Advanced Boiler Tube Leakage Detection using AI

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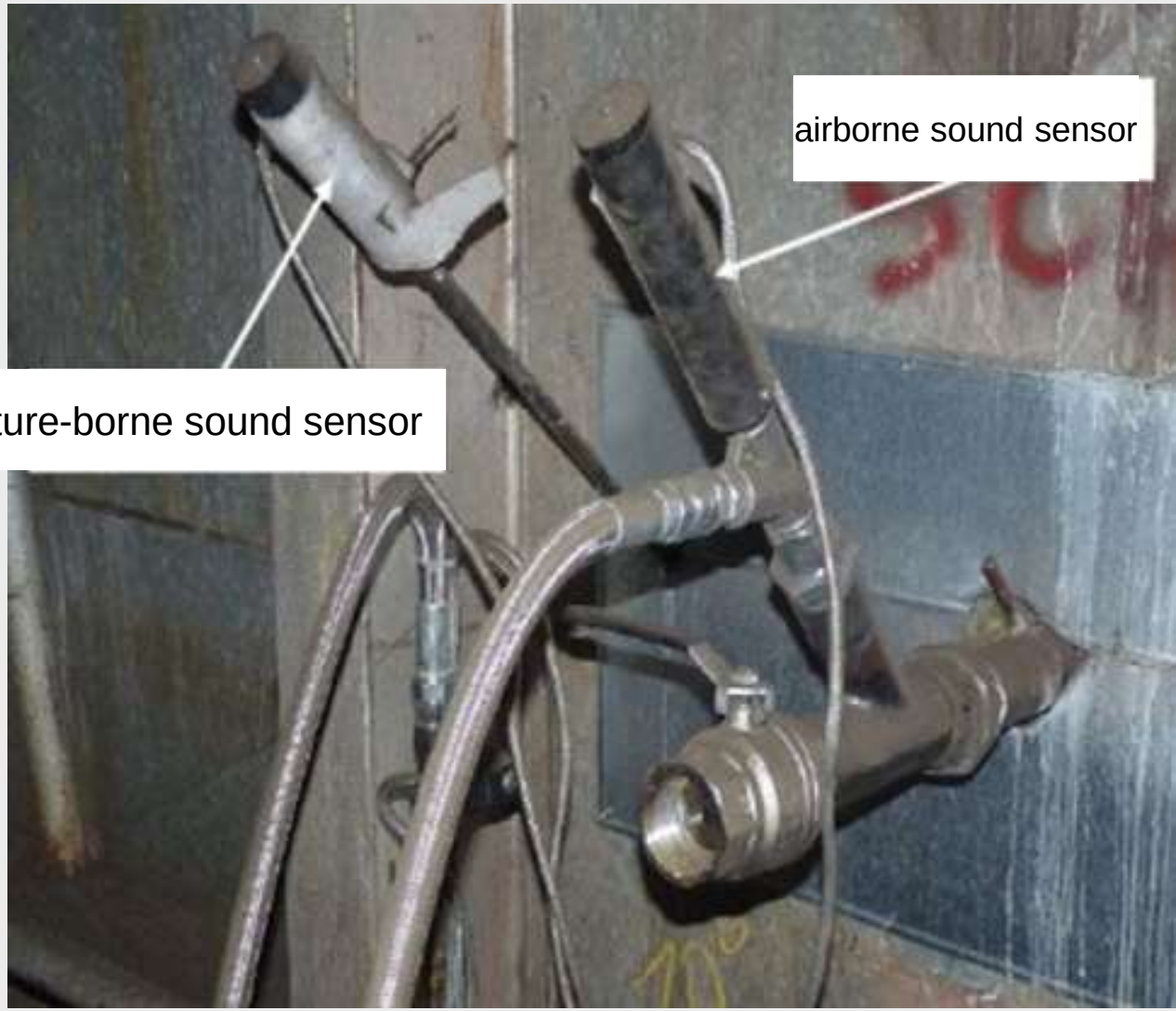
Avoid costly repairs and unnecessary downtime

- There are between 2 and 10 tube leakages per unit and year
- Unexpected leakages drive steam generator unavailability (60% of boiler outages are due to tube leaks)
- Smaller leakages may easily cause secondary damages of costly pressure components and may lead to deformation of the entire boiler.
- A single hour of unavailability of a 500 MW unit can cause losses of $15,000 to $25,000.

