

Lowering the Cost of Project Using Simple Analysis of SCADA Data A Real Case Example

Presented by:

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2013-10-15

PHM Conference 2013, New Orleans

Presentation Overview

- **TCE presentation**
 - TCE Mandate
 - TCE Location
 - TCE Infrastructure
- **A real case of signal trending**
 - SCADA Turbine Status Overview
 - SCADA Temperature Analysis and Threshold Determination
 - Cost Comparison
 - Winter Effect on Cost
- **Recommendations**

TechnoCentre éolien Mandate

Founded in 2000, the TechnoCentre éolien is a research and technology transfer center that helps companies adapt their technology to withstand the cold climate, develop new products for the wind energy industry, and integrate the supply chain in Québec.

The TechnoCentre éolien is working in four principal areas :

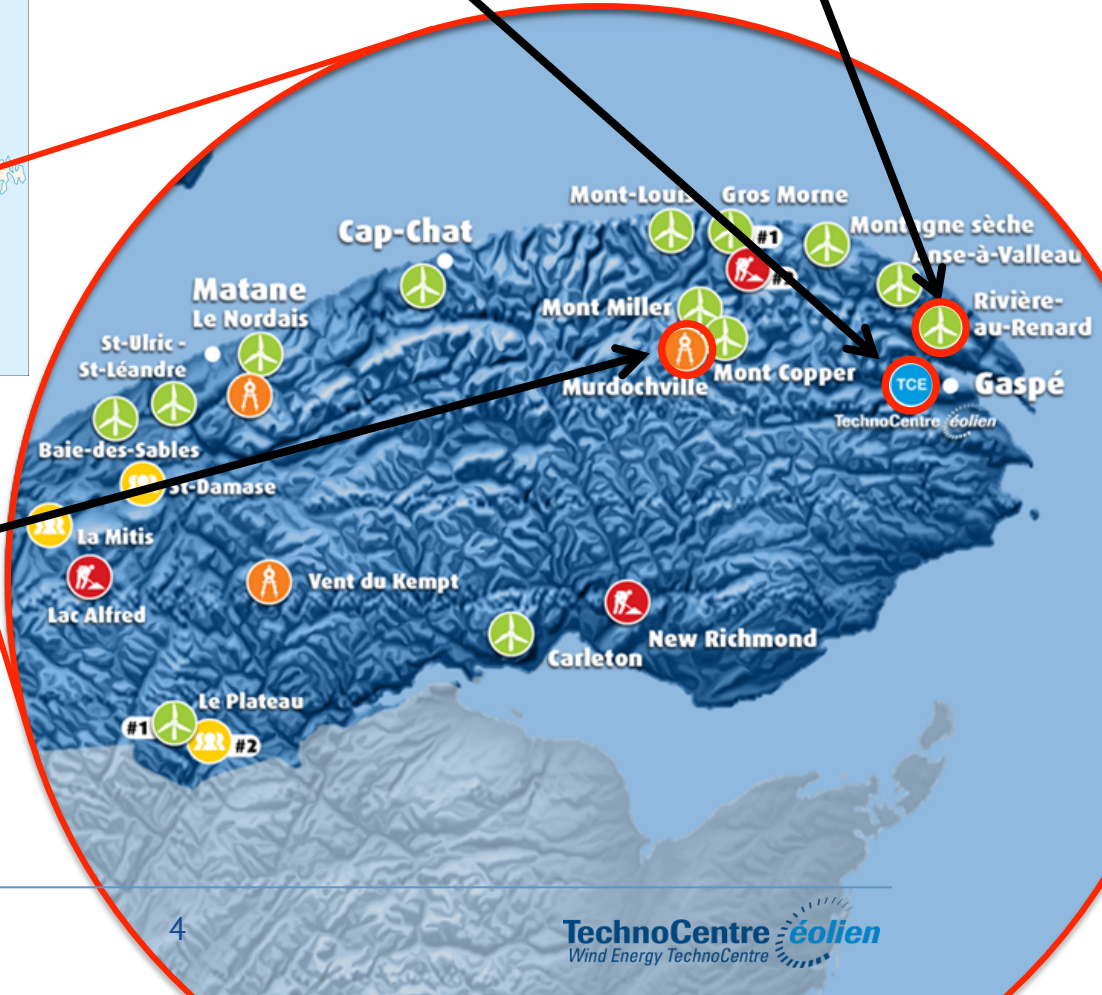
- *Technical assistance*
- *Applied research*
- *Economic development*
- *Communication/event*

TCE Location



TCE R&D wind farm

Office



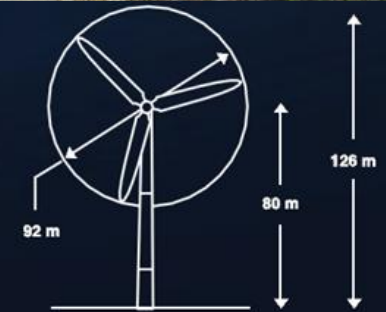
Murdochville's met masts

R&D Wind Farm

- Two 2.05 MW Repower MM92 CCV
- Commissioned March 2010
- In Rivière-au-Renard, Québec, Canada
- Icing & complex terrain
- R&D, technological transfer, technological validation, performance assessment.



