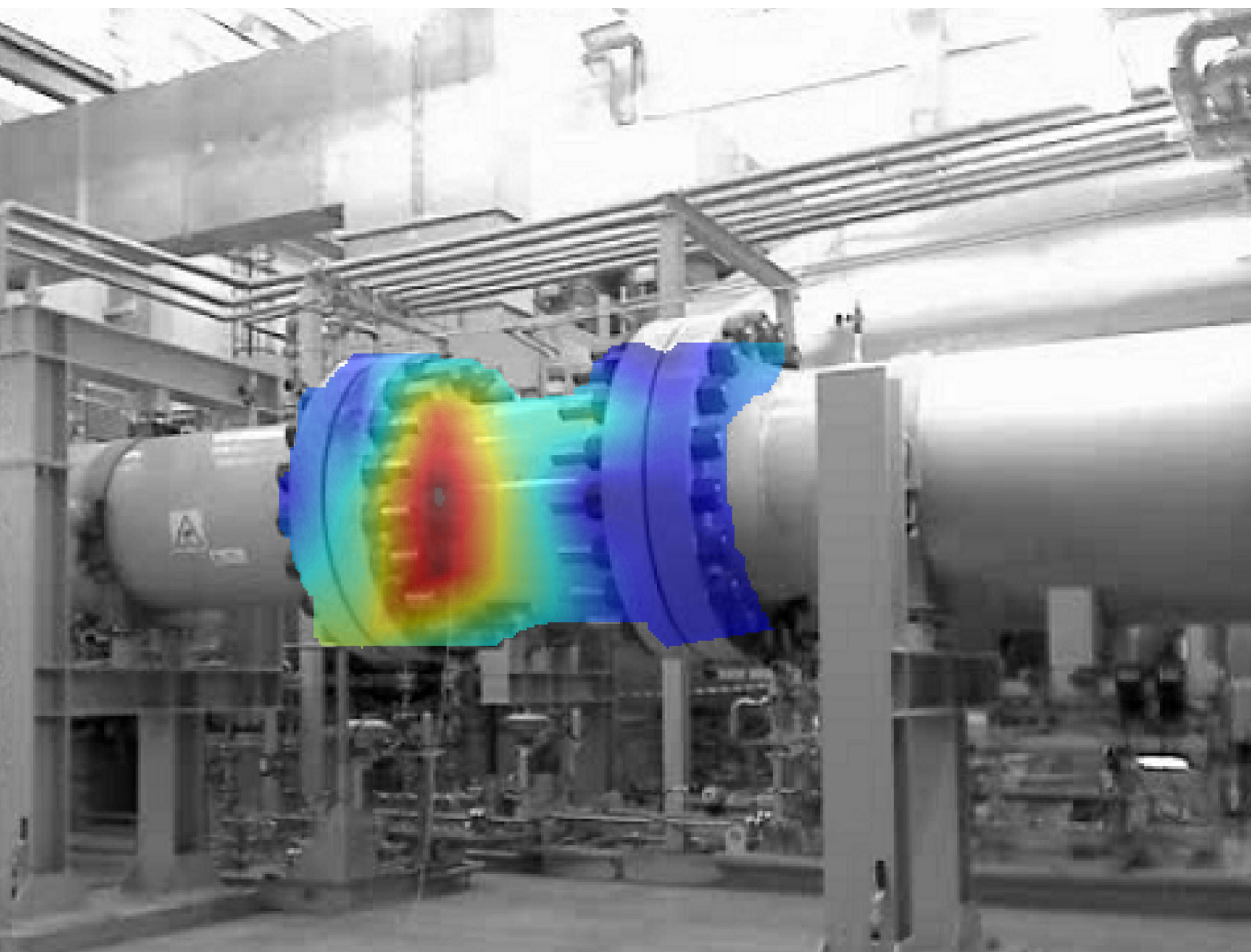




# Application Case

# Large compressor for the oil & gas industry noise assesment

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# LARGE COMPRESSOR FOR THE OIL & GAS INDUSTRY NOISE ASSESSMENT

## SCAN&PAINT FOR SOUND MAPPING IN REVERBERANT CONDITIONS

In this application the sound field produced by a complex, large structure (industrial compressor) in a highly reverberant environment with a high ambient noise level (115 dB SPL) is measured. The Scan&Paint system is used to perform the measurements. The main parts to be measured in this test are the compressor and the associated process pipework.