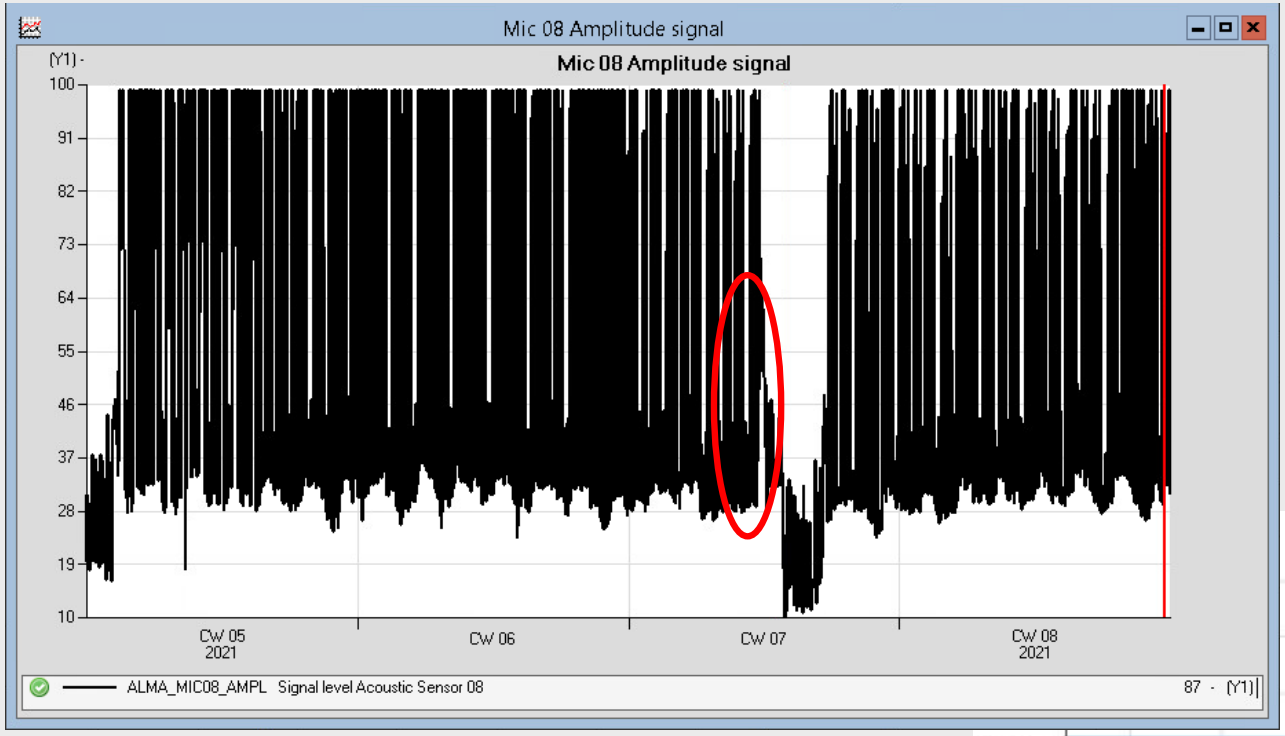
$$$

Acoustic leakage detection

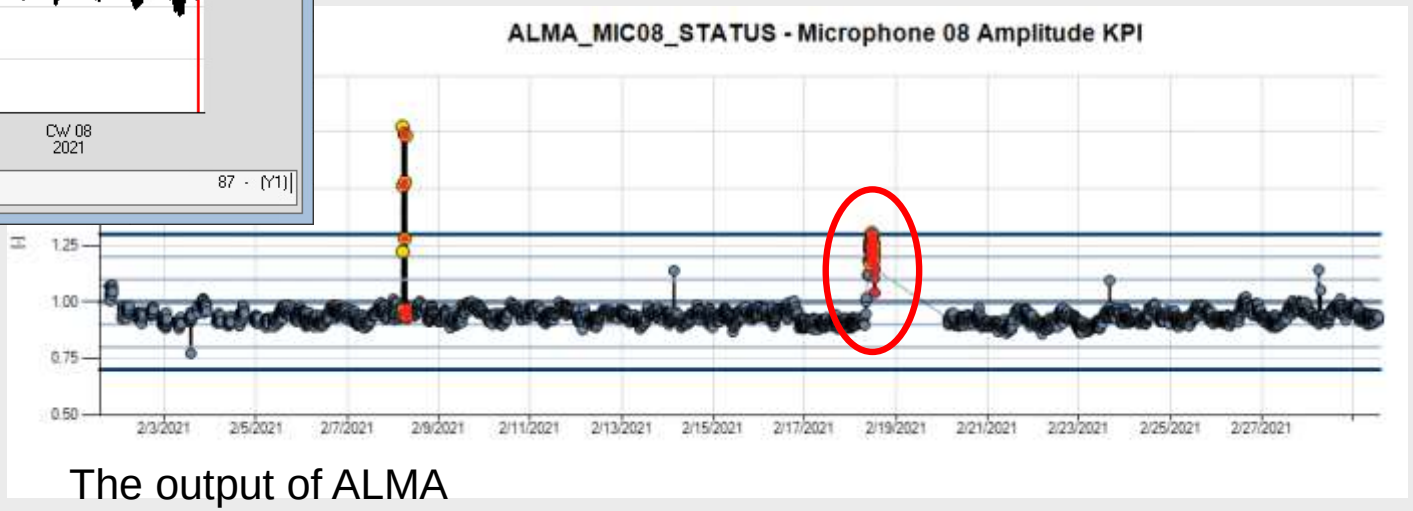
- Equipment:
- 15 to 30 Sound Senors
- Cables
- Evaluation Computer



