



Predictive maintenance techniques based on data analysis

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STEAG – experienced partner

**3.6
billion**

sales (in EUR)

6,500
employees

7,600

installed power in MW
worldwide

**Operation
& Maintenance
WIND**

**>1.3 GW
references
in WIND**

over
100,000 MW
in our
technology

**SR::Suite
and services**

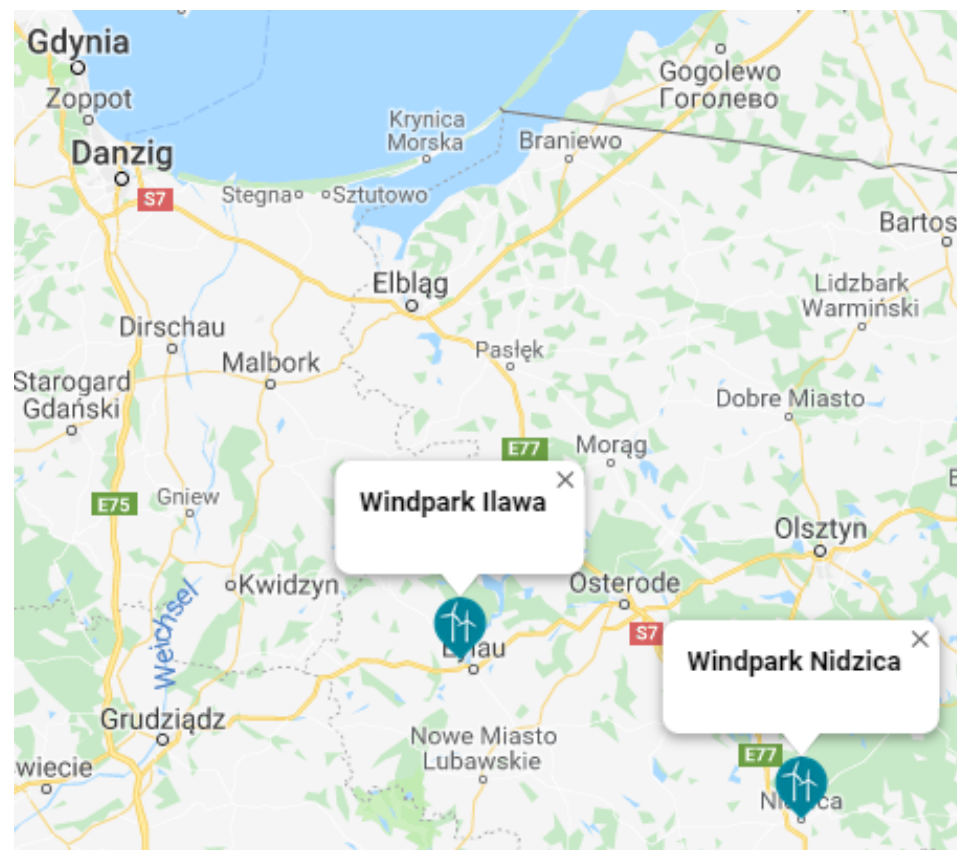
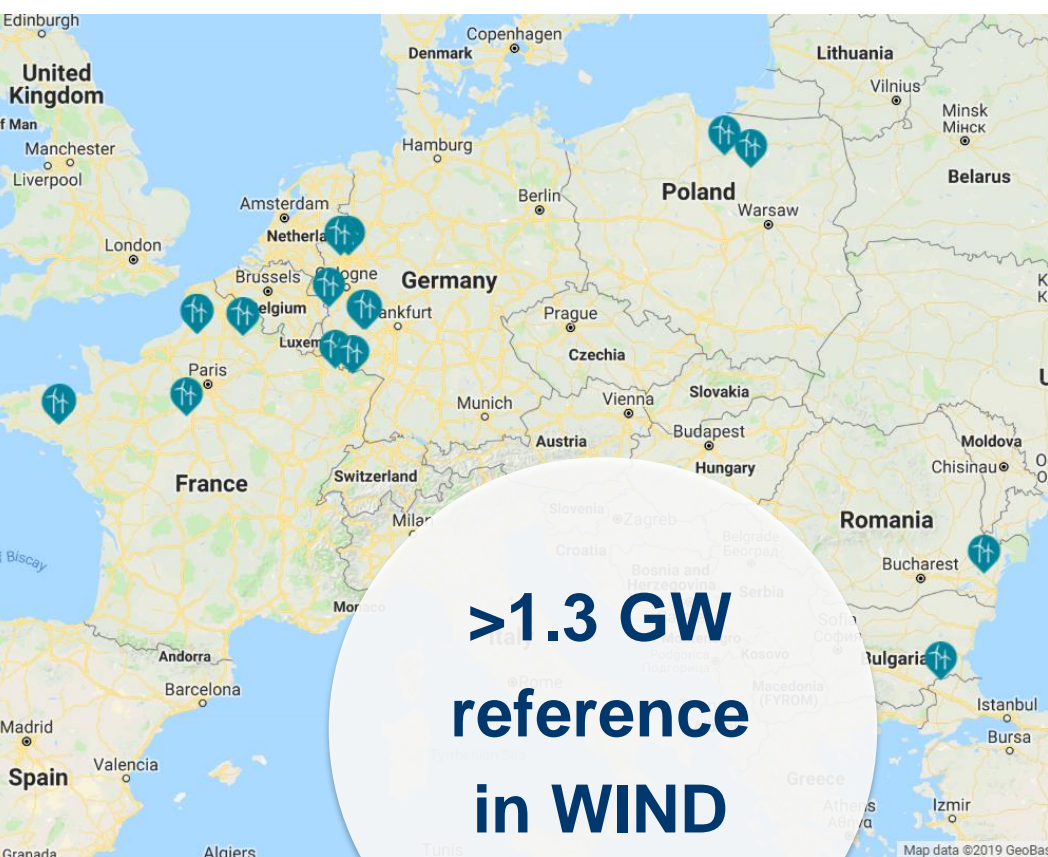
**>6,500 MW
whole scope
of maintenance**

own wind
power

**>220 MW
>89 units**

**>800
delivered systems
for energy sector**

Turbines in Ilawa PL and Crucea RO same model (Vestas V112, 3 MW)



