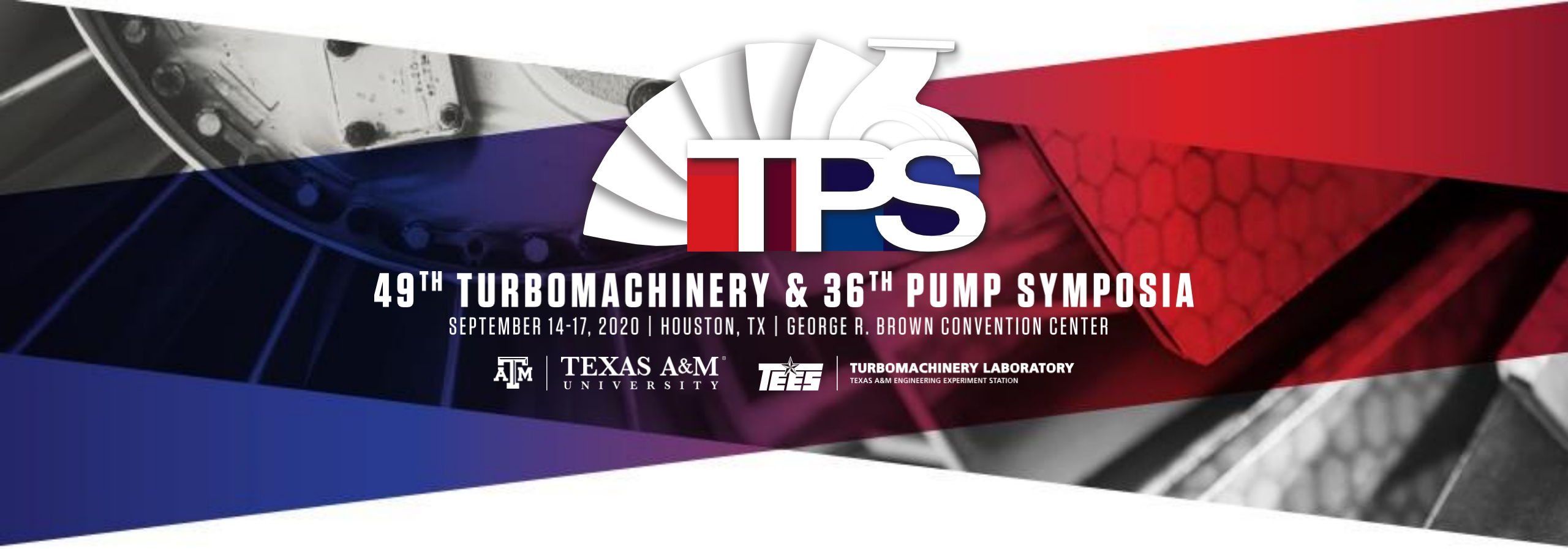


Video Based Vibration: A tutorial and case study with a live demonstration and data analysis on real life pump data