Do you see the leakage?



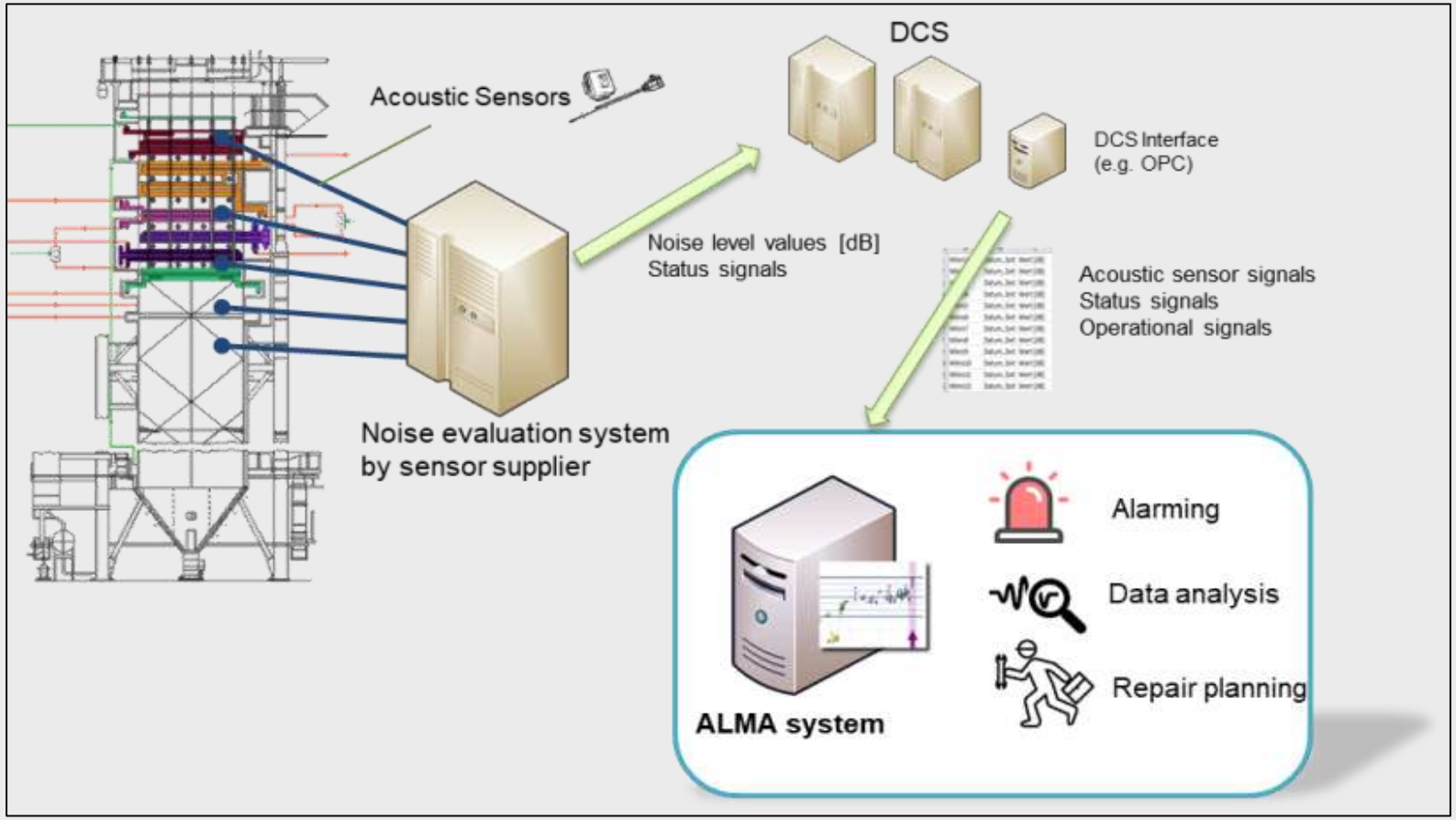
Data from the microphone



The output of ALMA

How to make tube leakage detection fast and reliable?

- ALMA = Advanced Leakage Monitoring & Alerting



Focus on what matters

- The Next Level of Prediction

Let‘s combine data science with engineering excellence

Raw process data

AI learning process

Digital Twins

maximize accuracy by combining machine learning and engineering domain know how

Wake me up if action is needed

Significance check