Description	Value
Number of wind turbines	2
Model	REpower MM92 CCV
Rated power / Wind turbine	2.05 MW
Frequency	60 Hz
Rotation speed	7.8 – 15 RPM
Start-up speed	3 m/s (10.8 km/h)
Shut-down speed	24 m/s (86.4 km/h)



IEC wind class: 2
 Annual average wind speed: 7.9 m/s
 Topography: Complex site with high turbulence, near the sea
 Temperature: -30°C to +30°C
 Ice conditions: Up to 40 mm of ice

Met Masts



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Met masts name	TMV2	TMV3	MMV2
Height (a.g.l.)	15.3 m	20 m	126 m
Altitude (at the base)	915 m	530 m	325 m
Tower type	Tripod self supported CSA S37-01	Temporary monopole guyed wire	Tripod permanent guyed wire CSA S37-01
Location	Murdochville (Qc)	Murdochville (Qc)	Rivière-au-Renard (QC)

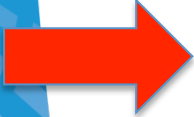
Microgrid



- Two 25 kW wind turbine
- One 7.5 kW wind turbine
- One compressed air storage

- Two 50 kW diesel generator
- One 15kW diesel generator
- One Battery storage

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 - **Winter Effect on Cost**
- Recommendations

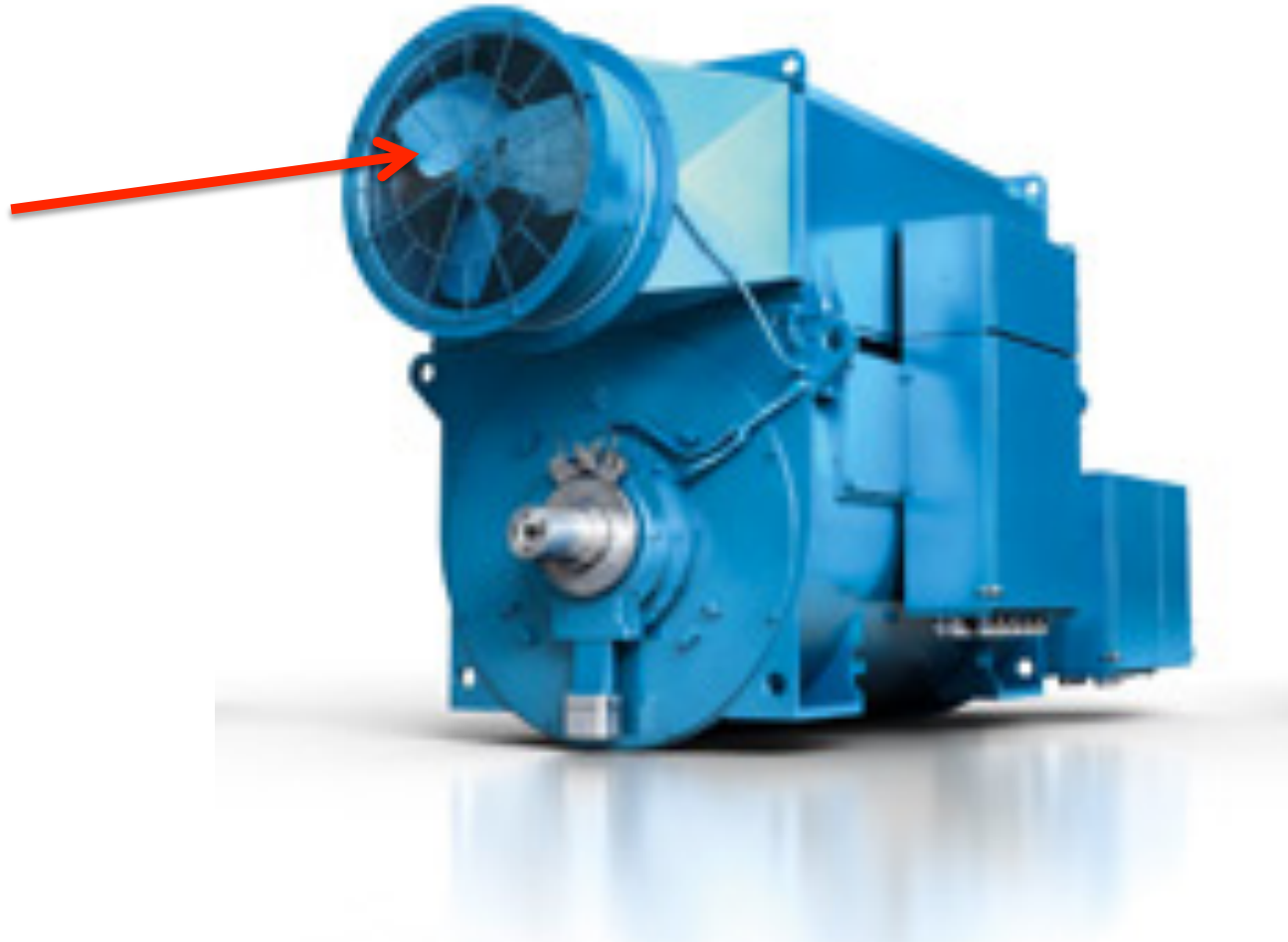
Methods Used for Predicting a Failure Using SCADA Data

