# 2D Outdoor Measurement

## The Acoustic Camera for Environmental Noise Analysis and Heavy Equipment

### CHALLENGE

The energy company Vattenfall Europe Wärme AG introduced noise reduction measures to their power plants in Berlin. Before taking action against noise pollution, the loudest noise sources needed to be identified. After the implementation of acoustic treatments, their effectiveness needed to be analyzed.

### SOLUTION

The Acoustic Camera as a mobile system allows high flexibility for outdoor measurements. All measurements can be conducted during machine operation. After localizing the sound sources, changes can be designed and implemented to reduce noise impact. The measurements using the Acoustic Camera validated the effectiveness of the noise reduction treatments implemented on the vents. As a contribution to a quieter environment with minimal noise impact, Vattenfall is integrating the Acoustic Camera in a comprehensive long-term measurement campaign.

### BENEFITS

- Fast and easy set-up
- No expensive machine down-time
- Large measurement distances
- Mobile system for flexible measurement positions
- Analysis in time and frequency domain

### MEASUREMENT

| | |
|---|---|
| **Measurement object** | Vents of steam turbine transformers |
| **Microphone array** | Star48 AC Pro |
| **Software NoiseImage 4** | Acoustic Photo 2D<br>Recorder Interface<br>Spectral Analysis<br>Advanced Algorithms |
| **Data acquisition** | Data recorder mcdRec |

Within a couple of months, two measurements were conducted. The Acoustic Camera was set up across the vent deck on an oil tank at a height of 23 m. Both times, the Star array was put at the same spot at a distance of 25 m to the objects of interest. Both measurements were conducted during operation of the vents. In the first measurement, the noise sources were characterized. In the second measurement, the effectiveness of the noise reduction treatments was analyzed.

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**RESULTS**

In the first campaign, the loudest noise sources on the vents were identified. The results showed that the area around the middle vent produced the highest noise level, as seen in the acoustic photo in Figure 1 on the left. Based on the analysis results, the appropriate noise reduction methods could be implemented.

The loudest vent was equipped with a converter which allows for an adjustment of the rotation speed if necessary. In addition, the outlet of the middle vent was outfitted with damping material. The two other vents were damped from the outside.

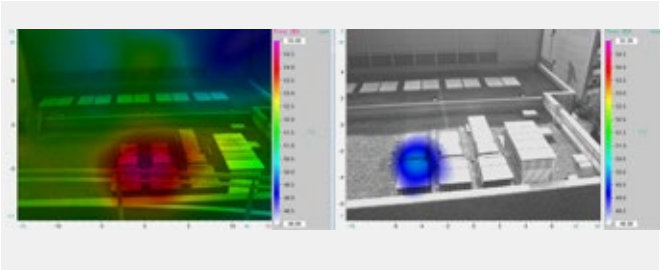

**Fig. 1:** Overall result before and after damping

The second measurement tested the effectiveness of the noise mitigation efforts. The right side of Figure 1 shows the analysis result after changes were implemented.

The overall sound pressure level was reduced by 7 dB, and the left vent was identified as the second loudest source. In order to pinpoint the changes of sound pressure levels (SPL) at specific frequencies, a frequency-selective analysis was conducted. The result is a great tool to visualize changes in SPL. Various comparisons are shown in Figure 2 – 5 (before on the left, after on the right) with an integration interval of one second in each calculation.

The introduction of the converter and the outlet treatment on the middle vent resulted in a strong decrease of the overall sound pressure levels and frequencies interest. The same measures could also be introduced to the other vents.

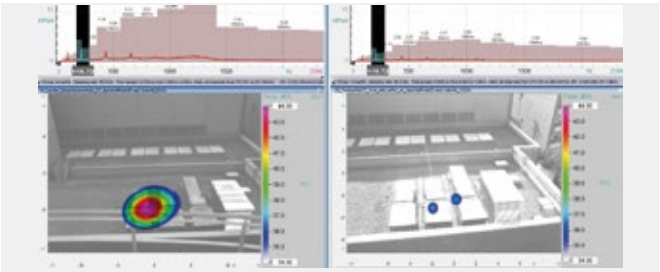

**Fig. 2:** Spectral analysis for the third octave bands of the second peak in the spectrum before and after damping

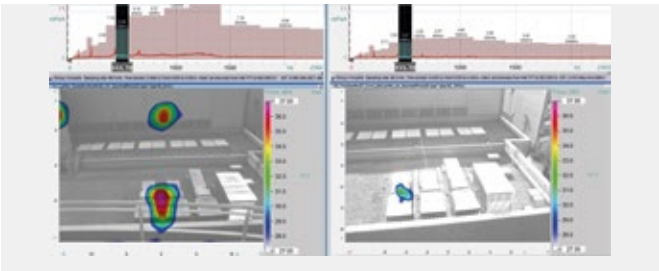

**Fig. 3:** Spectral analysis for the 500 Hz third octave band before and after damping

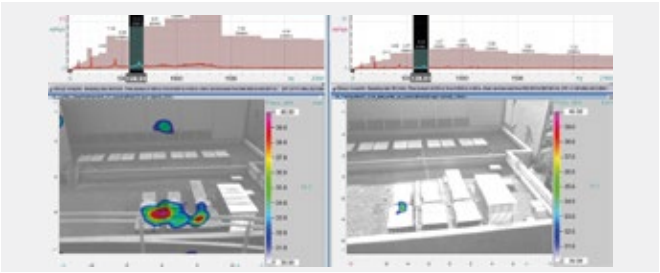

**Fig. 4:** Spectral analysis for the 630 Hz third octave band before and after damping

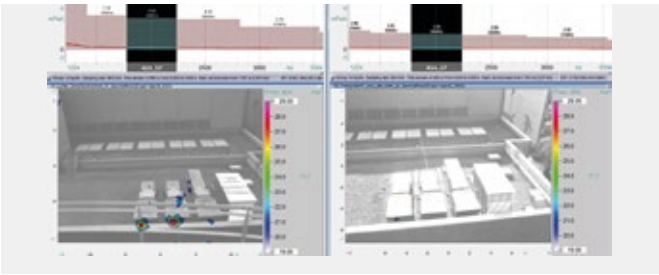

**Fig. 5:** Spectral analysis for the 2 kHz third octave band before and after damping



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