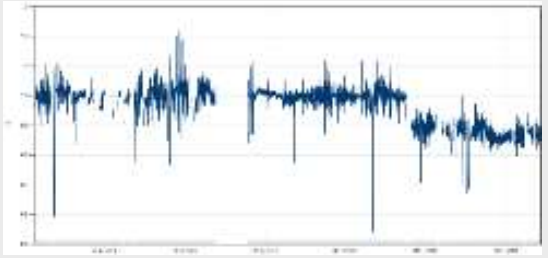
validate urgency
(e.g. monetary impact)

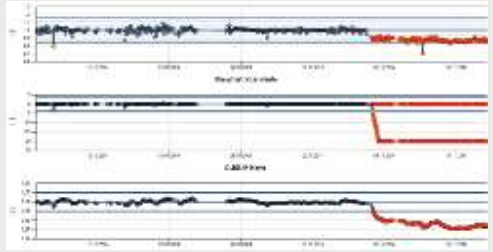
Continuous real-time analysis

Tell me what I should do and when I need to act

Decision making

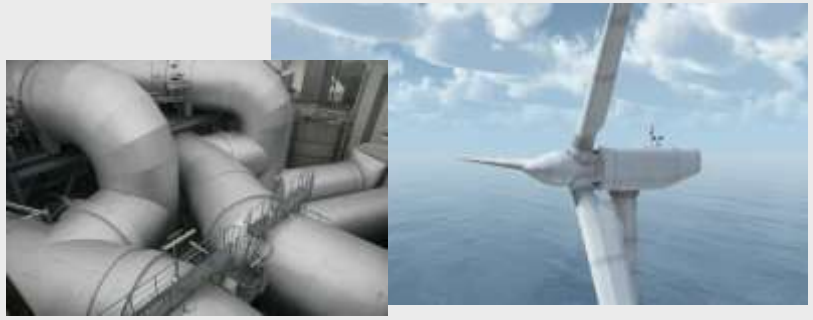
supported by root cause analysis & trend projection





AI to support Predictive Maintenance

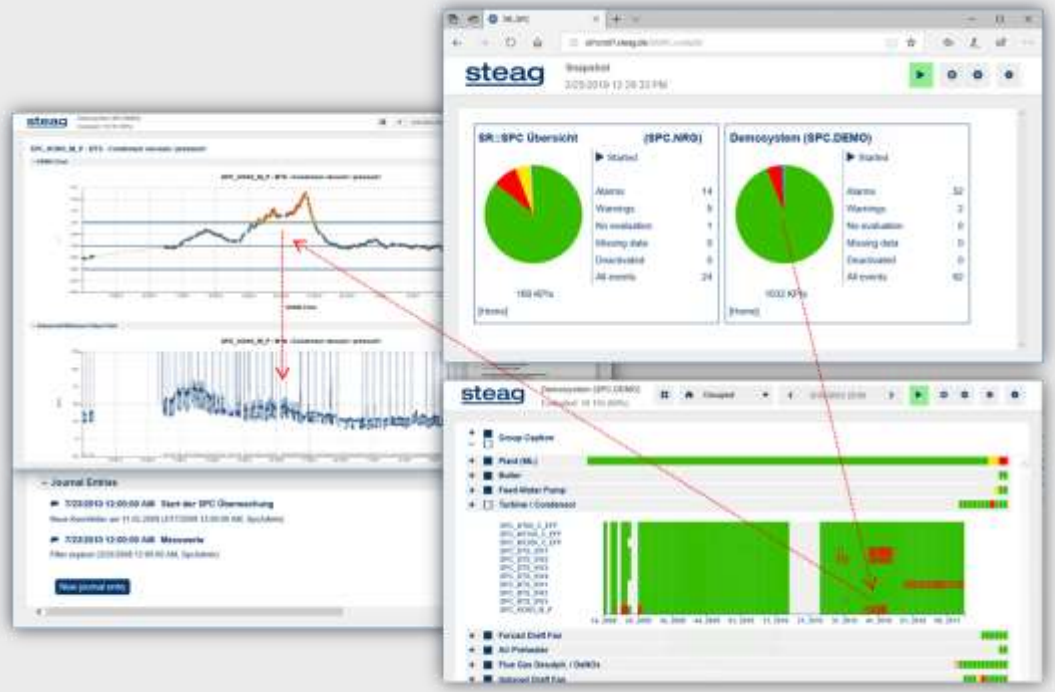
Act on right moment, reduce additional costs of unplanned outages and increase overall planned availability through predictive maintenance