1. Signal Trending (easy)
2. Physical Models (moderate)
3. Artificial Neural Networks (hard)

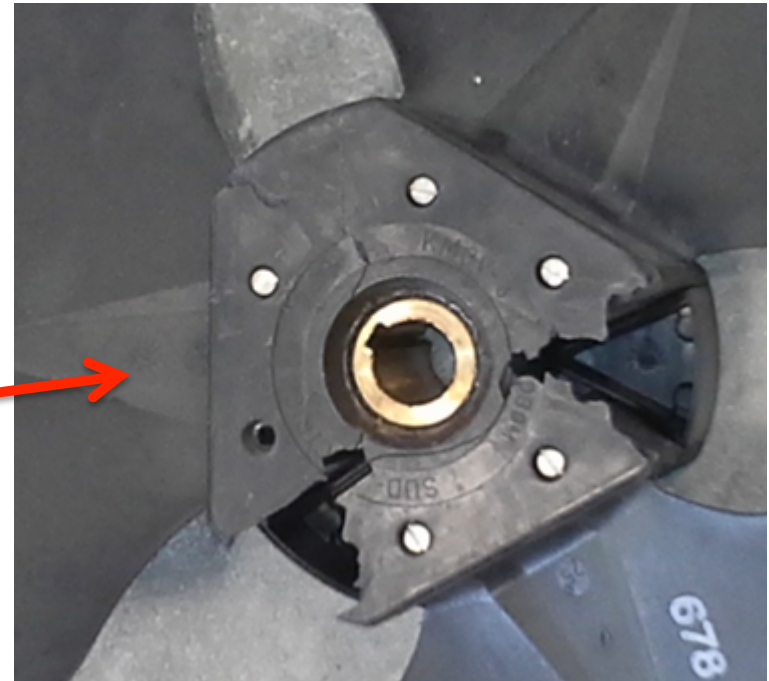
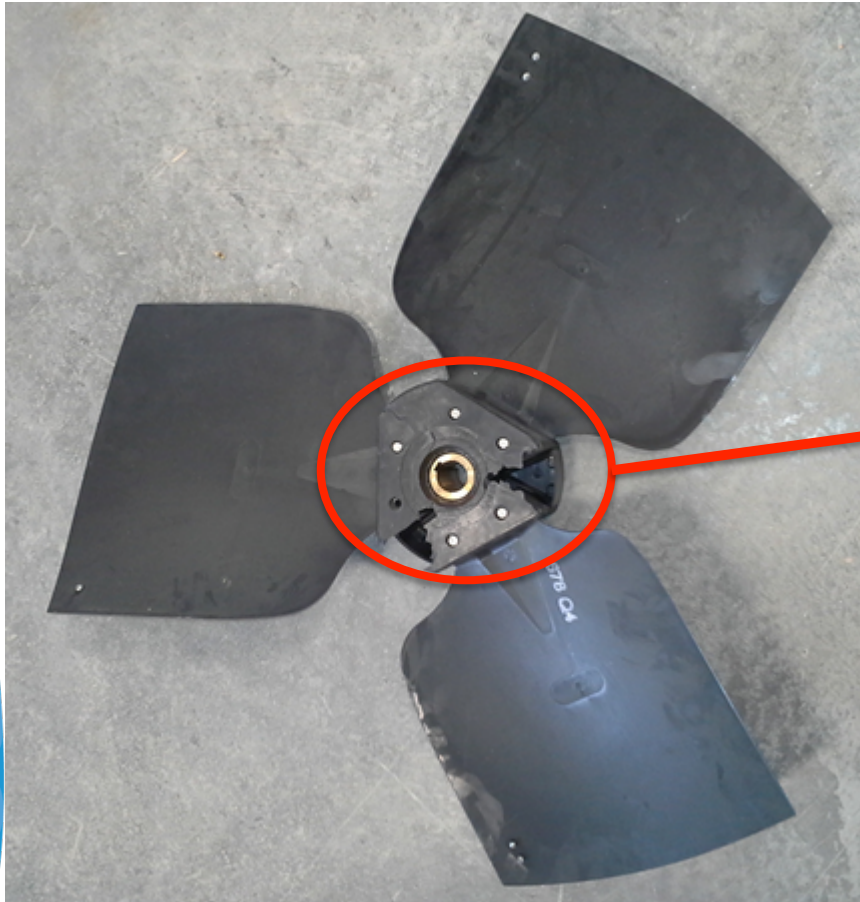
References

