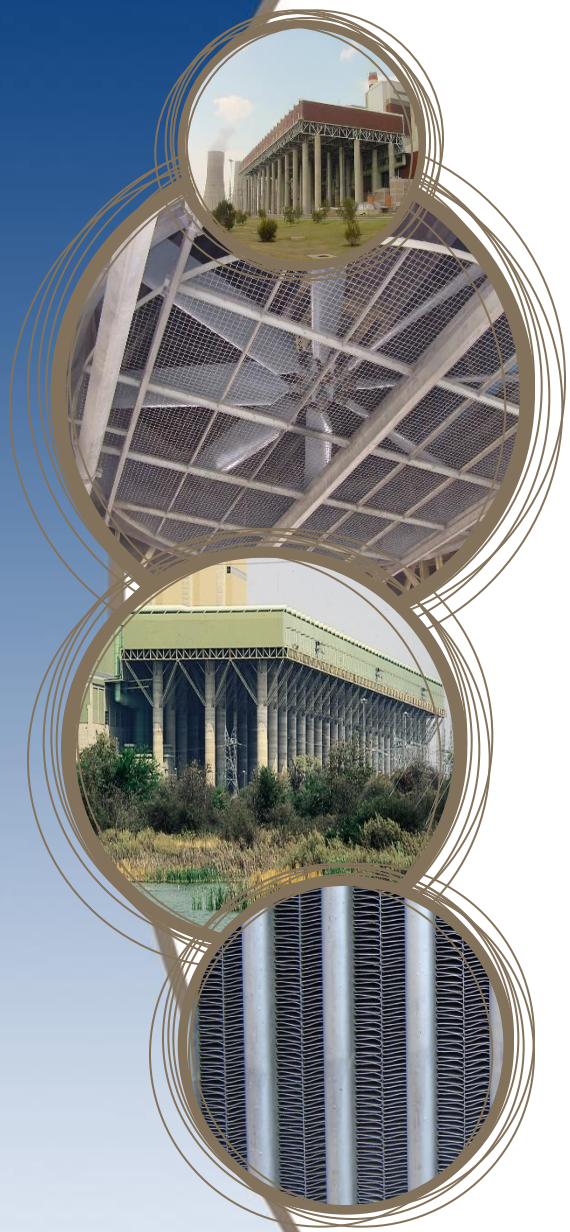

Medupi Power Station ACC Performance During Windy Conditions

2017 ACCUG Las Vegas

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Presented by **Ockert Augustyn**

Content

- ACC specification
  - Performance specification
  - Minimum design features
- Medupi ACC specification
- Matimba and Medupi Design
- ACC Performance

Eskom ACC fleet

- Eskom – only power utility in South Africa
- 4 ACCs
  - Majuba > 3 x 657 MW [1996-2001]
  - Matimba > 6 x 665 MW [1987-1991]
  - Medupi > 6 x 794 MW [3 units operational]
  - Kusile > 6 x 800 MW [1 unit operational]
- Fans: 48-64 (~10m diameter) per unit
- Platform height: 45-60m

Eskom ACC fleet

ACC Specification - background

Performance specification

- ACC performance requirements are specified by purchaser
- Supplier is responsible for all design aspects of the ACC
- Performance guarantees are verified by acceptance test
- Suitable specification/tolerance for performance drop during adverse weather
- Low risk to supplier since test codes limit wind speed during test

>> *Performance parameters used to mitigate risks*

ACC Specification - background

Significant risks for purchaser associated with performance specification

- Supplier may assume that safety margins or features added to their bid would render them less competitive
- Purchaser may not be able to disqualify offers or justify more expensive offers
    - *All offers may claim to meet performance requirements*

ACC Specification - background

Significant risks for purchaser associated with performance specification

- Performance characteristics of an ACC in windy conditions remain unknown until commissioning
  - Usually too late to implement design changes if required
- Successful test provide no guarantee that performance will not degrade significantly under high wind speeds

ACC Specification - **Matimba's ACC**

- **ACC specification type**
  - Performance specification
- **Operational experience**
  - Significant capacity loss during adverse weather (high temperature, wind speed & direction)
  - 12 vacuum related units trips occurred at Matimba during first 7 years of operation
  - 2016 – multiple cases of >1000MW load loss

ACC Specification - **Matimba's ACC**

- Performance test was successful
  - Test done during favourable wind direction

>> **Conclusion**: Performance specification is not acceptable due to high performance risk

ACC Specification - **Matimba's ACC**

Purchaser specifies minimum ACC design features

> mitigate performance deterioration during adverse conditions

Advantage to Purchaser

- All offers must comply with minimum requirements
- No surprises during tendering process
- ACC position is fixed at early stage
- Mitigation for wind effect is incorporated in design

ACC Specification - **Matimba's ACC**

Purchaser specifies minimum ACC design features

Advantage to Supplier

- All suppliers tender on same basis
- Minimum design features are defined

>> Require purchaser to perform basic analysis in advance (informed client)