Current sensor-based data

Digital replica / digital twin

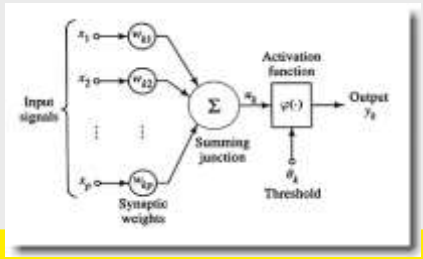
Compare



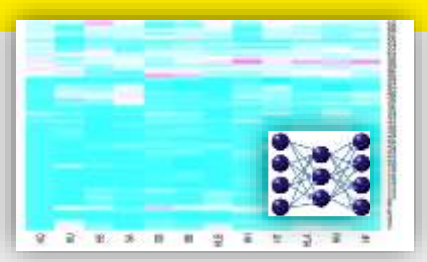
... anomaly detection
... early stage information
... avoid false alarms

Building Digital Twins

Sensor-based data

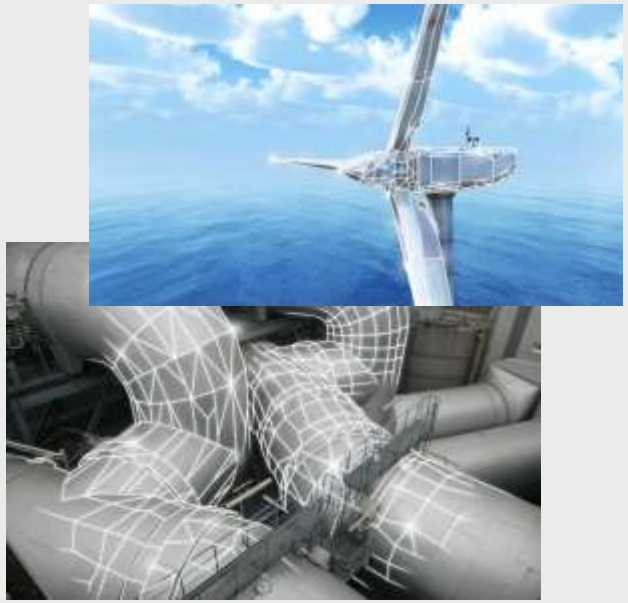


Training



HQ KPI

Big Data methods



Expertise on cause and effect is used.

Engineering in the modeling phase enables the best possible performance

➔ **“Experts HQ-KPI”**

Correlations between the measured values are recognized and independent key variables are automatically identified.

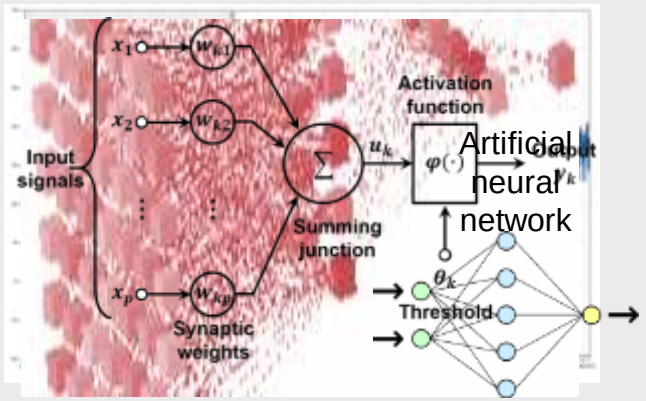
AI enables automatic monitoring for a large number of measurements