The total noise level in the compressor hall exceeds the noise levels allowed for this type of facility. To comply with the regulations it is critical to find the dominant sound source leading to the exceed of the allowed threshold. with an unparalleled dynamic range.

The three main aims of the measurement are to:

1. Locate the dominant sound source which is causing abnormal noise levels
2. Estimate the in-situ sound intensity and sound power of the measured machinery
3. Rank the detected noise sources

Due to the size of the measured machinery, it is not possible to capture its whole surface with one camera.

Therefore, the compressor, and the associated process pipe work, will be measured separately. The image below shows a schematic view of the compressor and process pipes along

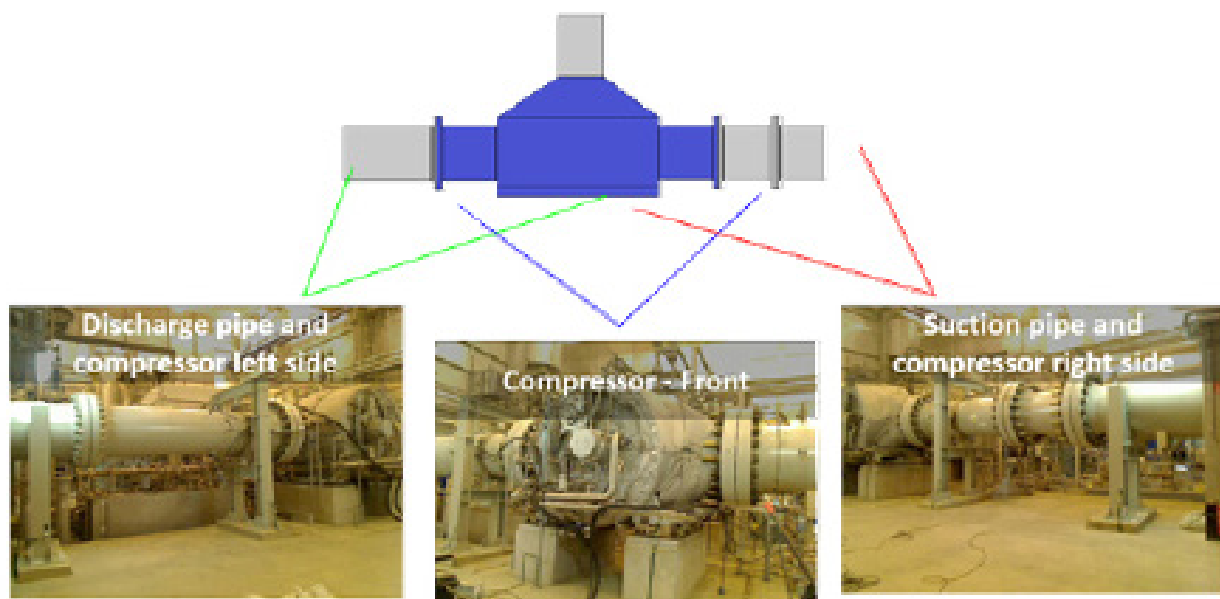


with the location of the video camera and its view angle. As can be seen, three measurements are taken to capture the entire surface of the machinery. The average scanning time per camera position is only 10 minutes.

## MEASUREMENT PRINCIPLE

Scan&Paint is a new and fast solution designed to visualize stationary sound fields and provide a solution to the ultimate acoustic problem of localizing noise sources in high background noise environments. It is a fast and easy-to-use tool designed to localize noise sources on almost any surface and in the full acoustic bandwidth. The setup of the Scan&Paint system is very simple and easy. The system comprises of a single PU intensity probe, signal conditioner, DAQ (Scout 422) and a standard laptop. The PU probe included in the Scan&Paint system allows for direct measurement of sound pressure, particle velocity, sound intensity and acoustic impedance. Due to the unique characteristics of the particle velocity sensor, there is no need to create anechoic conditions

during your measurements. The advantage favored by a majority of NVH engineers. The Scan&Paint method surface is scanned with one PU probe, while a camera, positioned toward the measured surface, records the scan. The recorded video and audio data are automatically synchronized by the software, thus minimizing the processing time. In the post-processing stage, from each frame of the recorded video, the position of the probe is extracted. The auto-tracking function embedded in the software enables the automatic recognition of the location of the probe, using a freely customizable color marker. At each tracked probe position the particle velocity, sound intensity and sound pressure are calculated from the time block of data assigned to each probe position. A high resolution sound color map is produced as a result.