Requirements for the **Medupi ACC**

- Atmospheric conditions based on 40 m Above Ground Level
- Design Wind speed 9 m/s from any direction
- Wind wall height to extend to top of steam duct
- 2.5 m wide solid walkway around entire perimeter of platform
- Wind cross on ground level, 33% of fan inlet height
- Performance guarantees had to be verified by means of CFD analysis before construction

Requirements for the **Medupi ACC**

- 50 m Gap between ACC and Turbine House

Requirements for the **Medupi ACC**

- No gap shown for Matimba

Medupi ACC – wind wall

Medupi ACC

ACC design comparison

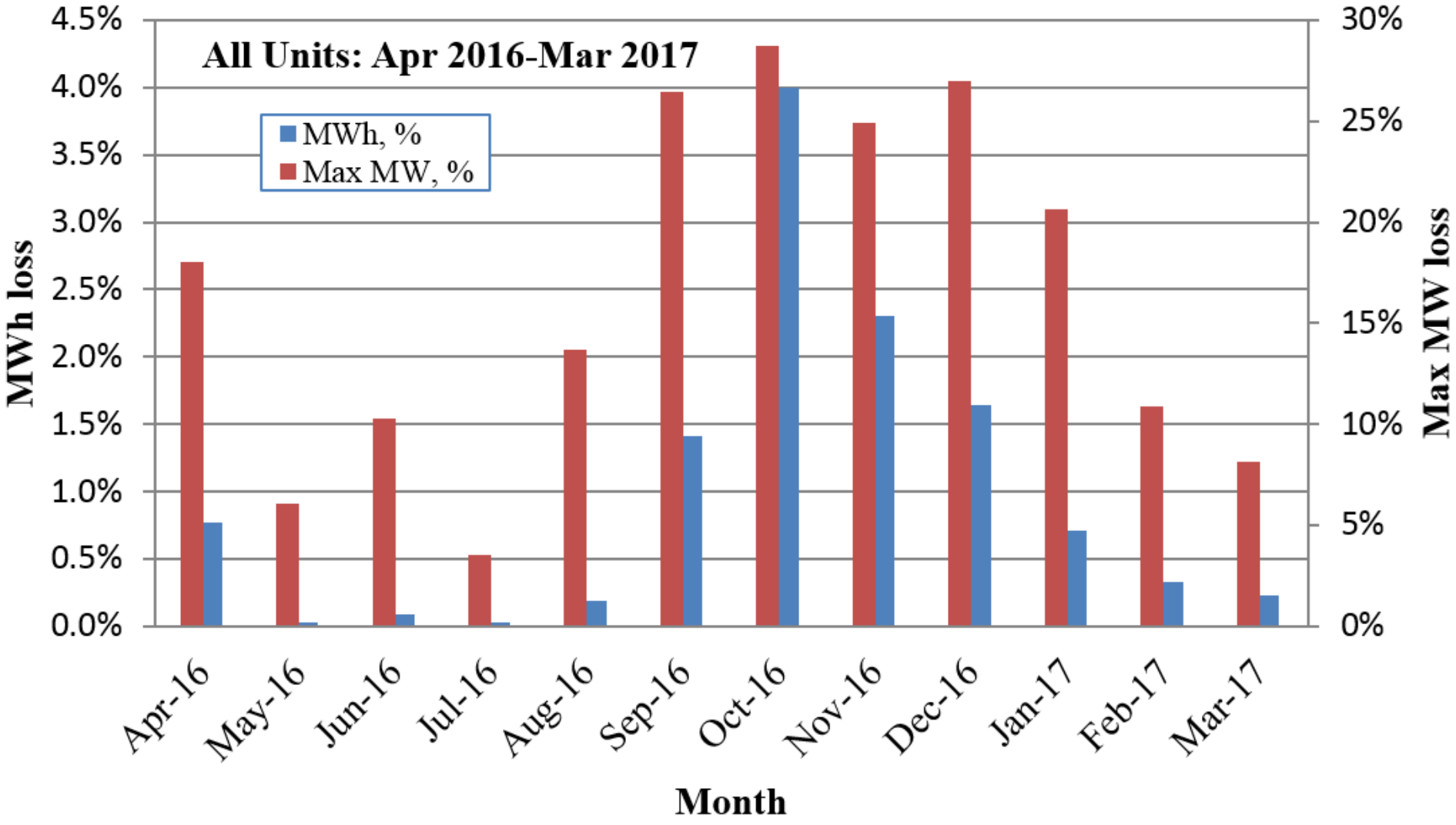
	Matimba	Medupi
Total Gross Electrical Output, MW	6 x 665	6 x 794
Total heat rejection rate by ACC, MW	6 x 905	6 x 932
Design Ambient Temperature, ˚C	18	23.7
Design Wind Speed, m/s	0	9
Design ACC pressure, kPa(a)	17.9	14.1
Total ACC platform length, m	509	669
Platform Width, m	70.8	108
Fan inlet height, m	45	54
Wind wall height, m	10	14.4
Fan stall margin, %	10	65
Walkway width, m	1.5	2.5
Number of fans	6 x 48	6 x 64
Fan Diameter, ft.	30	34