M. Wilkinson et al. 'Comparison Methods for Wind Turbine Condition Monitoring with SCADA Data', EWEA 2013

Generator Fan Failure



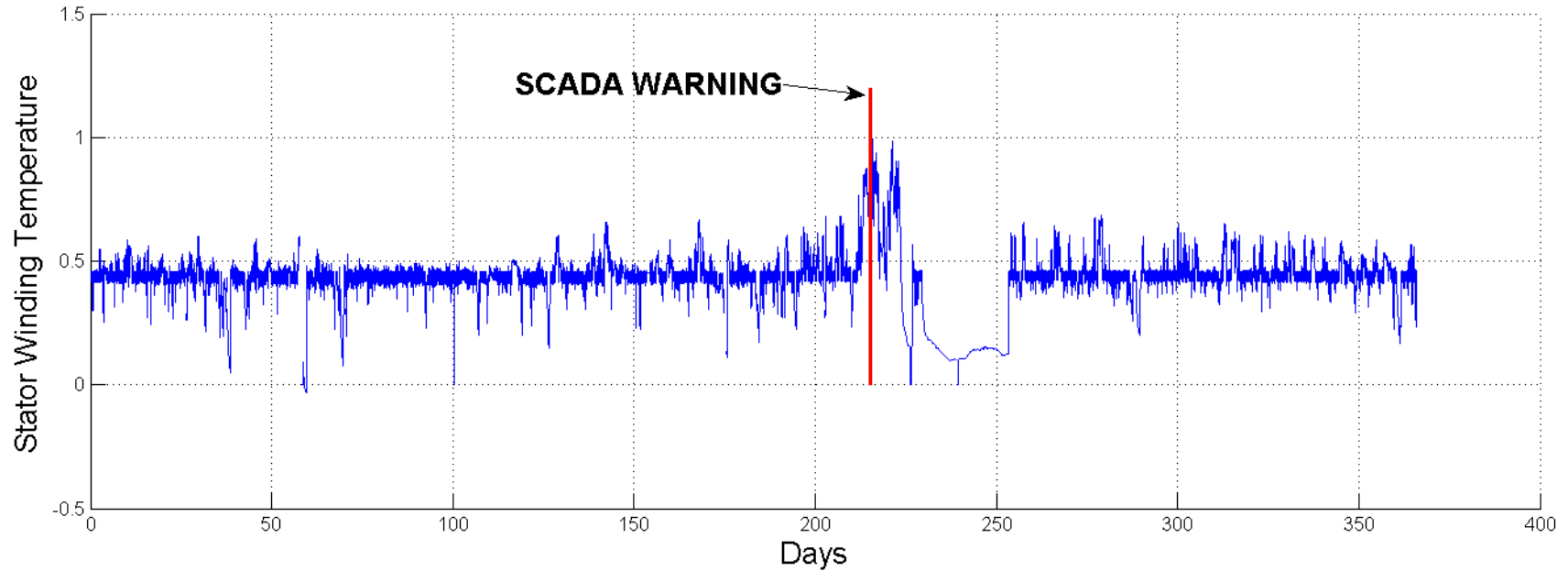
Generator Fan Failure



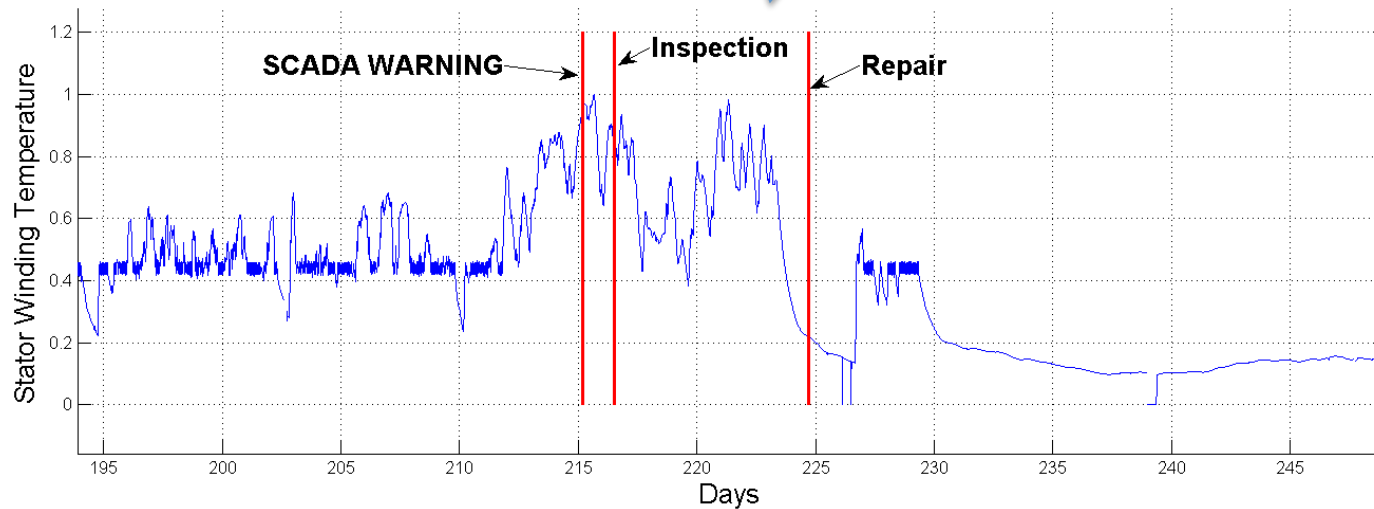
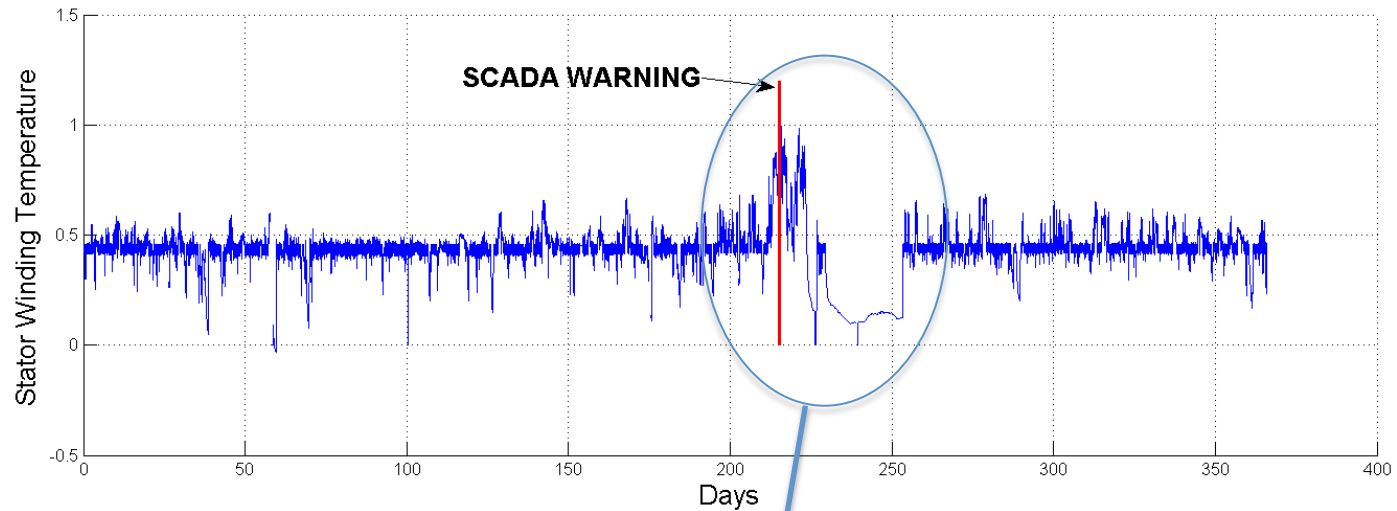
SCADA Status Overview Turbine 1