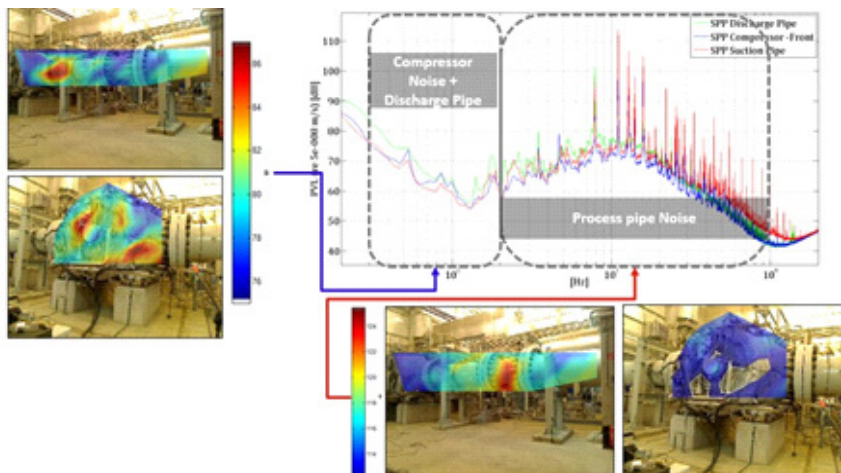


*The three camera angles measured to capture the whole object.*

# MEASUREMENT RESULTS

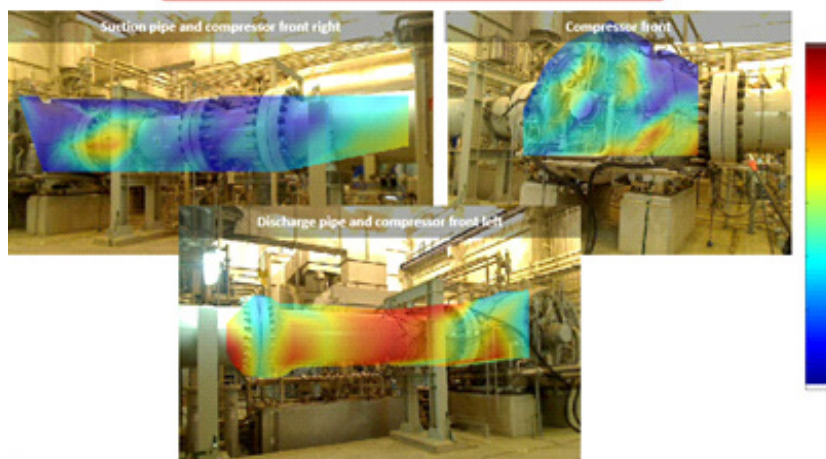
Large compressor for the oil & gas industry noise assesment

The figure on the left contains the averaged particle velocity spectrum recorded over the three measured sections of the machinery. The accompanied colour maps show the distribution of sound sources in the highlighted frequency ranges.

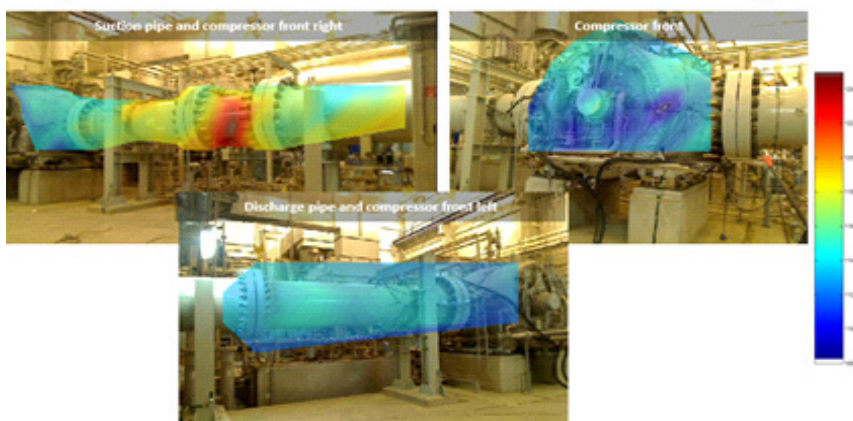


Since most of the radiated acoustic energy is carried in the frequency range between 200 Hz and 20 kHz, the location of the noise sources causing the excessive noise should be revealed while studying the distribution of noise sources for this frequency range. In the lower frequency range (below 200 Hz), the contribution of the noise sources to the total noise in the compressor hall is low. Figures below and left demonstrate the sound source ranking for the studied machinery in the highlighted frequency ranges. The color maps reveal that in the frequency range between 40 Hz and 200 Hz, the noise is emitted by the compressor itself and the discharge pipe. The noise radiated by the suction pipe in this frequency range is nearly 10 dB lower than in case of the other components. However, in the most energetic bandwidth (200 Hz-20 kHz), the noise radiation from the compressor and the discharge pipe is 16 dB lower than in case of the suction pipe.