STEAG Wind sites

Construction of Crucea



Experienced operator vs thousands of tags



Analyzed wind farm

**STEAG wind
farm**

108MW

36x3MW

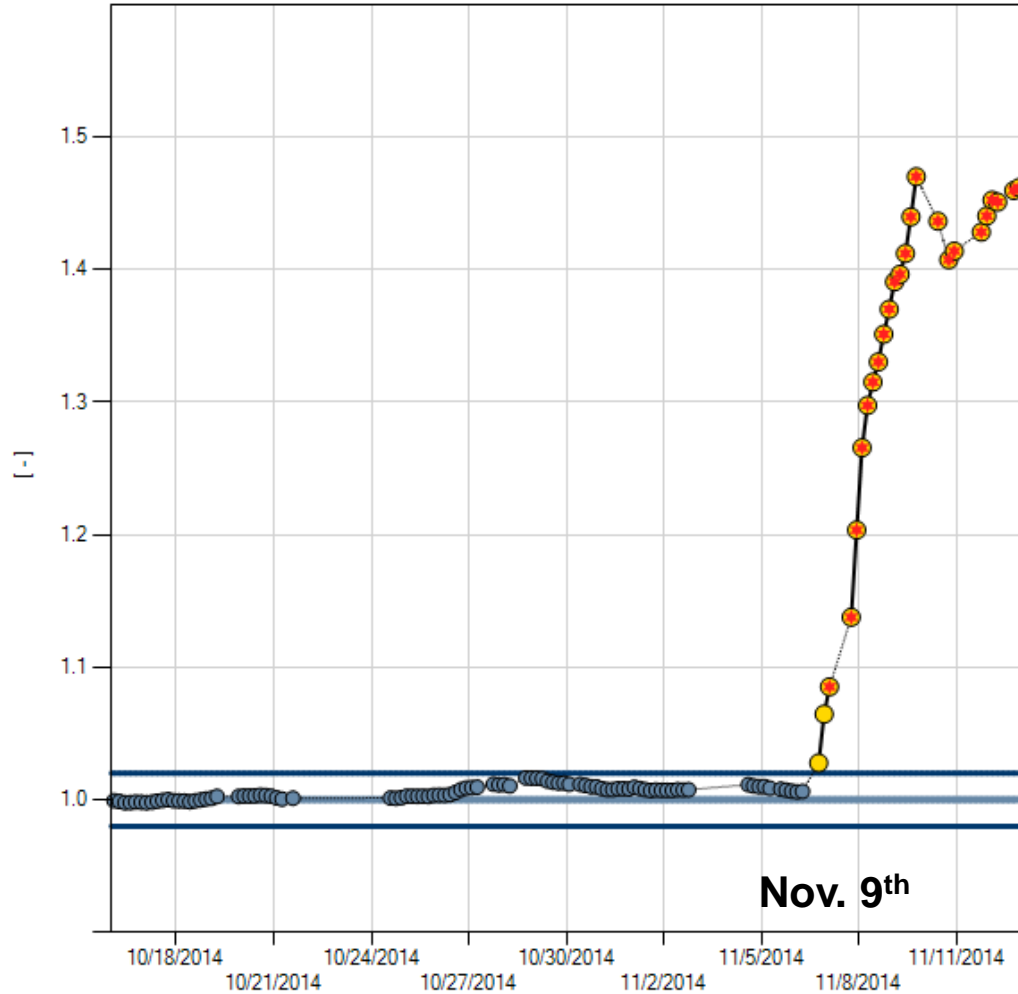
Analysis period

Sep. 2014