Jeff Hay, PhD, CEO RDI Technologies

RDI TECHNOLOGIES

BIO

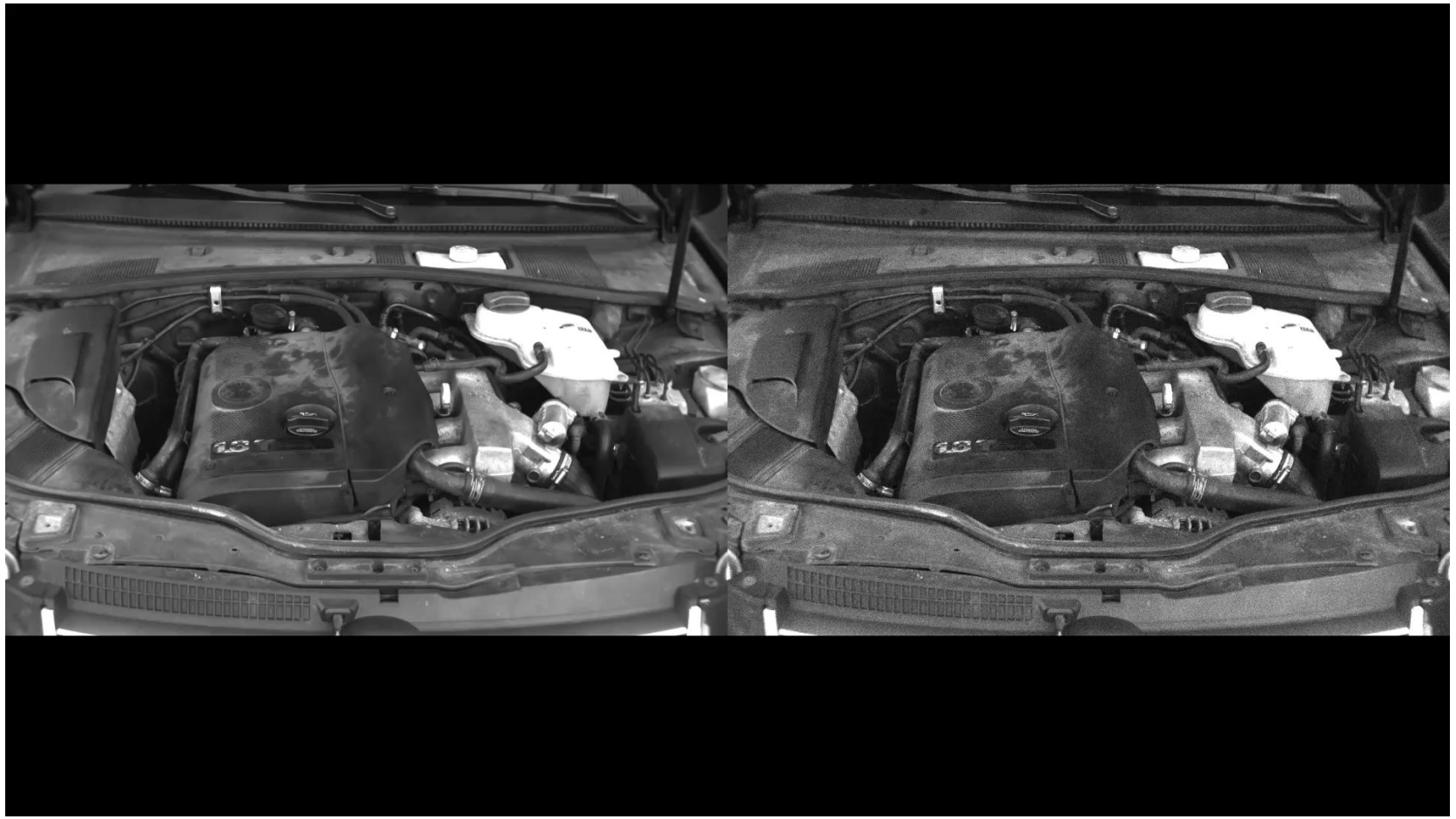
Jeff Hay, CEO RDI Technologies

- Interests in Photography
- PhD in Applied Optical Physics
- Started research in Astronomy
- Originally developed optical technology for DOD and DHS
- Left research to work within large CBM service company and then full time at RDI to bring products to market

Short text of an Abstract (approx.80 words) to print in show guide

Recent advances in camera technology allows the user to detect subtle motion and amplify that motion to a level visible with the naked eye. Furthermore displacements, phase and frequency of motions can all be determined from the video to allow for a comprehensive analysis of machinery. A series of pump case studies and a live demonstration will be highlighted along with new advancements such as transient motion tracking, vectors and motion mapping.