## Measurement Results: 40 Hz– 200 Hz



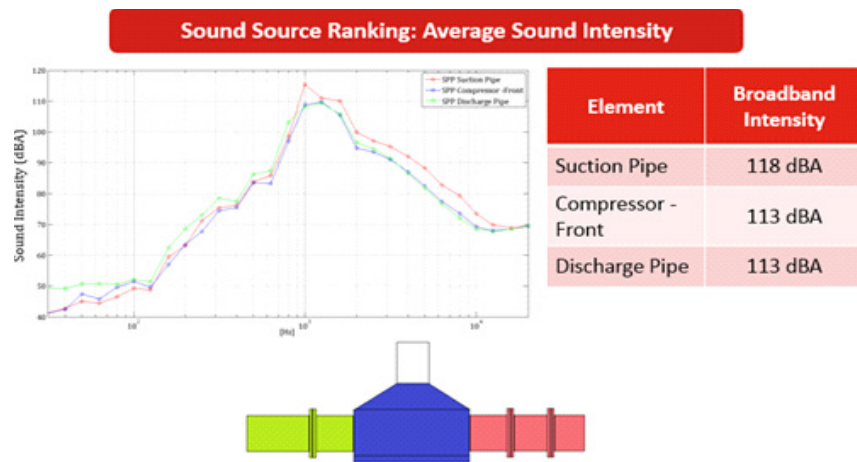
## Measurement Results: 200 Hz– 20000 Hz



A detailed study of the noise distribution along the suction pipe highlights only one dominant source of noise in the middle section of the suction pipe. This part of the pipe contains a strainer which was designed to capture possible debris left inside of the pipe during its installation process. During normal operation of the compressor the strainer would resonate causing the entire pipe to vibrate and produce the excessive noise. After the strainer was removed the noise level in compressor hall was decreased to an

acceptable level. Furthermore, as part of the measurement campaign, the average sound intensity and sound

power of different elements have been estimated:



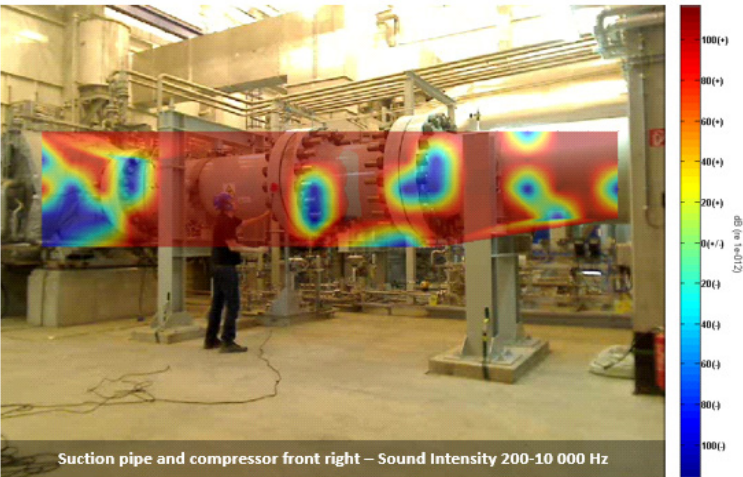
# CONCLUSION

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The measurements were carried out in a reverberant environment with high ambient noise level. In such conditions, localisation of the noise sources with conventional measurement techniques (sound pressure, sound intensity mapping) would not produce a reliable result. Example of the sound intensity distribution across the suction pipe is presented below:

The distribution of sound intensity across the suction pipe does not allow to draw any conclusion as per the location of the noise sources. Due to the near-field properties of the particle velocity, the environmental factors can be neglected, and there is no need to create expensive anechoic conditions. The source of the excessive noise have been established on

the surface of suction pipes' strainer. Sound intensity and sound power level of individual components have been successfully determined. All of the presented data and conclusions were drawn from a 45 minute measurement campaign.



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