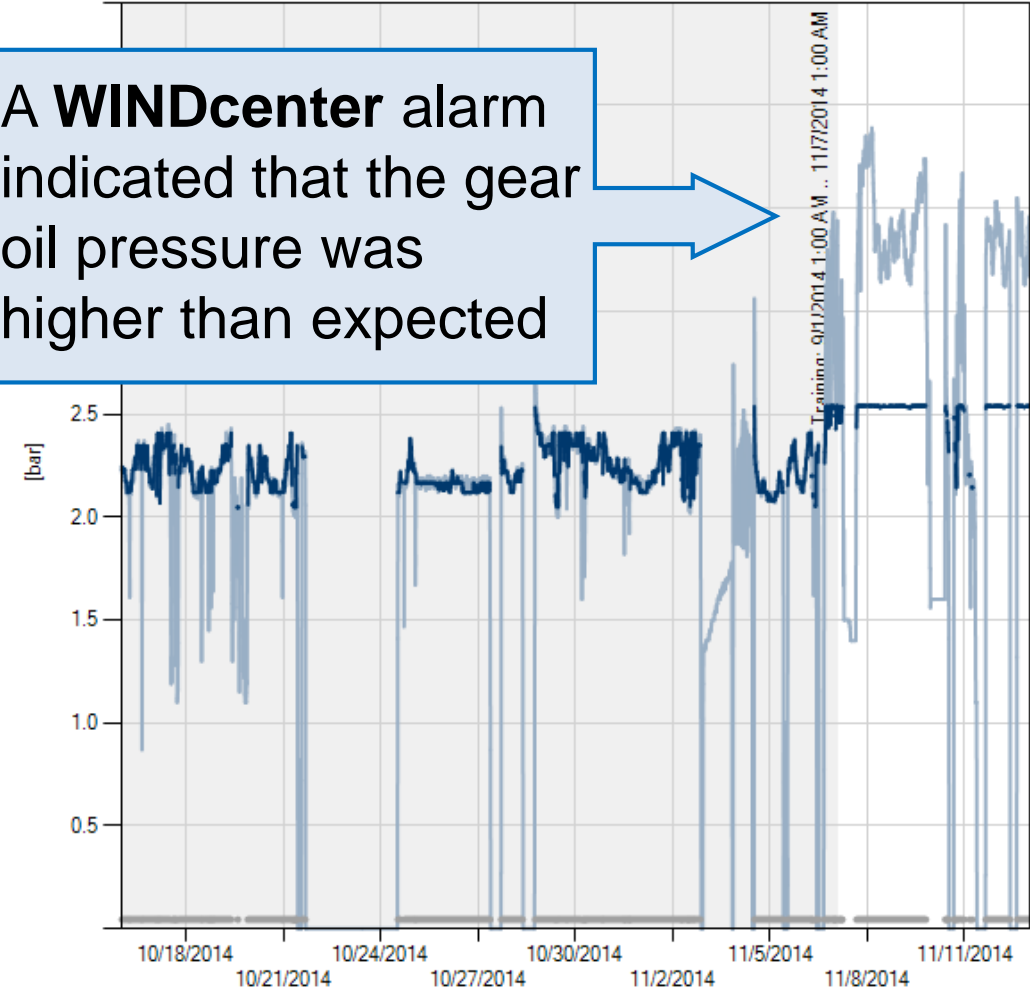
Sep. 2015

1st year
of
operation

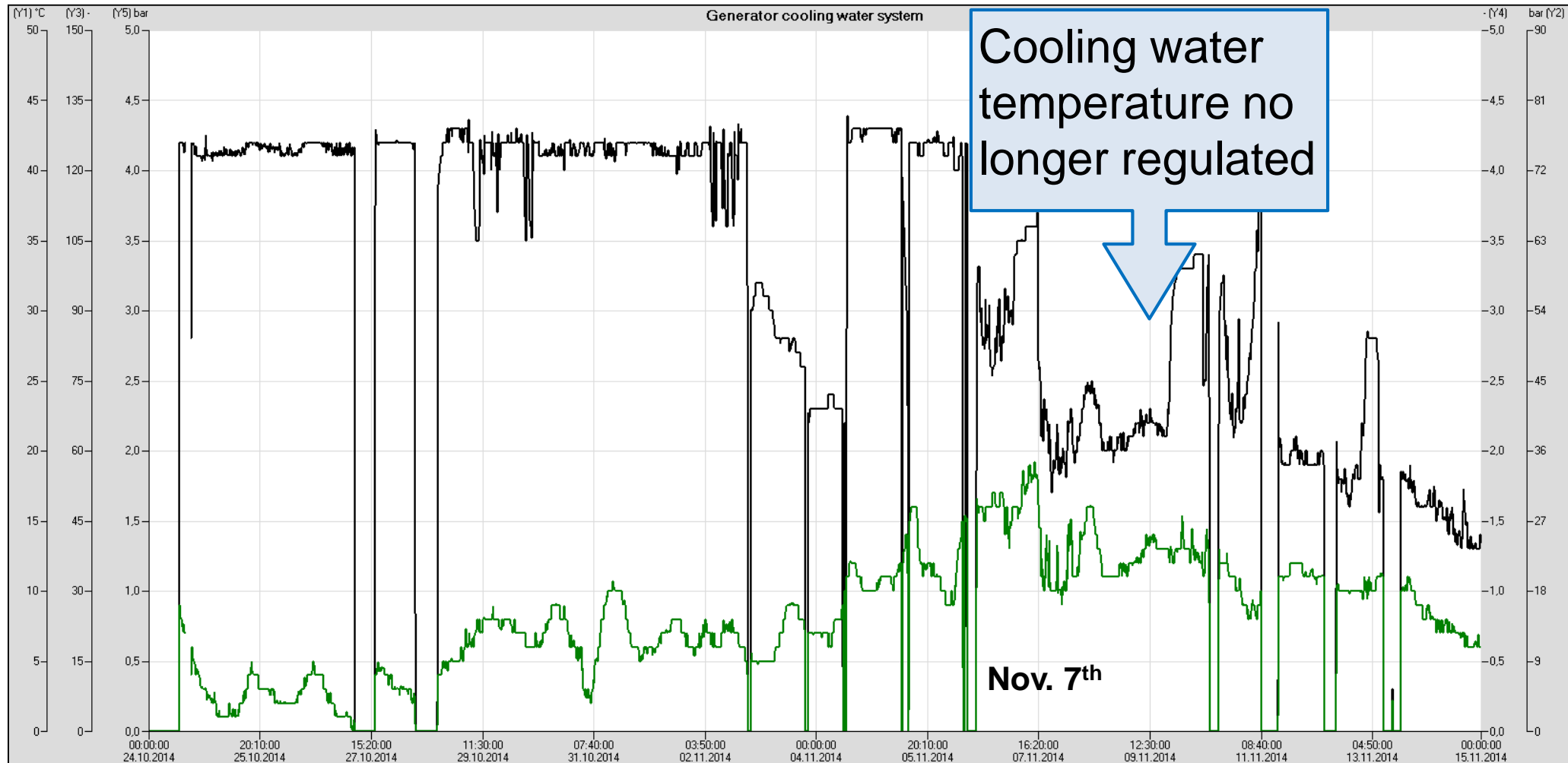
Case study 1: Gear oil pressure



A **WINDcenter** alarm indicated that the gear oil pressure was higher than expected