➔ **“Big Data” ML-KPI**

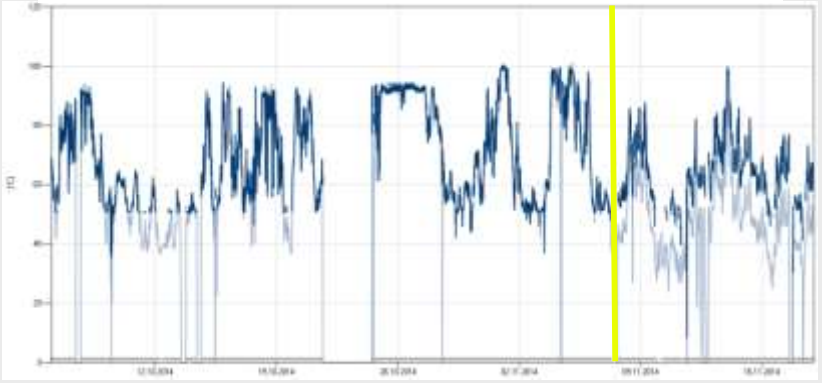
Machine Learning and Significance Testing for Reliability

1. Sensor data

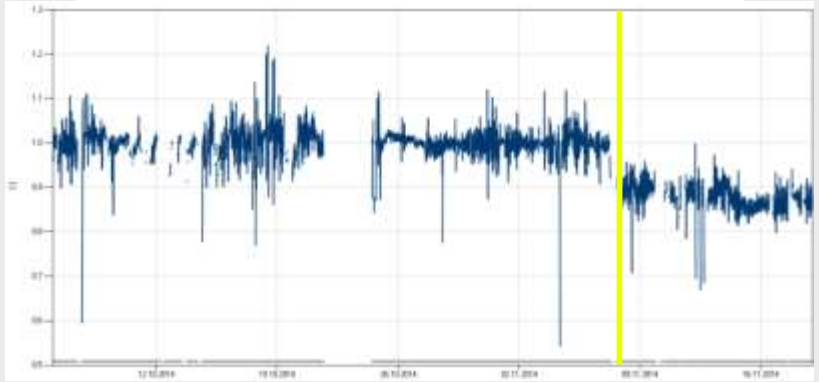
2. Learning process



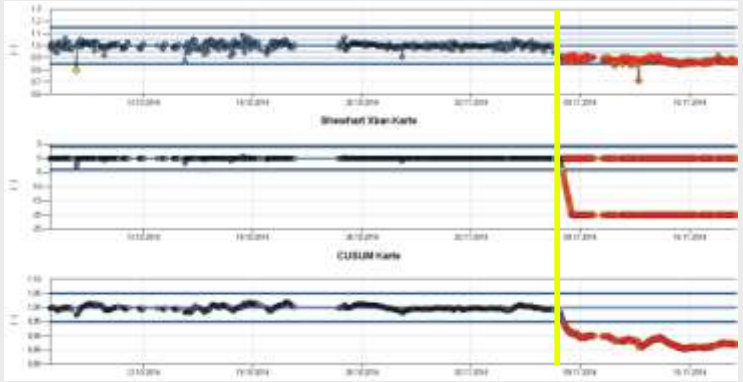
3. Actual and reference data



4. KPI = (actual/reference)

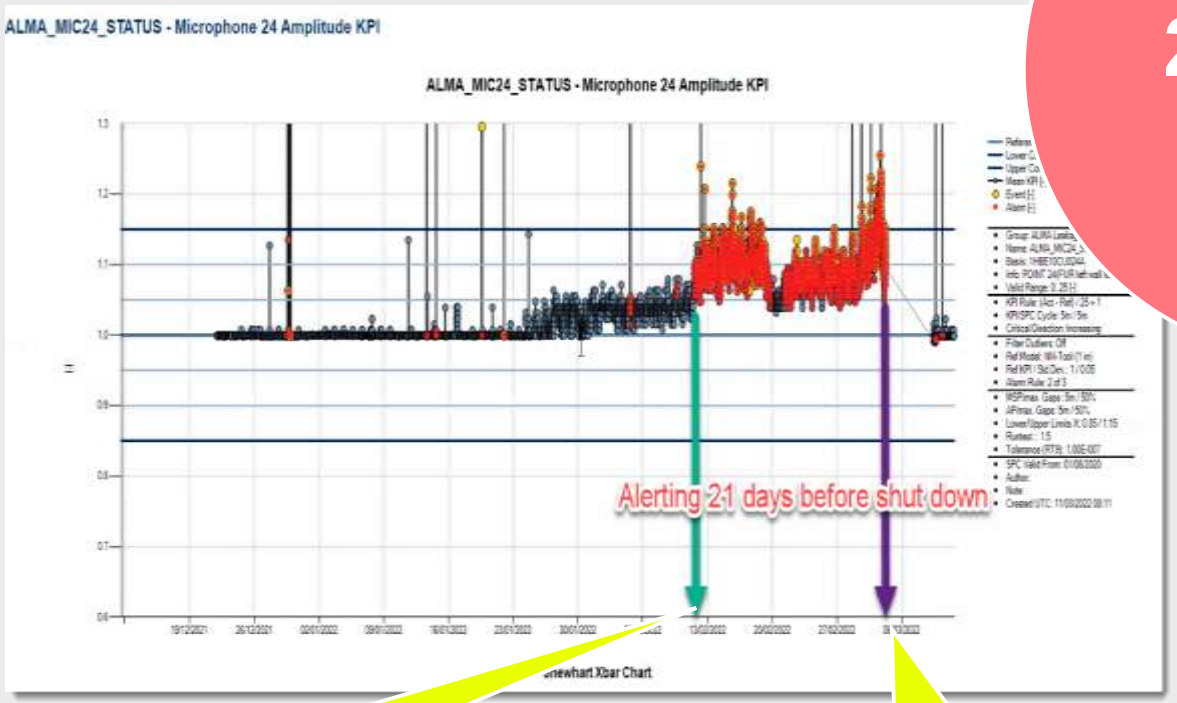


5. Significance test



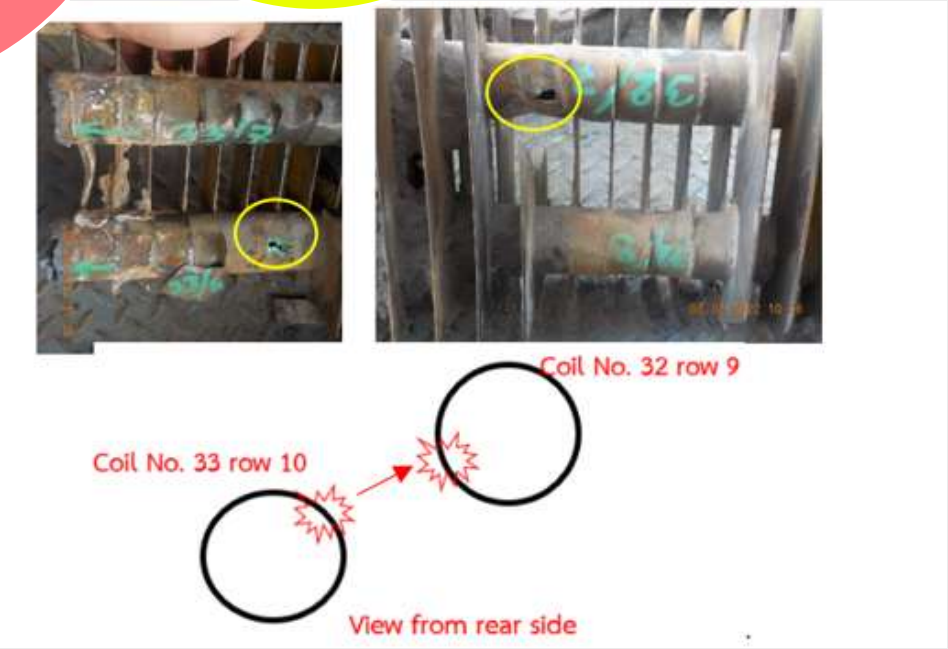
6. Root cause analysis

Case study ALMA: Damages could have been avoided way before it occurred



Alerted
21 days
before boiler shutdown

Secondary damages could have been avoided