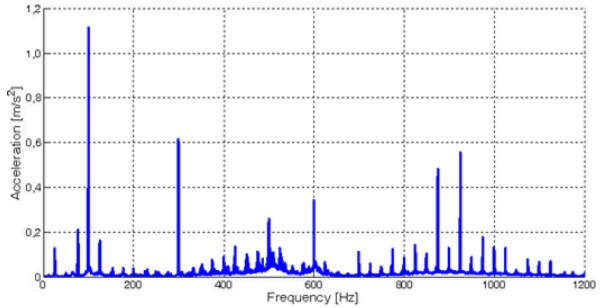
What is Video Based Vibration

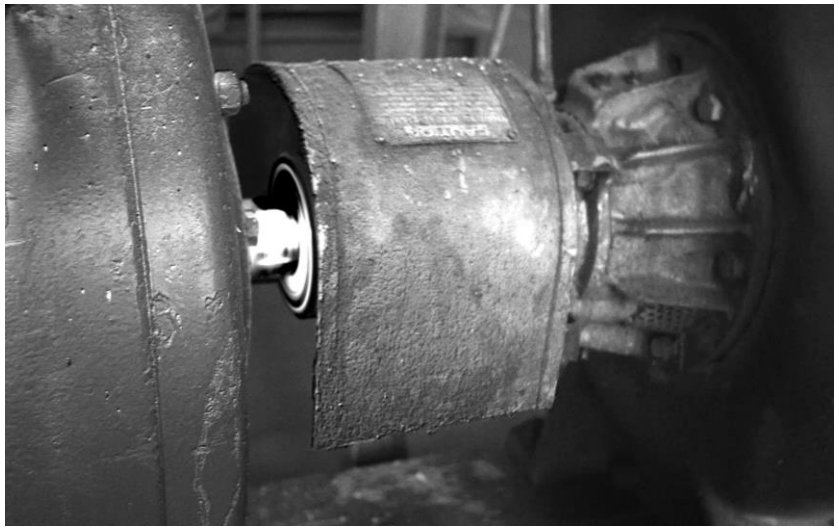


What is Video Based Vibration

Technology Overview

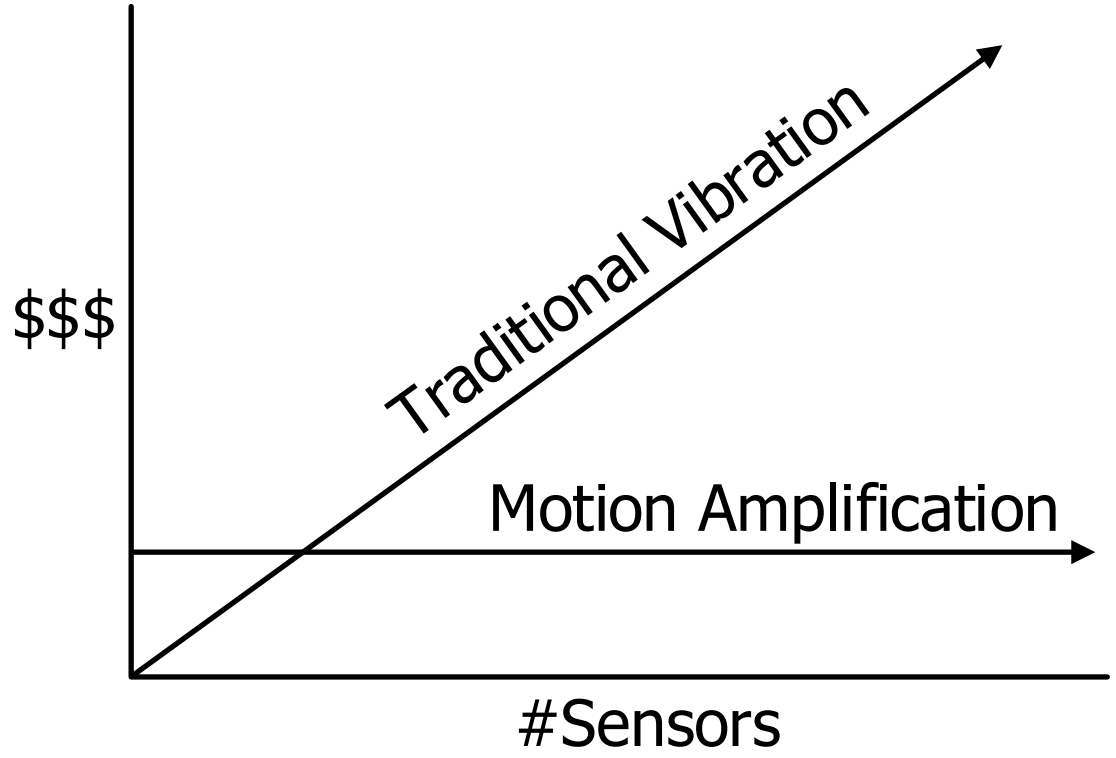
- Measure movement not visible to the human eye.
- Technology turns every pixel in the camera's view into a sensor
- The results lend themselves to a visualization of the motion.
- We can measure and quantify any structure or assets that a camera can see.





See the Big Picture

- Traditional Vibration is limited by cost and access to sensors
- Camera based collection allows you to scale data collection without adding cost
- Visualize the entire asset in one collection
- Every point is measured and quantified. No guessing between points



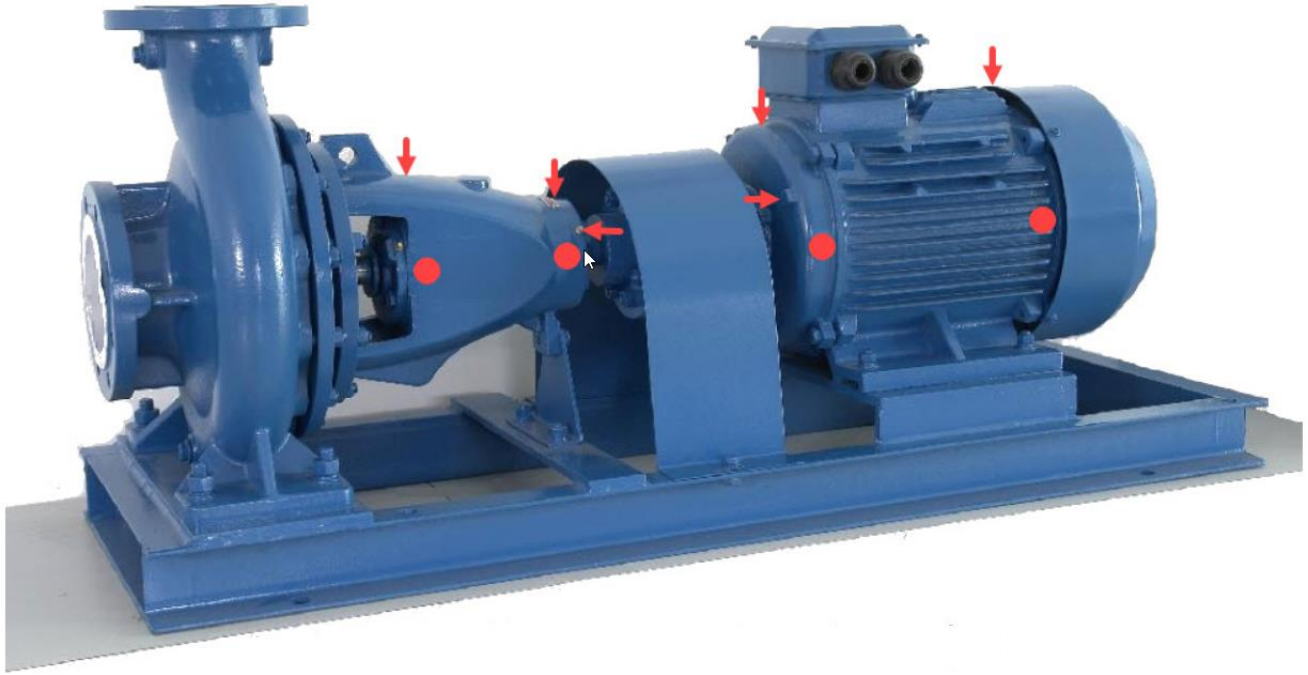
Technical Specifications

- Fundamental Measurement is Displacement
- Capable of Live Visualization
- Amplification factor to 500x
- Shows Overall and Frequency Based Motion
- <0.01 mils measurement
- 180 fps /1,400 fps in HD
- Up to 650 Hz/14,500 Hz in frequency at reduced resolution
- 2-axis measurement orthogonal to line of sight
- Synchronous measurement across image for Phase Measurement
- Measures Shaft Displacement

Benefit of Video Based Vibration

- Root Cause Finding Complementary Tool
- Communications Tool – Technical and non-technical
- Improved Safety: Totally non-contact
- Planned Shutdowns: Know what are your “Bad Actors” are doing
- Collection during operation
- Diverse applications – Machines, Structures, Manufacturing Processes, Piping, Visual ODS
- Setup & acquire data in minutes, portable and easy to deploy
- Actionable information: Results are easy to see in a standard video