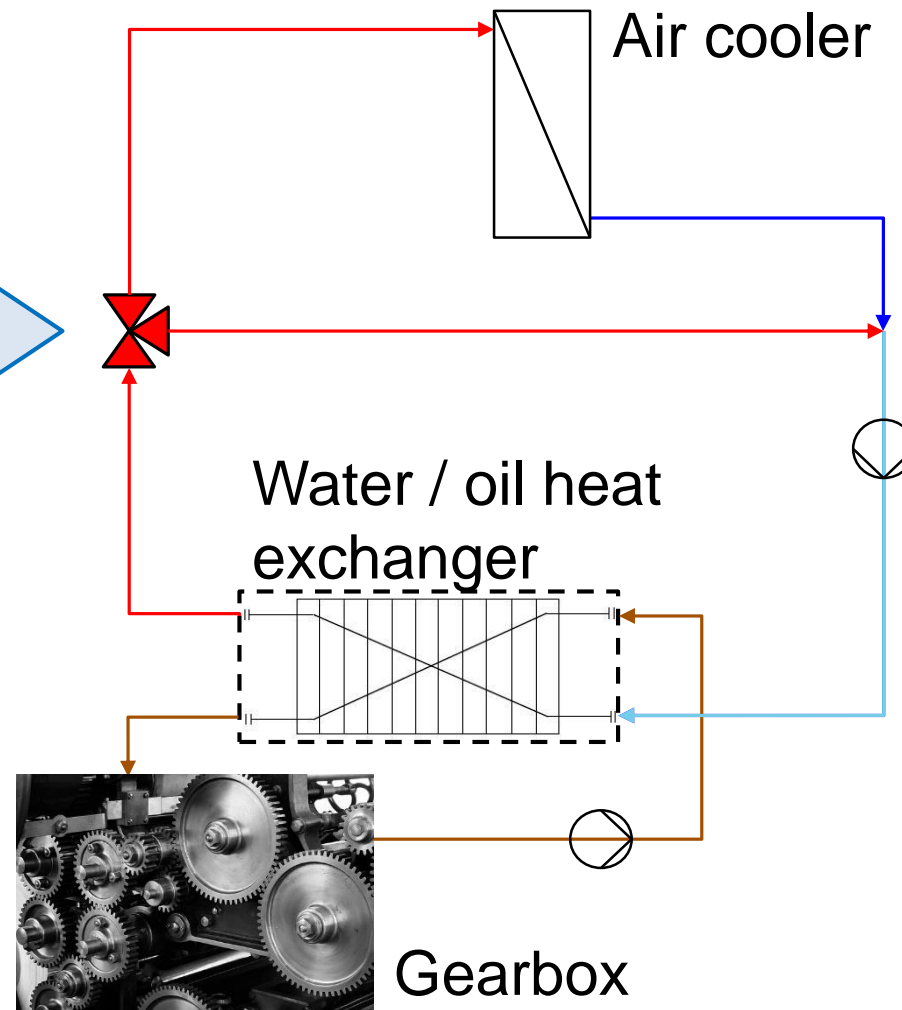
Case study 1: Gear oil pressure Root cause analysis



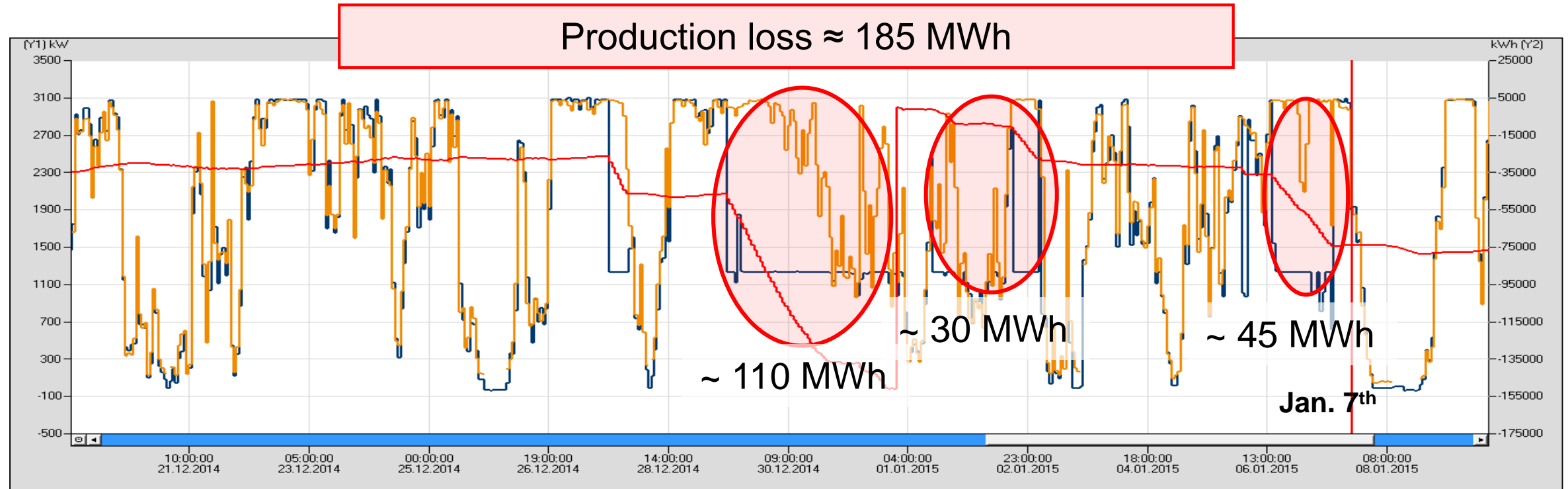
Case study 1: Gear oil pressure Root cause analysis