- 00:00 Stator high temperature Warning from turbine SCADA
- 15:30 Warning go off, wind below cut-in
- 32:00 Technician inspection reveal a generator fan failed
Turbine re-started with reduced power
- 9 days Fan replaced

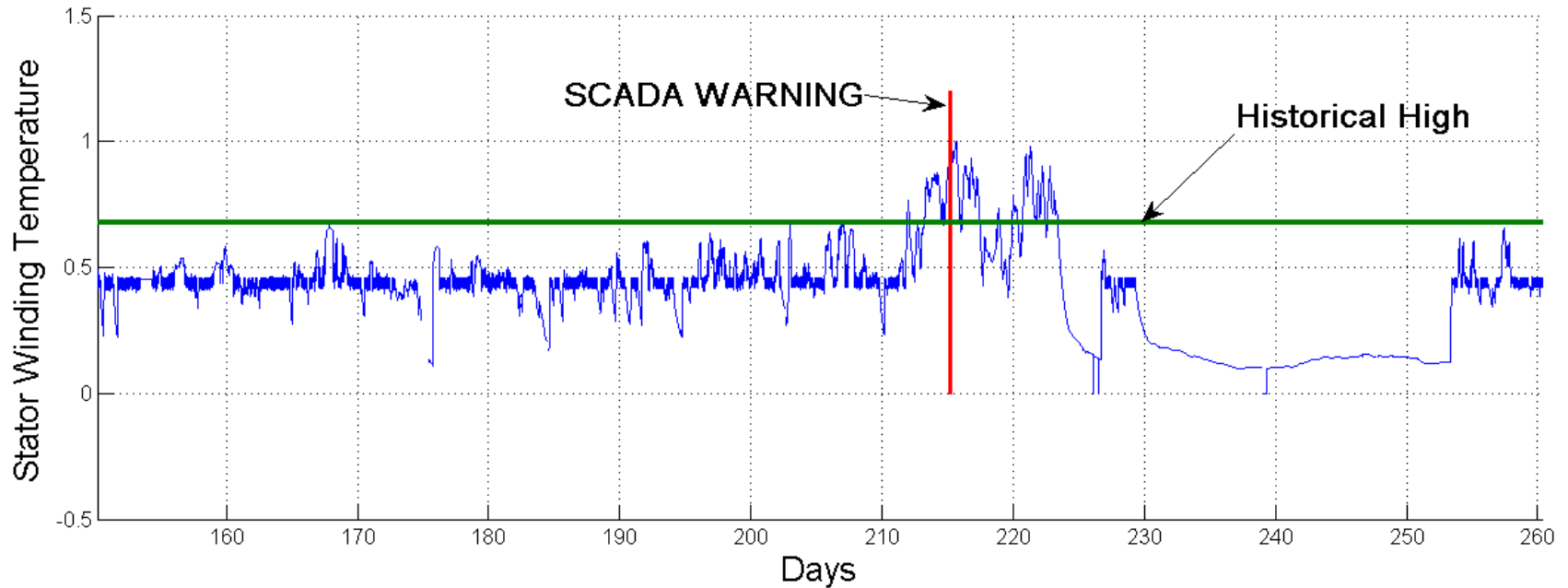
Stator Temperature Overview



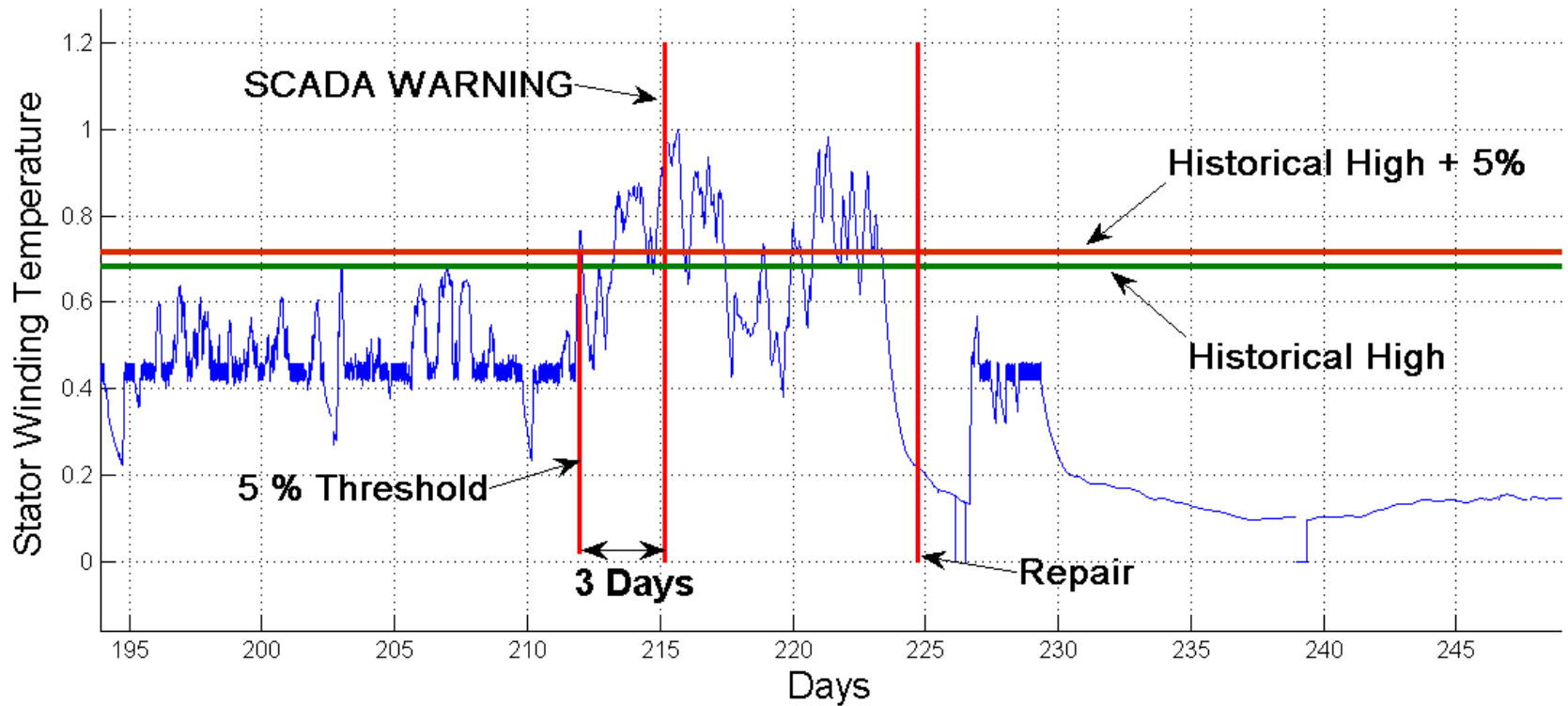
Stator Temperature Zoom