Typical Acquisition Process (Traditional)

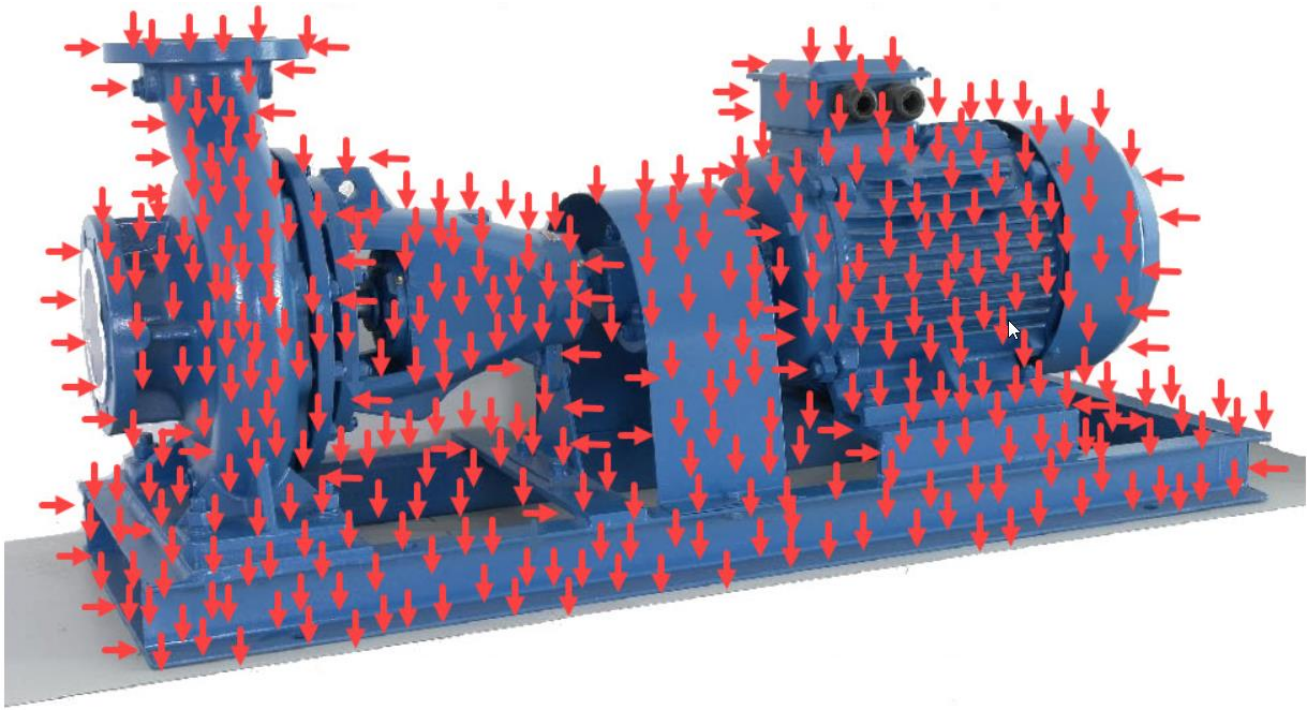


Vibration Measurement Locations -

NON-Simultaneous Data

Report: Detailed Explanation or Exception List with Spectra and Waveforms

Typical Acquisition Process (Camera)