WINDcenter's RCA determined that the 3-way-valve was defective

The **WINDcenter** recommended immediate valve repair/replacement on November 14th, 2014

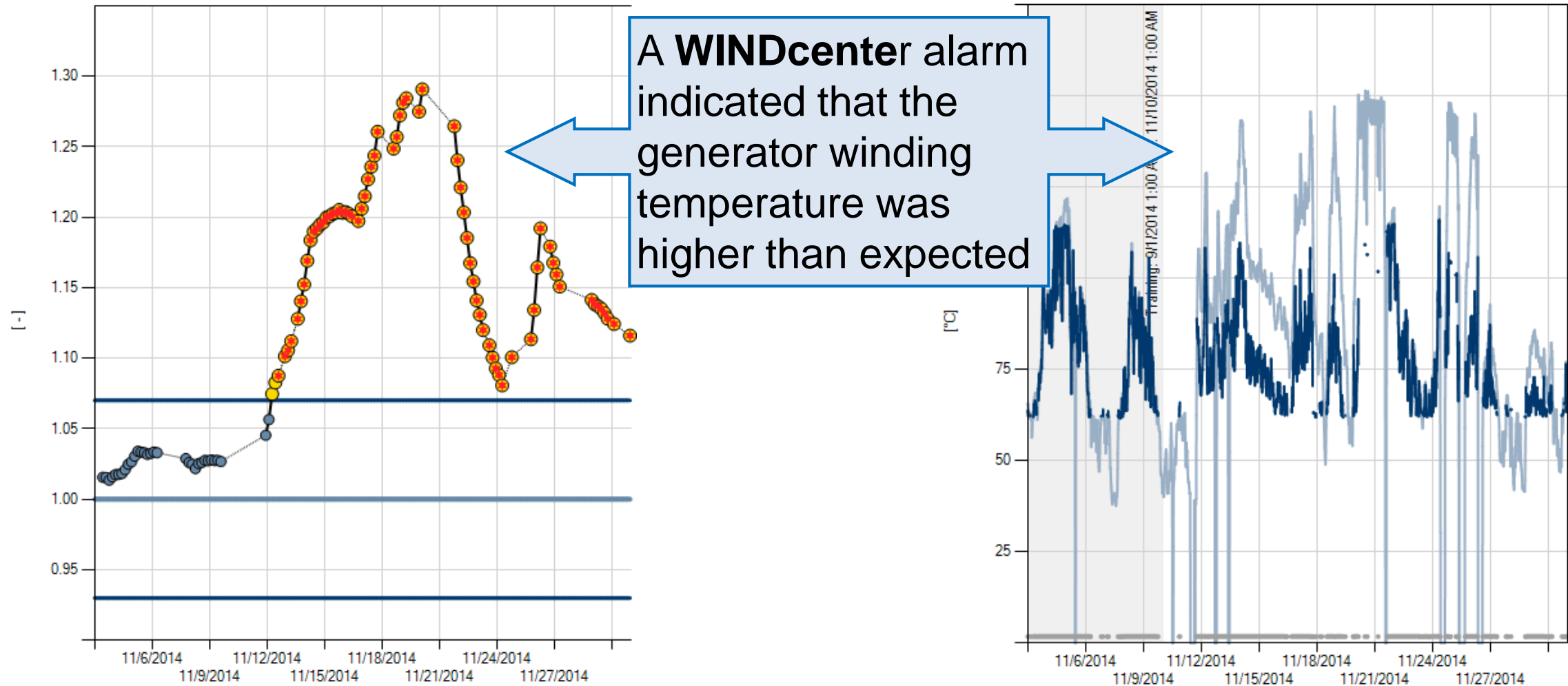


Case study 1: Gear oil pressure Production loss due to event



A similar behavior was observed on two other wind turbines.