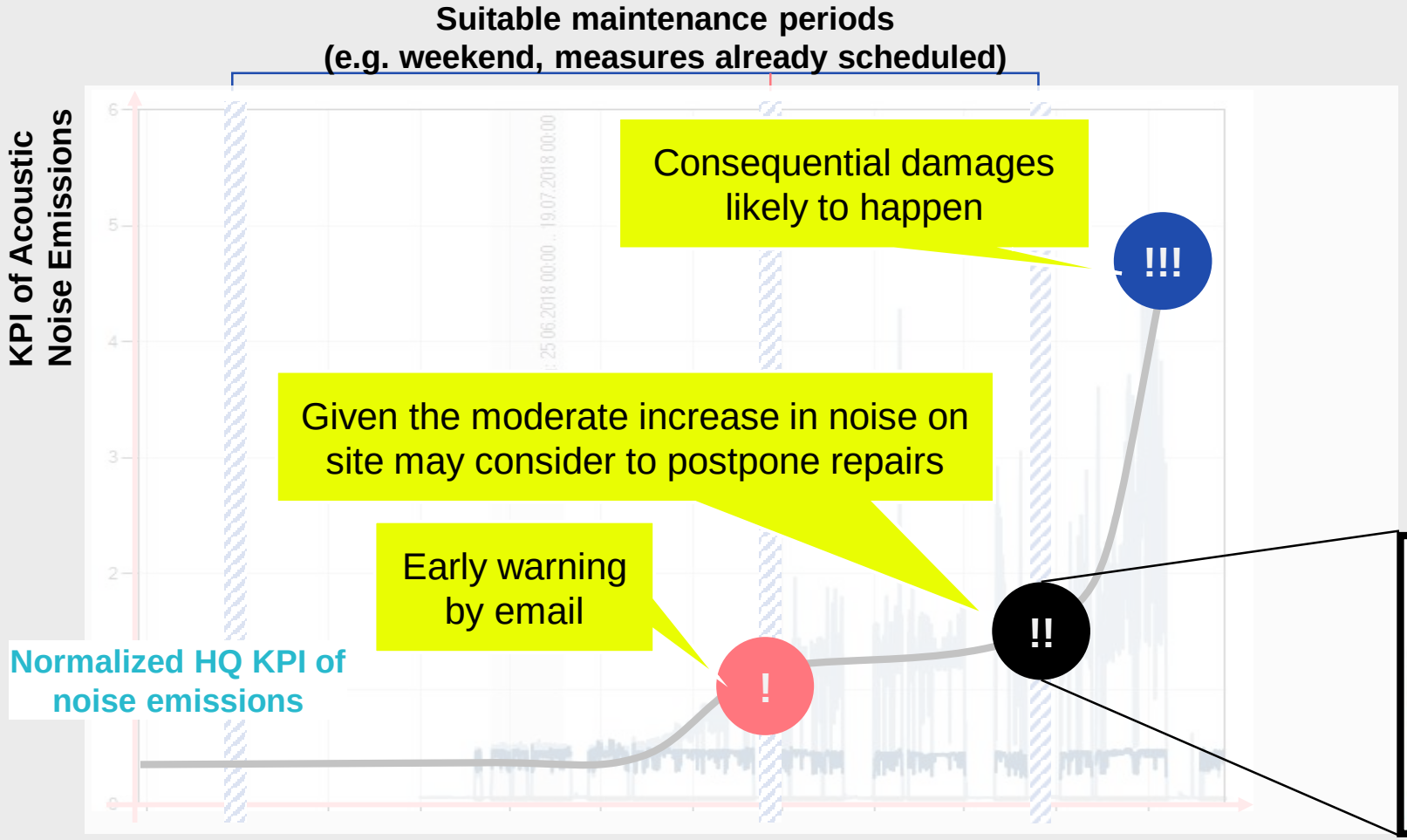


Alarm about leakage detection

Boiler shutdown

Case Study: Advanced Boiler Tube Leakage Detection

- Smart planning enabled by early and accurate prediction



Smart maintenance planning to avoid unnecessary downtime:

- Use of already scheduled maintenance events to carry out inspections and tube repairs
- Avoid consequential / secondary damages and thus shorten downtime and repair costs
- Proactive dispatch management
- Balance technical and economic impact

Summary

- **Reliable early detection of leaking spots (no false alarms)** enabling immediate (usually less costly) measures
- **Shorter and better planned downtimes** (consequential damages can be avoided) boosting the overall viability and reliability of the asset
- **Systematic trend analysis** telling the site team when repairs are to be scheduled (excellent decision making support)
- **Scalable platform solution** that grows flexibly with the individual requirements the client may have
- Long-term IT solution partner with a proven track record ensuring the **sustainability of the investment**

Thank you for your attention.

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