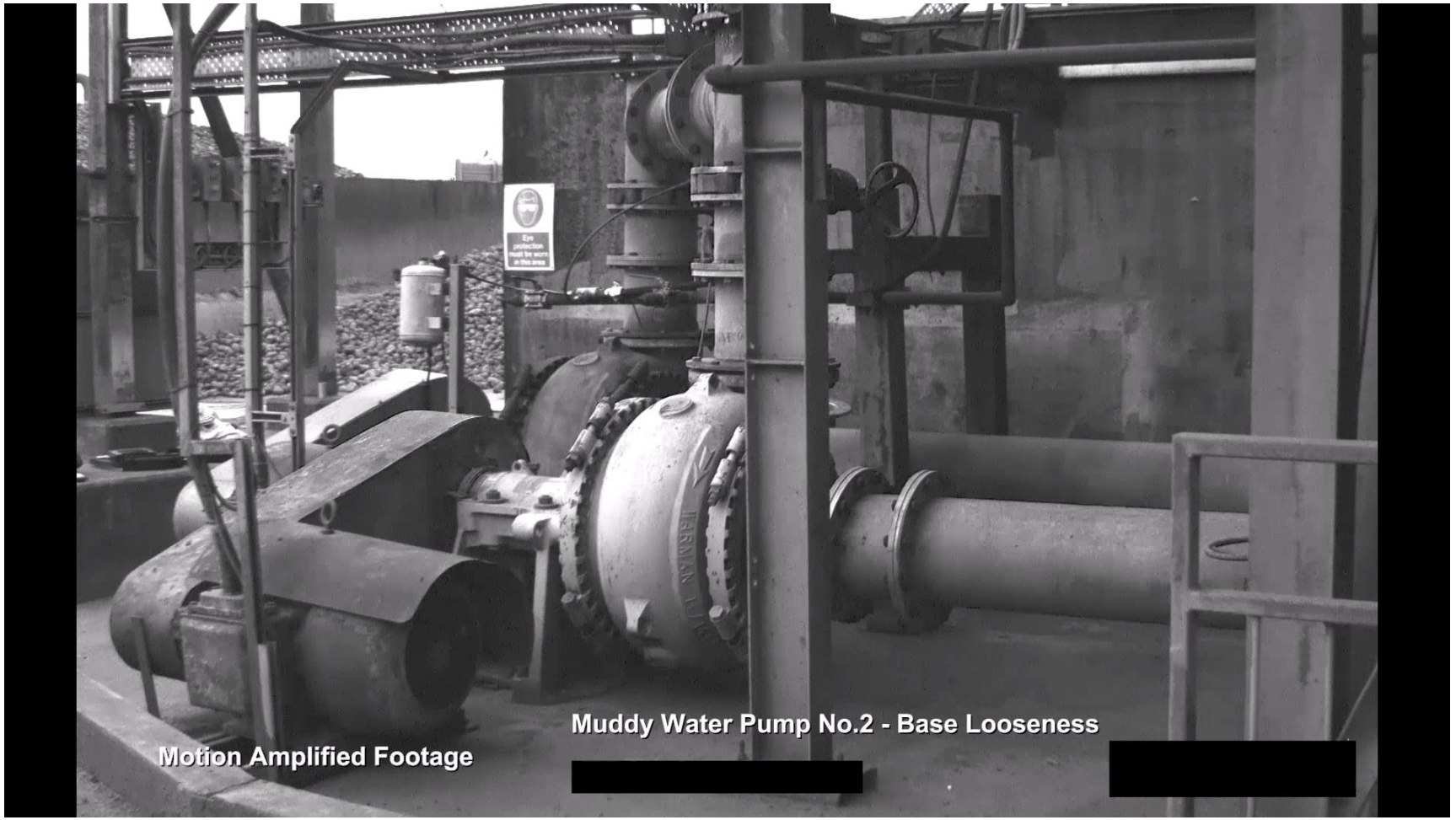


Vibration Measurement Locations ↓

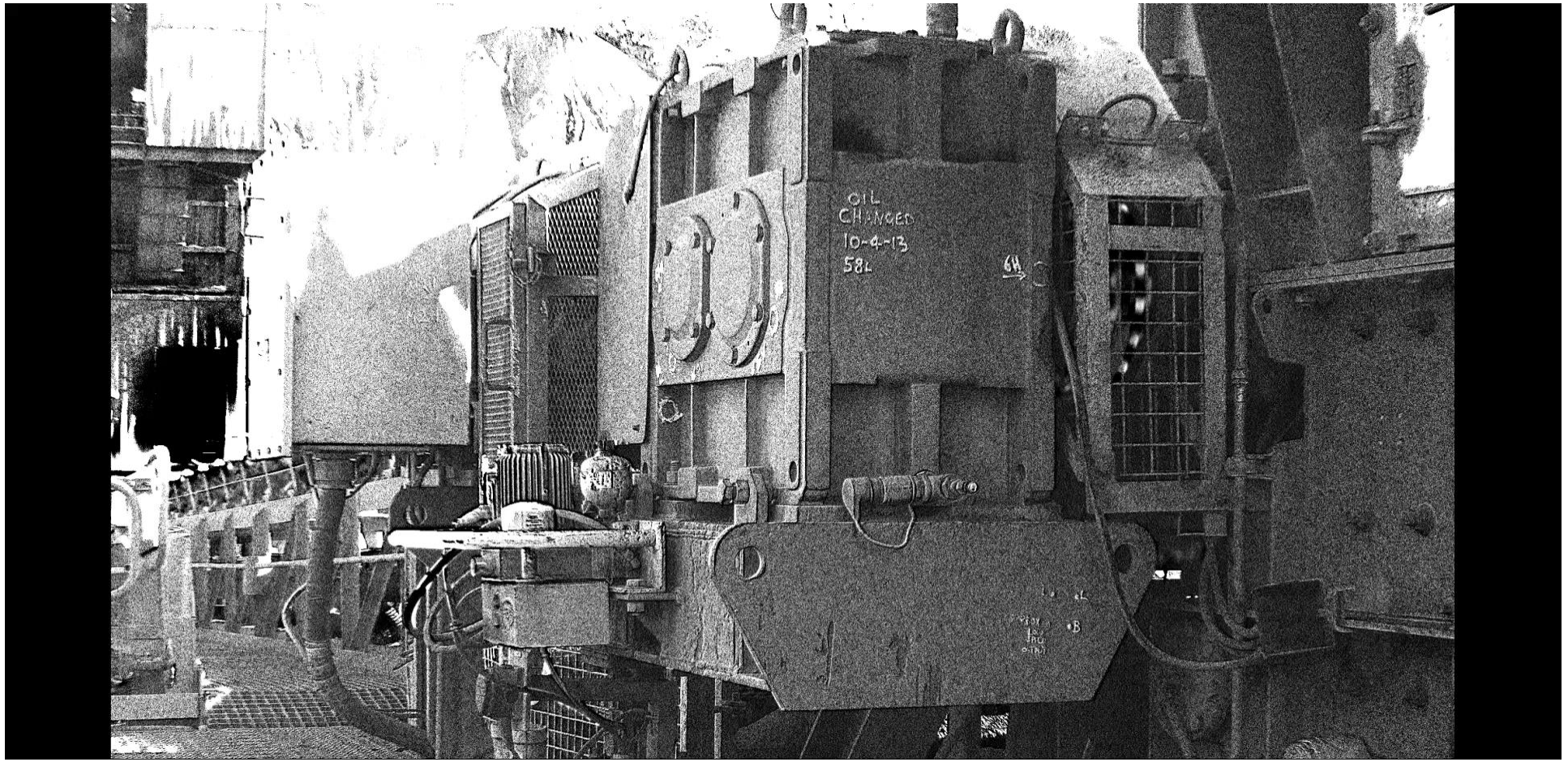
SIMULTANEOUS Data

Report: Video with optional Spectra & Waveform