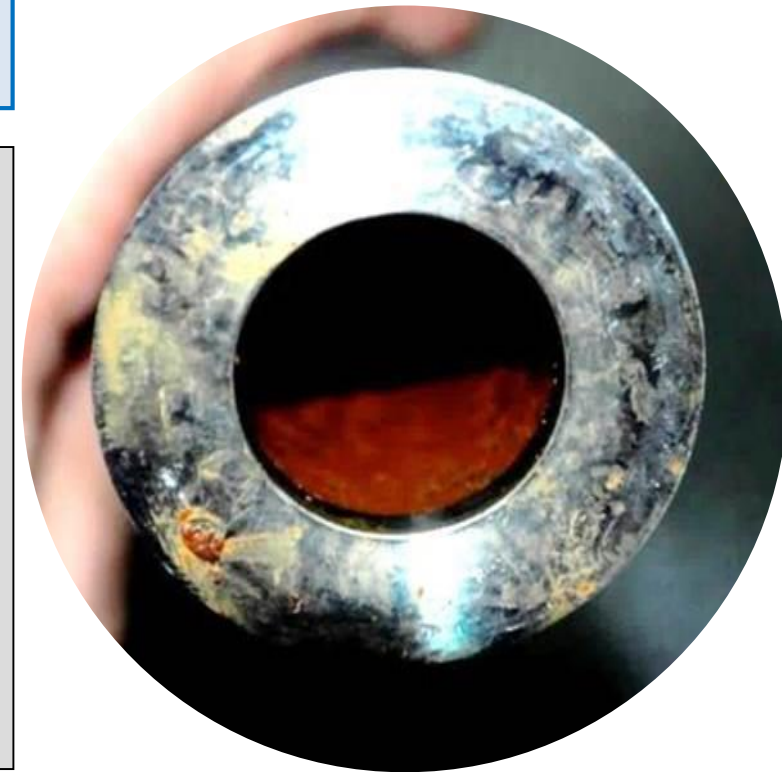
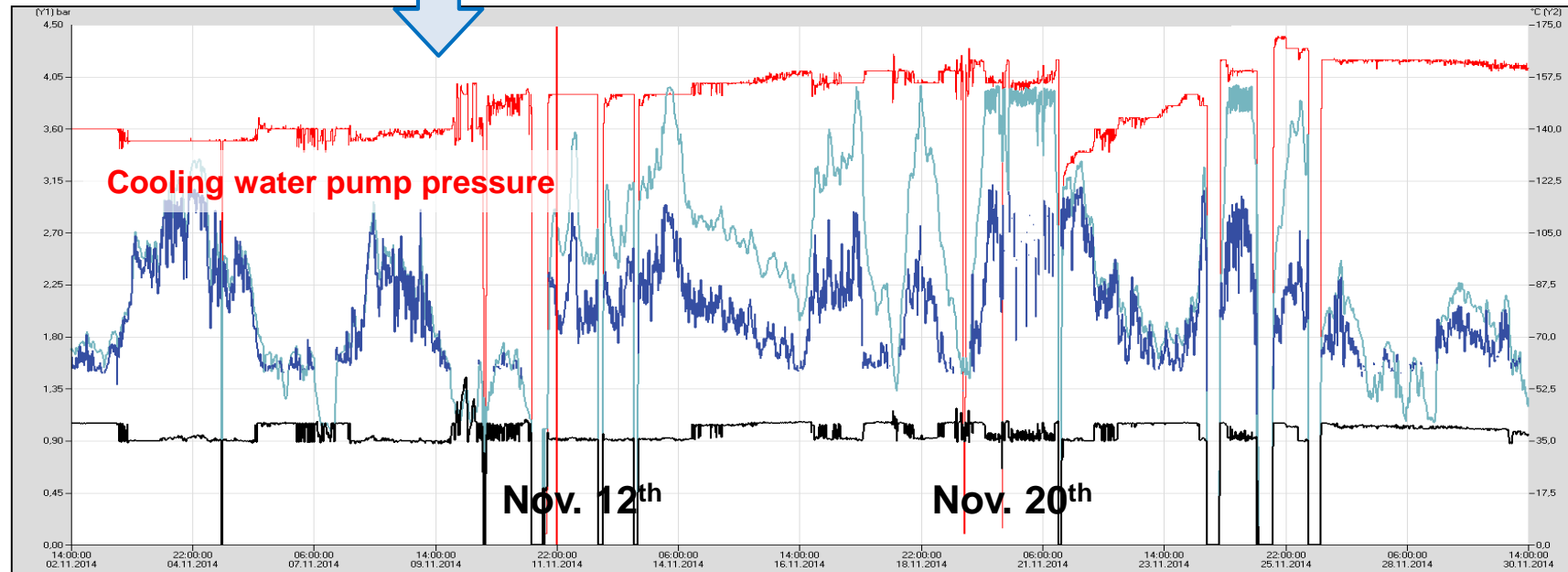
Case study 2: Generator temperature System alarm



Case study 2: Generator temperature Root cause analysis

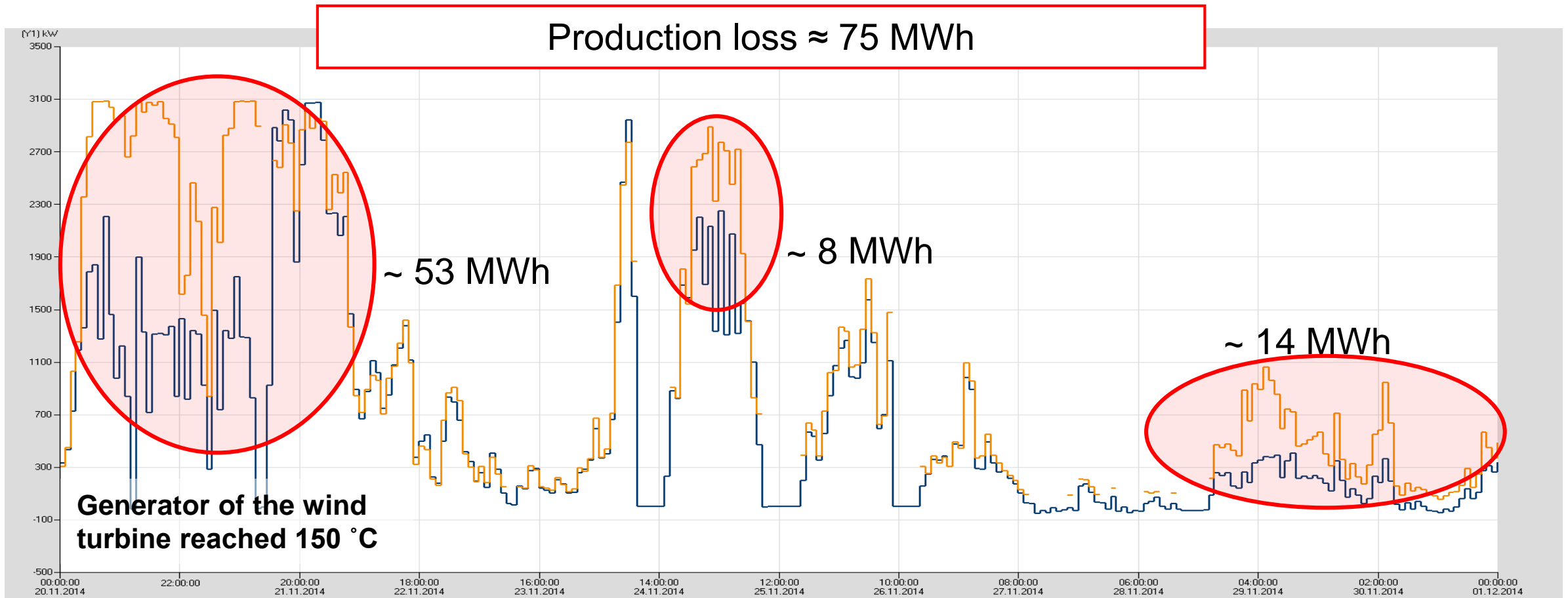
High cooling water pressure was detected by **WINDcenter's** RCA