Medupi operational experience

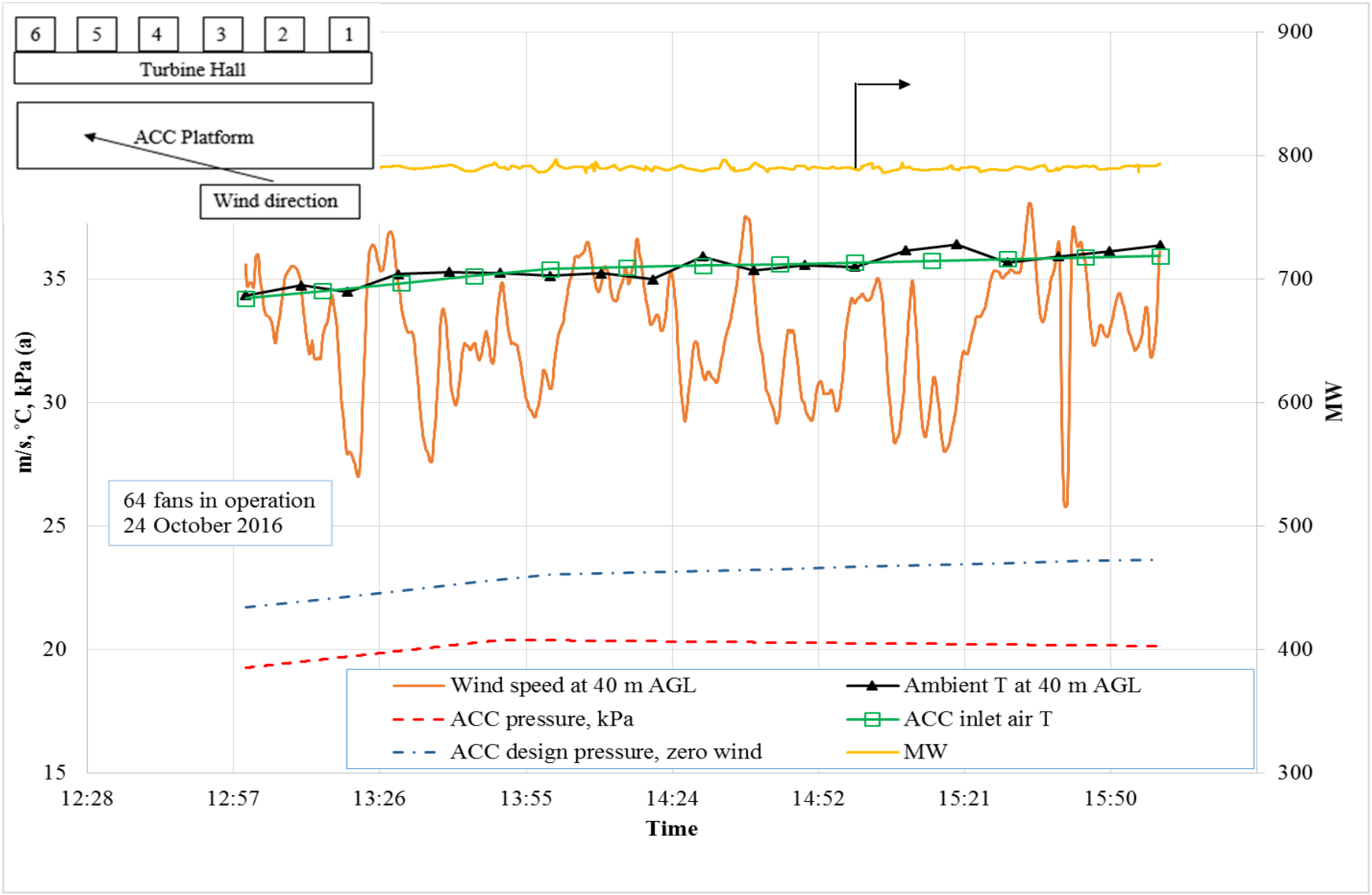
- Medupi unit 6 went into commercial operation in October 2015
- Official performance test done in December 2015
  - ACC performance measurably better than design
- **No** vacuum related load losses experienced since commissioning
- Due to close proximity of Medupi and Matimba the performances of the two ACC can be compared directly

Proximity of Matimba

Matimba vacuum related load losses



Medupi 6 performance, 24 October 2016



Conclusion

- Success of design features clearly demonstrated by site measurements
- Relative low cost requirements renders ACC performance almost immune to wind effects
- All incorporated into the initial design

Recommendation for new installations

- Purchaser to specify minimum ACC design features to minimize wind effects
  - Upfront work is required
- CFD as part of design can be omitted
- Fan pressure margin at selected blade angle of around 60% to be specified
  - In addition a high fan solidity at mid-span to be specified (> 0.4)

Acknowledgement

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  - Many of the design features incorporated in the Medupi ACC follows directly from his tireless work.
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Questions