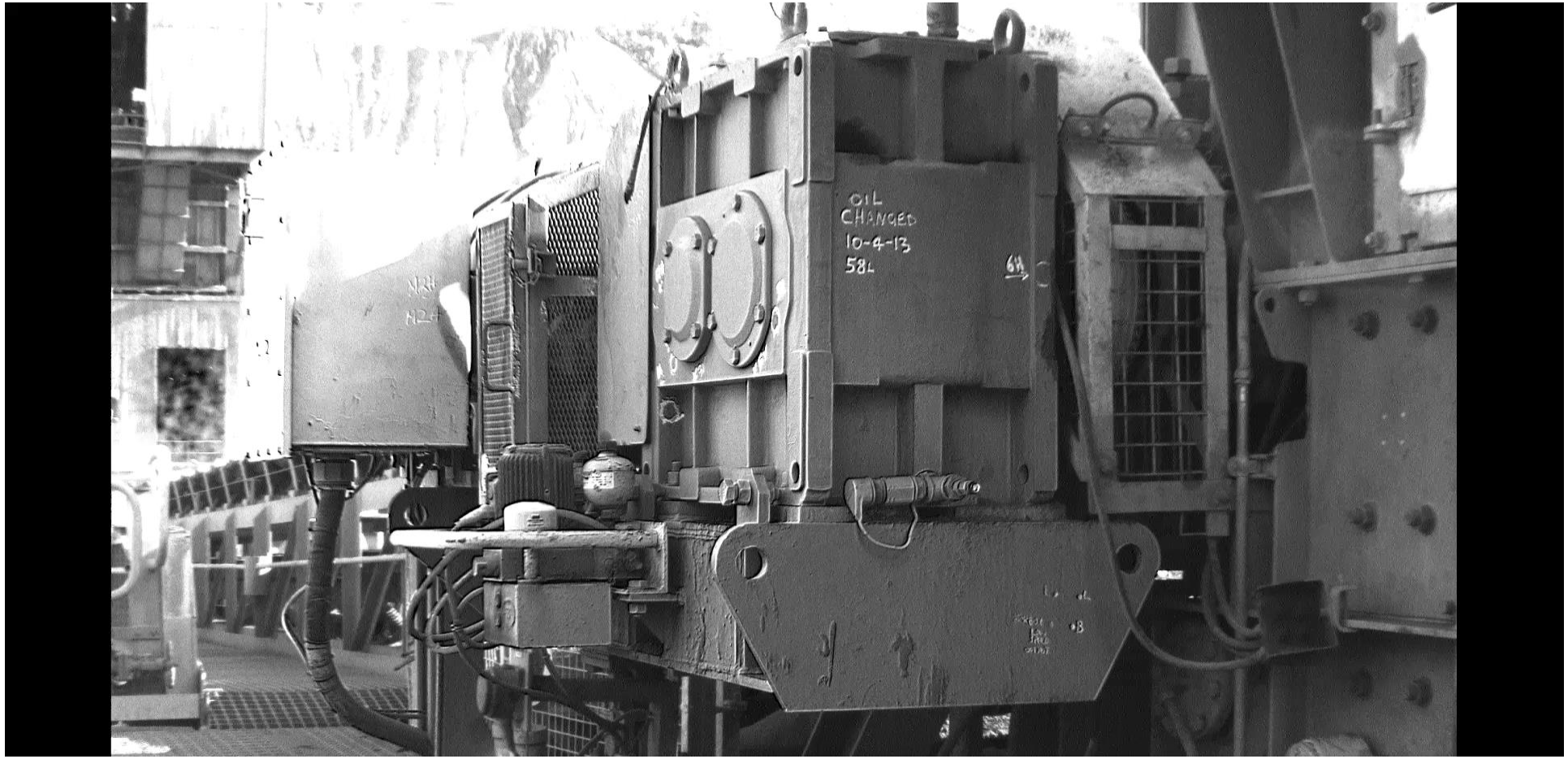
Advanced Technique: Filtering



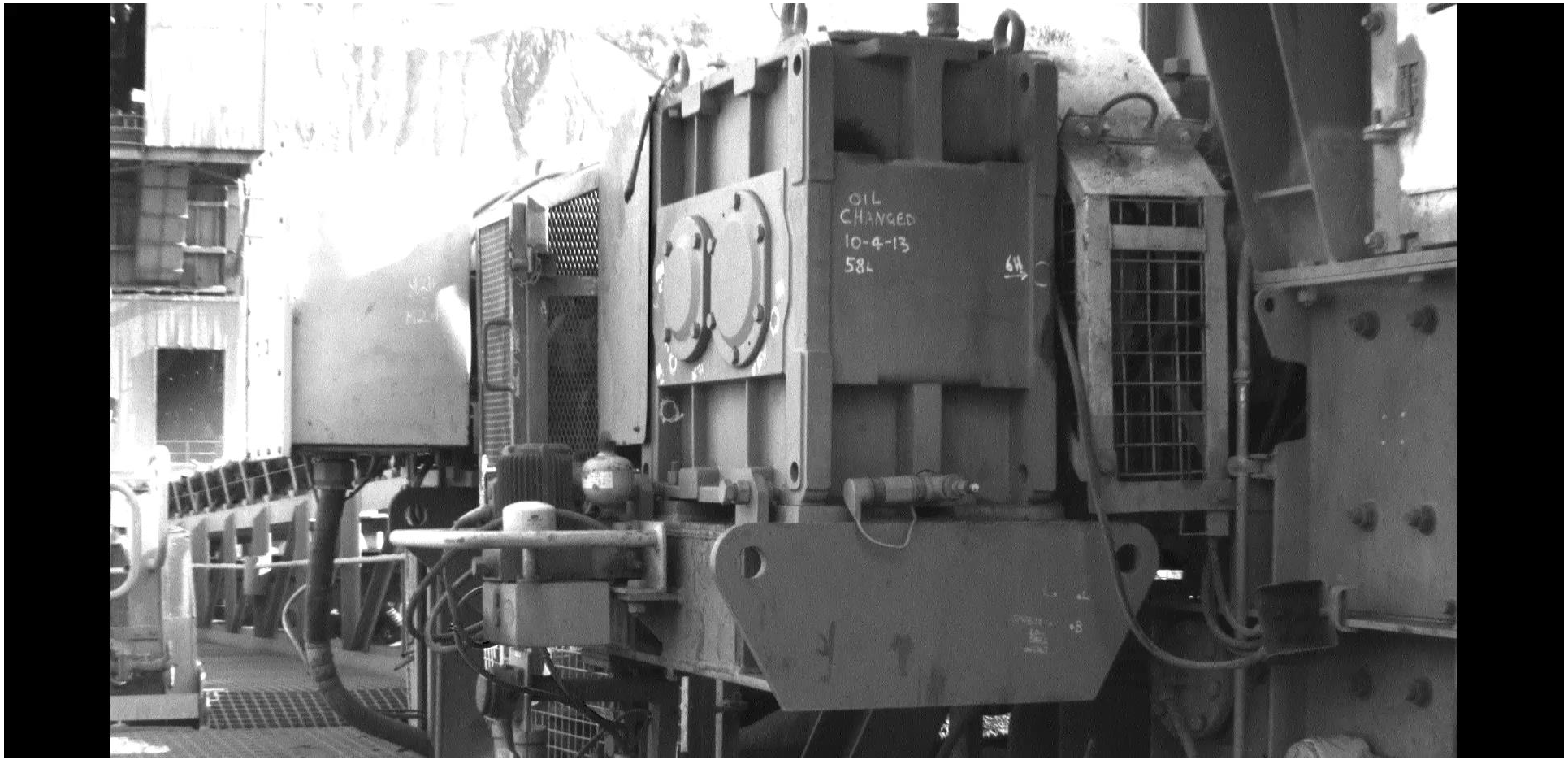
Advanced Technique: Filtering Overall



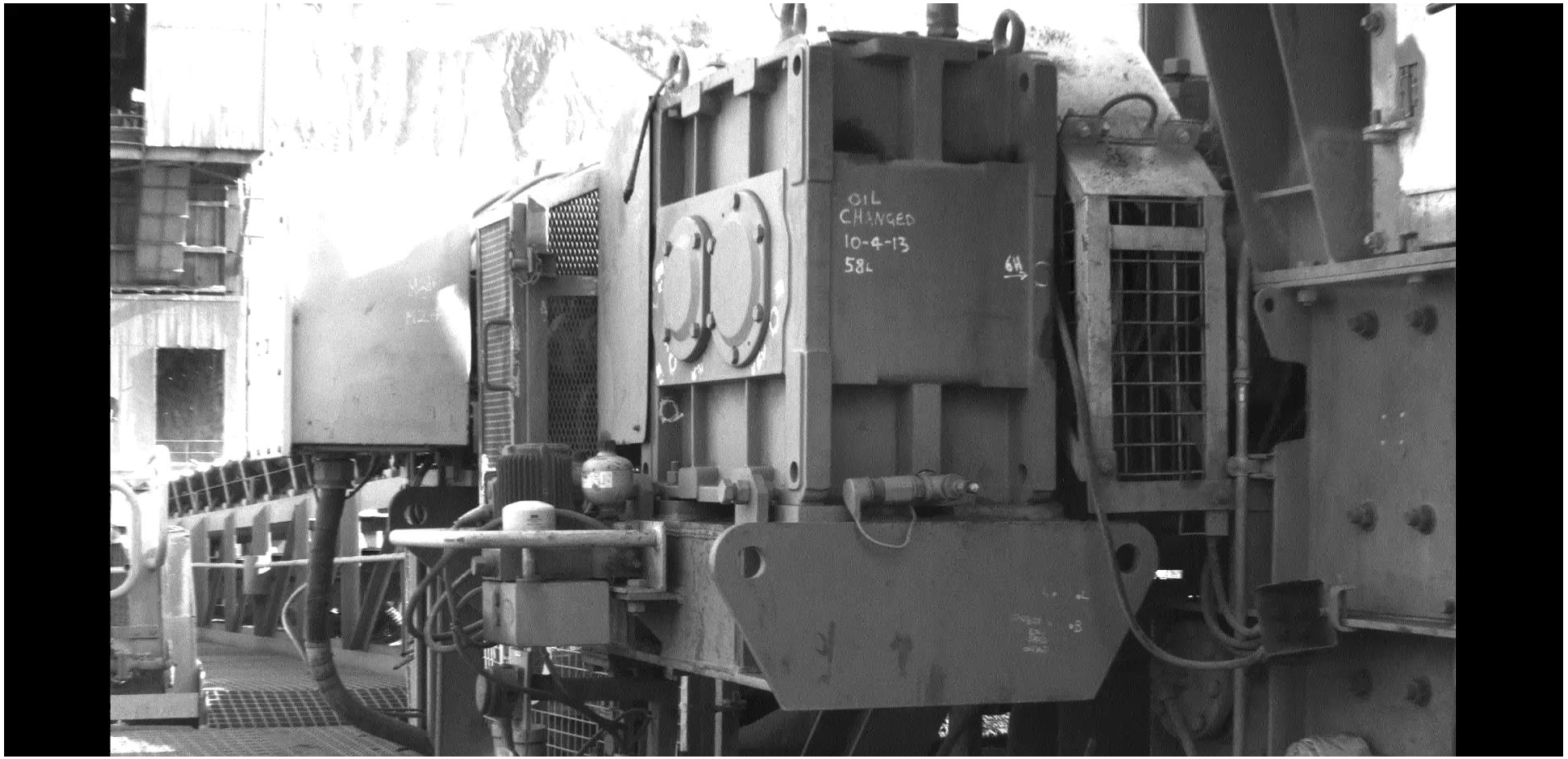