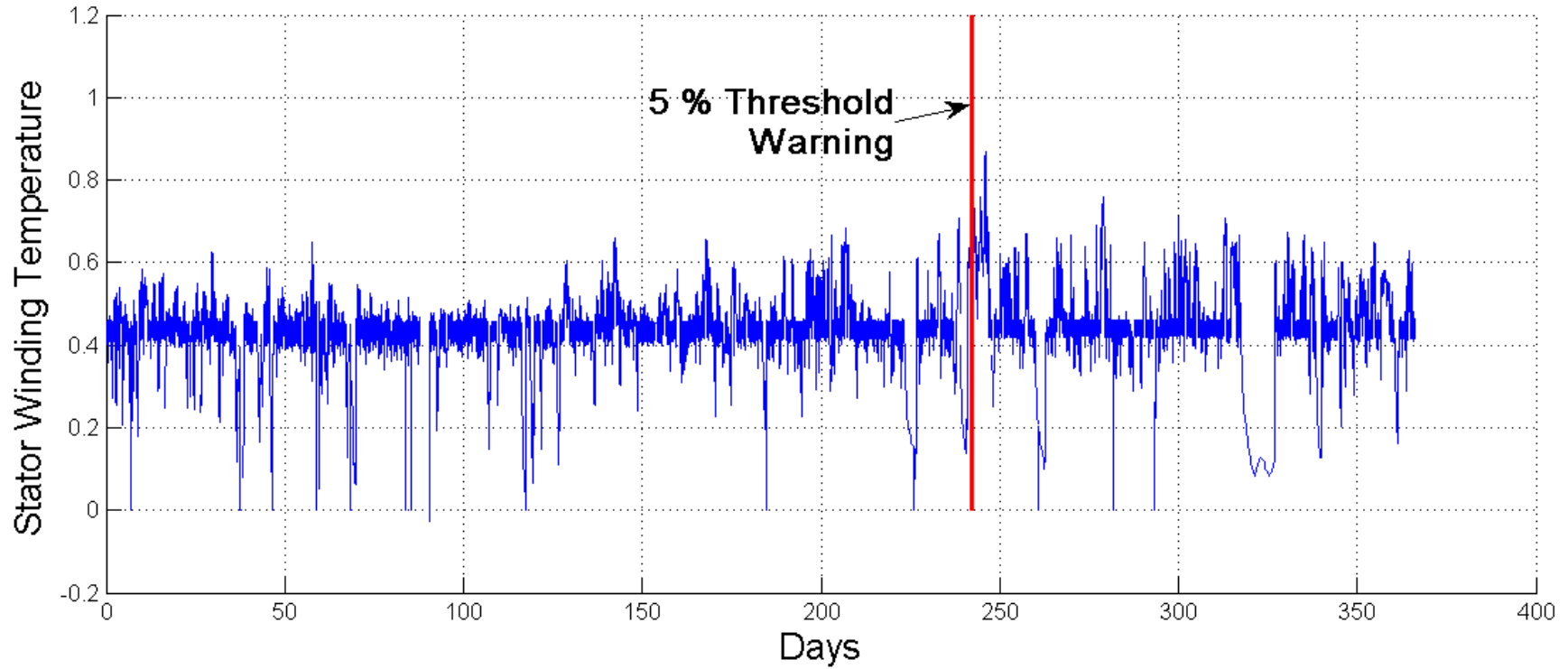
Stator Temperature Historical High



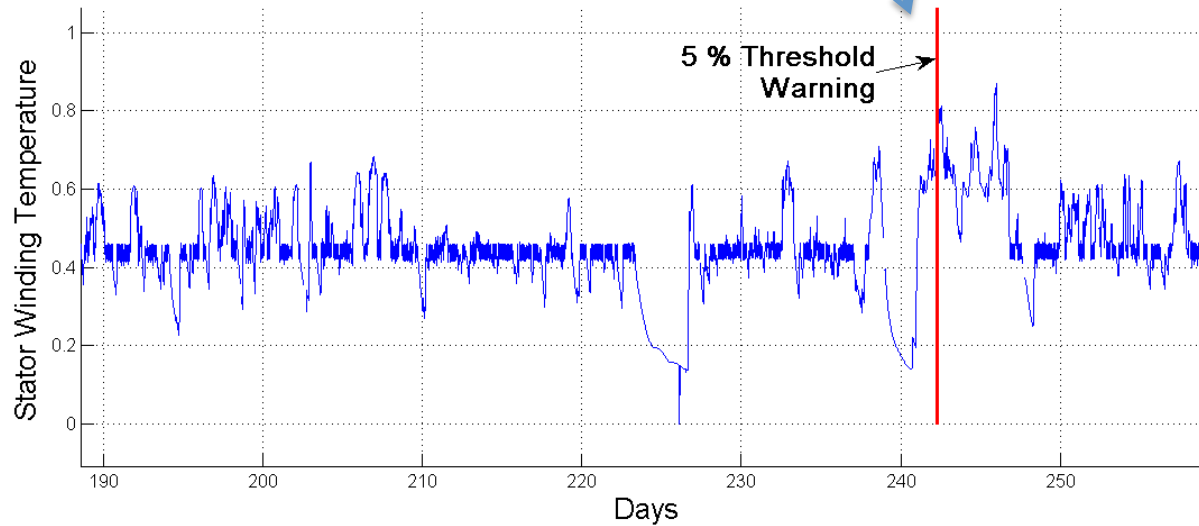
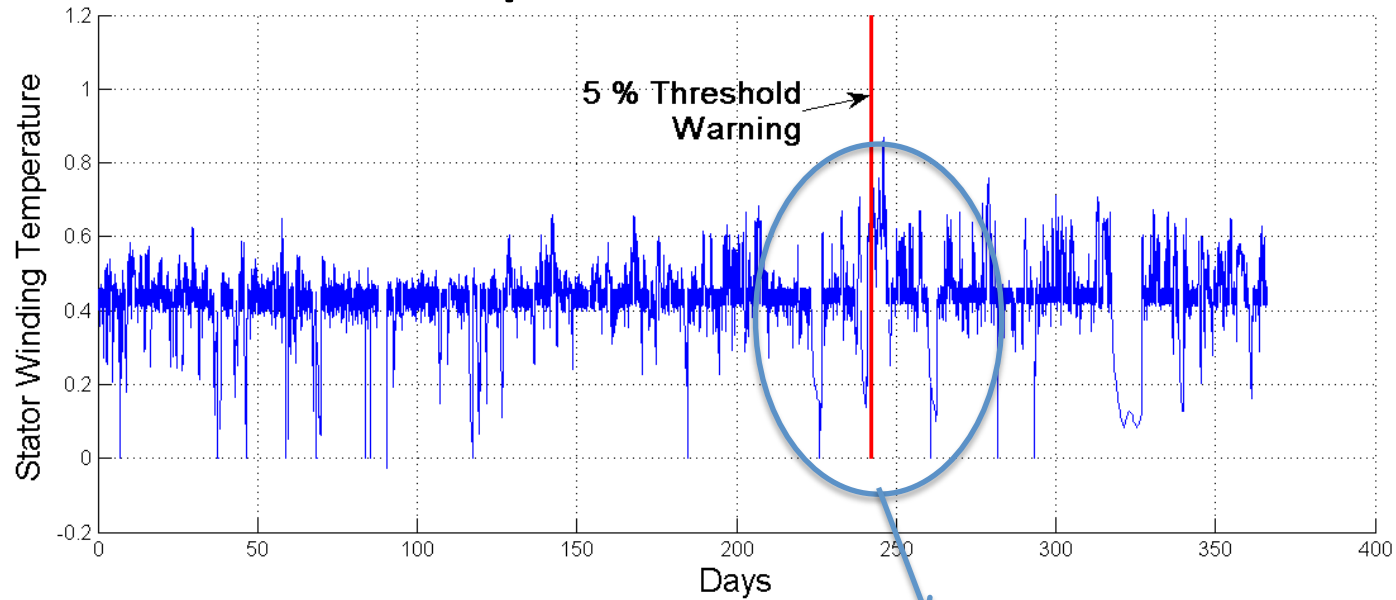
Stator Temperature Threshold