The **WINDcenter** recommended cooling water filter replacement on November 14th, 2014



Filter replaced on Nov. 21st and on Dec. 8th. Production **loss of 75 MWh**

Case study 2: Generator temperature Production loss due to event



Filter replacement on November 21st and on December 8th

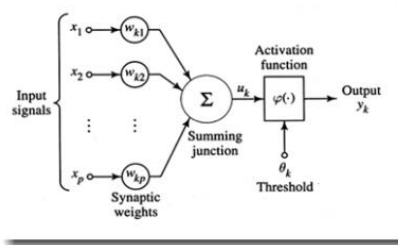
Analyzed wind farm: 36 WTs, 3 MW each, $\mu_{Cf} \approx 34\%$ 1 st operation year	#	Avoidable losses [MWh]
Case study 1 (gear oil pressure)	1	185
<i>Case study 1.1 and 1.2 (estimated)</i>	2	370
Case study 2 (generator temperature)	1	75
<i>Case study 2.1 and 2.2 (estimated)</i>	2	150
Total (1 year, 10 KPIs, measurable)	6	780



Digital Replica / Digital Twin – Data-Based Model

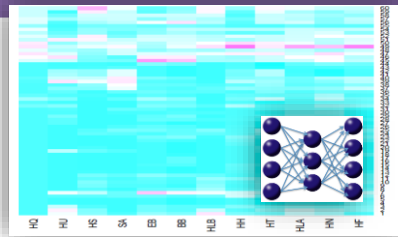
HQ KPI / Big Data Methods

Lifing models
Internet of Things
Anomaly Detection
Machine Learning
Bayesian Models
Deep Learning
Forecasting
Statistics
Data-Driven
Predictive Analytics
Digital Twins
Optimization Algorithms
Regression
Clustering
Big Data
Classification