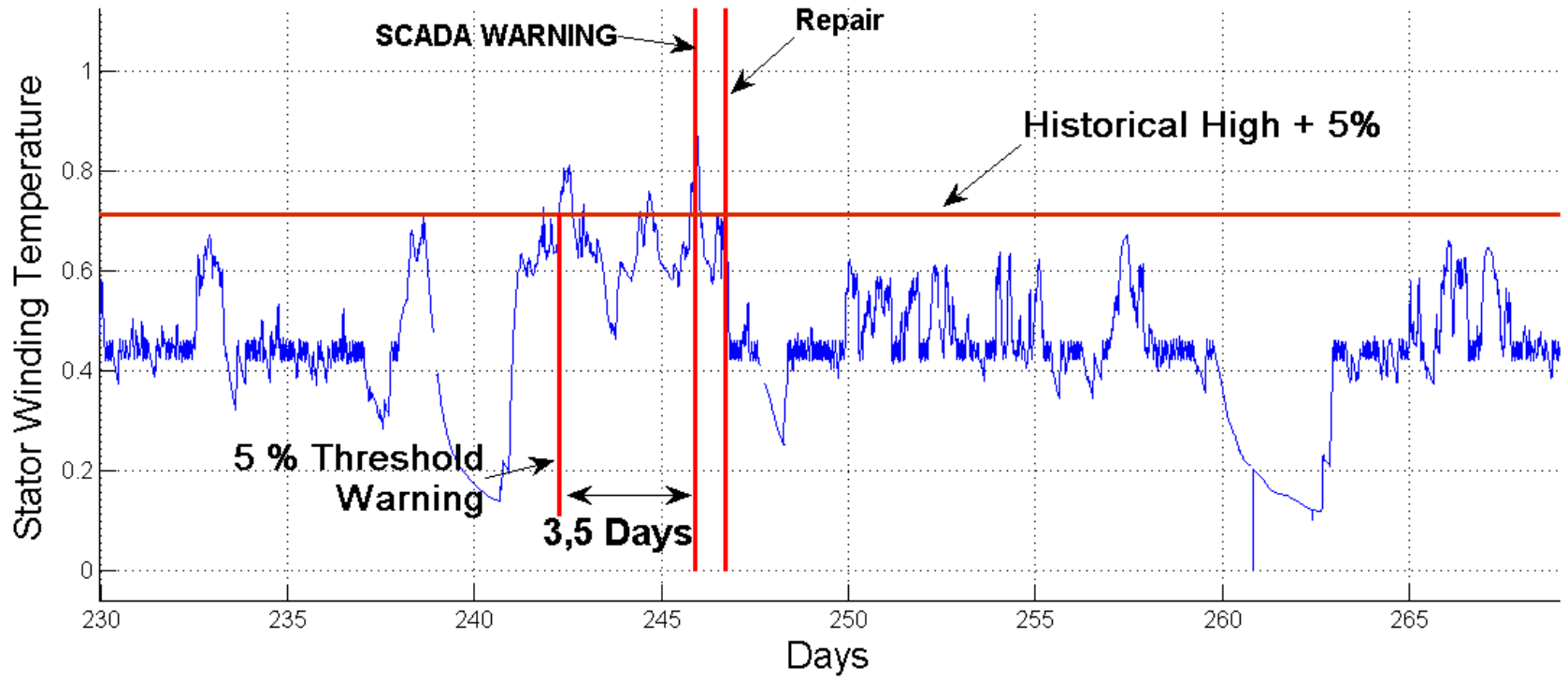
Stator Temperature Overview, Turbine 2



Stator Temperature Zoom, Turbine 2



Stator Temperature Threshold, Turbine 2



Cost Comparison

Items	Turbine 1	Turbine 2 With Signal Trending
Loss of production CF = 30%	9.5 days at limited power 9 000\$	$\frac{3}{4}$ days at limited power 800\$
Technician time	500\$	300\$
Total approx. loss	9 500\$	1 100\$
Difference	8 400\$ or 89%	

Winter Effect



Winter Effect



Winter Effect Definition

Winter Effect is an Increase in operation and maintenance cost due to an :

- INCREASE in Loss of Production
- INCREASE in Turbine Access Time
- INCREASE in Turbine Access Cost

Cost Comparison, Winter Effect

Items	Turbine 1	Turbine 2 With Signal Trending
Loss of production CF = 45%	9.5 days at limited power 9 000\$ -> 13 000\$	¾ days at limited power 800\$-> 1 000\$
Technician time	500\$-> 900\$	300\$-> 500\$
Vehicle fuel	200\$	100\$
Total	9 500\$-> 14 100\$	1 100\$-> 1 600 \$
Difference	8 400\$-> 12 500\$	

Winter effect =

4 600\$

500\$

30%

Recommendations

- Get ready before the commissioning of the turbine
- Validate real data with the wind assessment simulation
- Use neighbor turbine comparison
 - Wind vane and anemometer failure
 - North offset poor adjustment
- Involve site technician in development and tuning of the detection tools
- Don't only focus on main component
- Be aware of non-frequent turbine status code

Thanks you, Merci

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