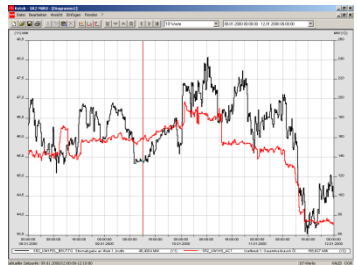


HQ KPI

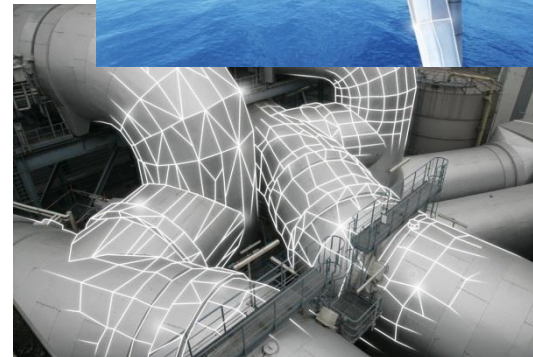
Training



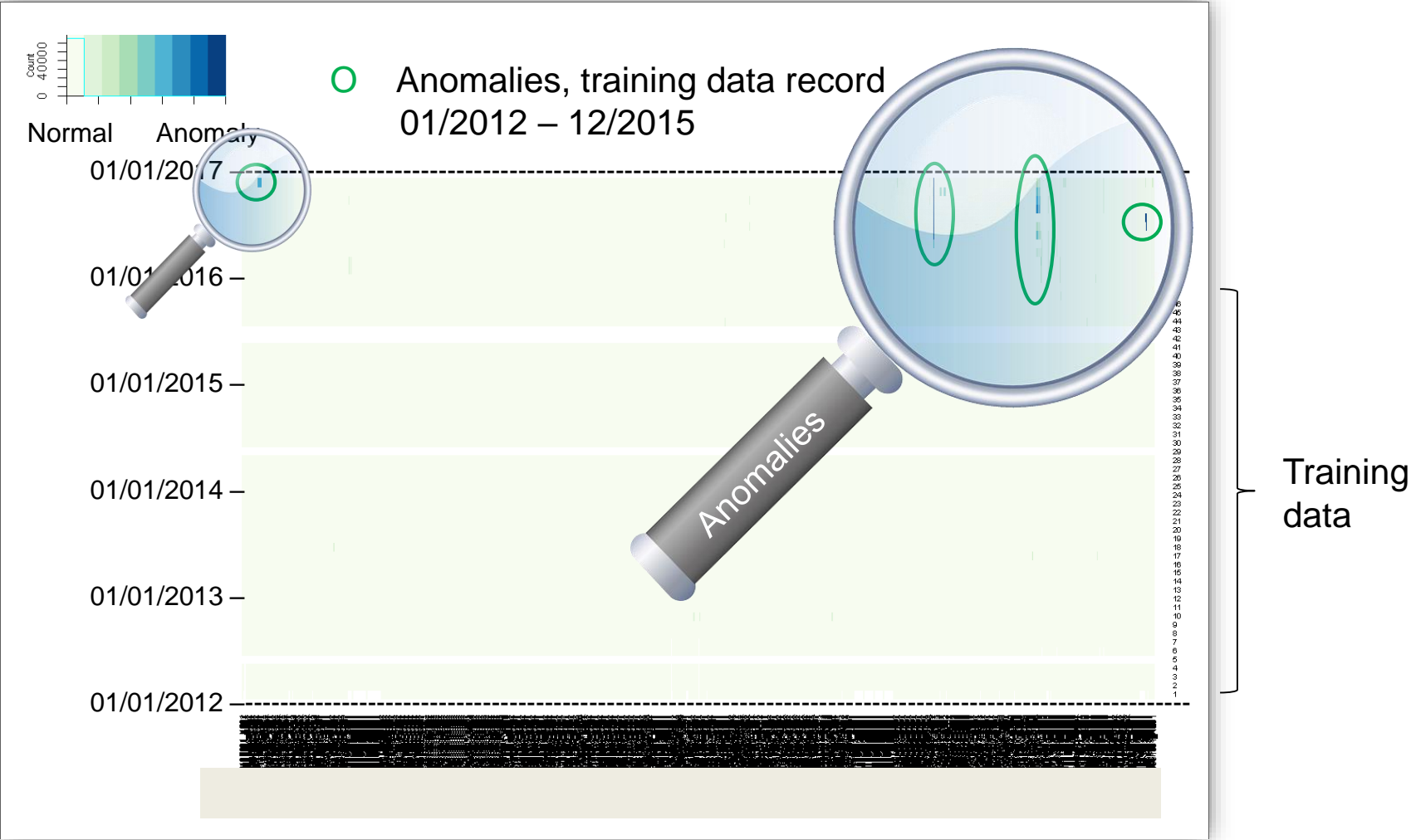
Big Data methods



Sensor-based data

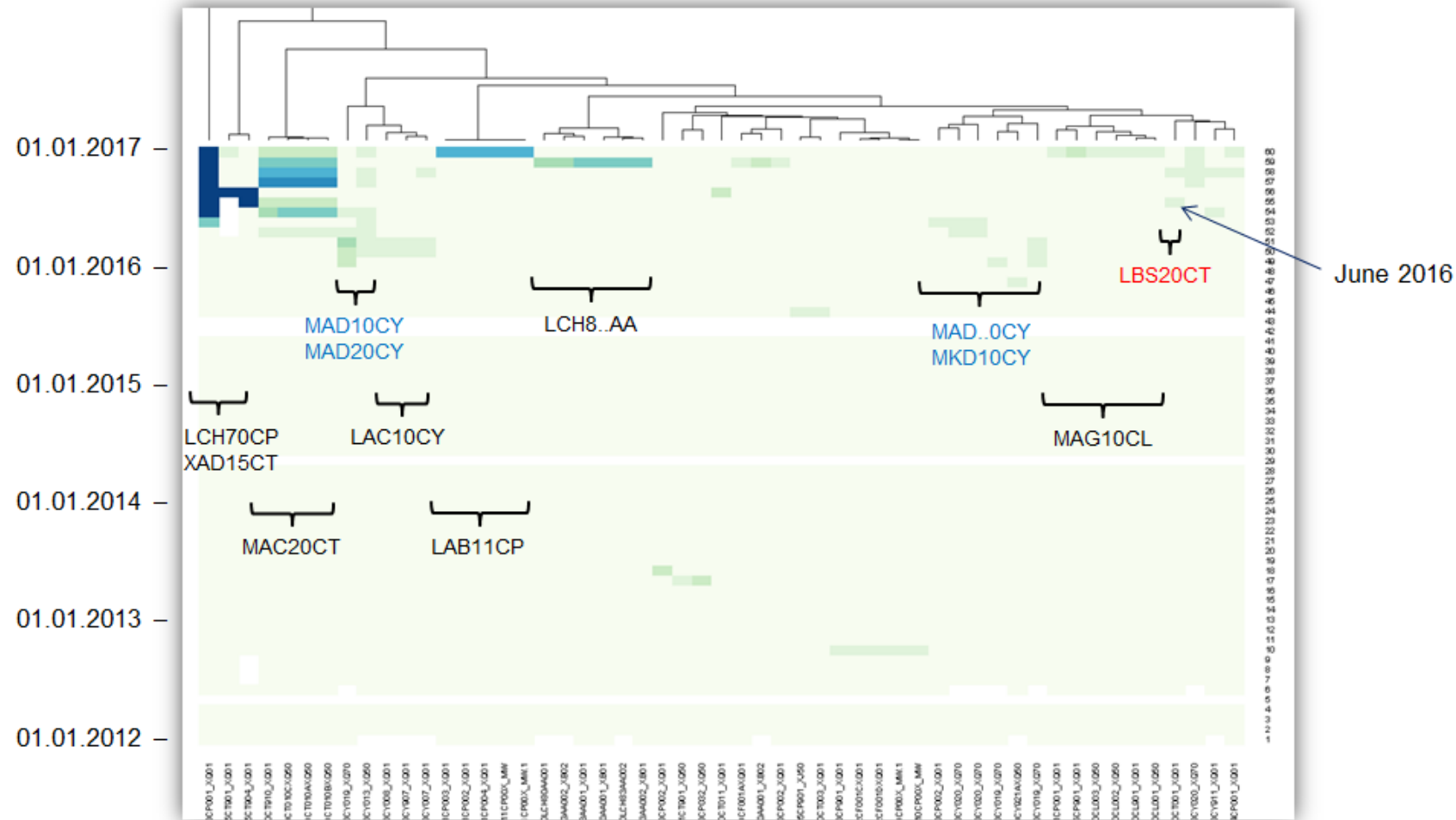


Highly Condensed Representation of Anomalies in a Heatmap



Hundreds of measurements in one view, five years data for a set of data for anomaly training from 01/2012 to 12/2015

Highly Condensed Representation of Anomalies in a Heatmap



Heatmap for turbine,
training data
01/2012 – 12/2015 (incl.),
anomalies above a
certain limit commented
with their respective
KKS groups

Summary



A smart combination of the advantages
of Expert KPI & Big Data

and

empowering the engineer are the best
compromise.

TRY ME

we offer a possibility
to test our solutions
in your facility