Advanced Technique: Filtering 2 Hz



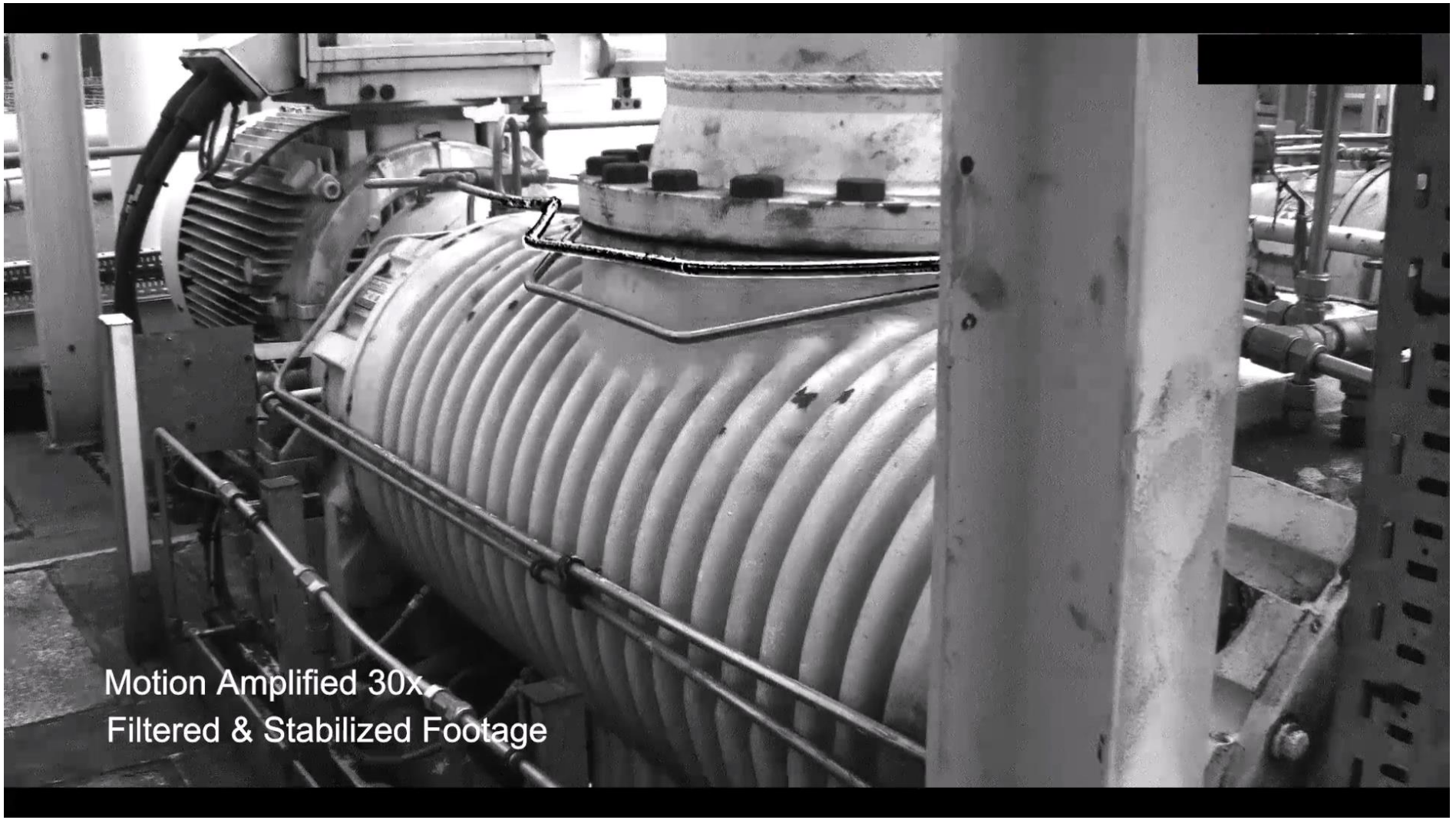
Advanced Technique: Filtering 25 Hz



Advanced Technique: Filtering Background



Advanced Technique: Stabilization



Recent Advancements

- **Live Visualizations**
- Motion Vectors
- Transient ROIs
- Transient Amplification
- Motion Map

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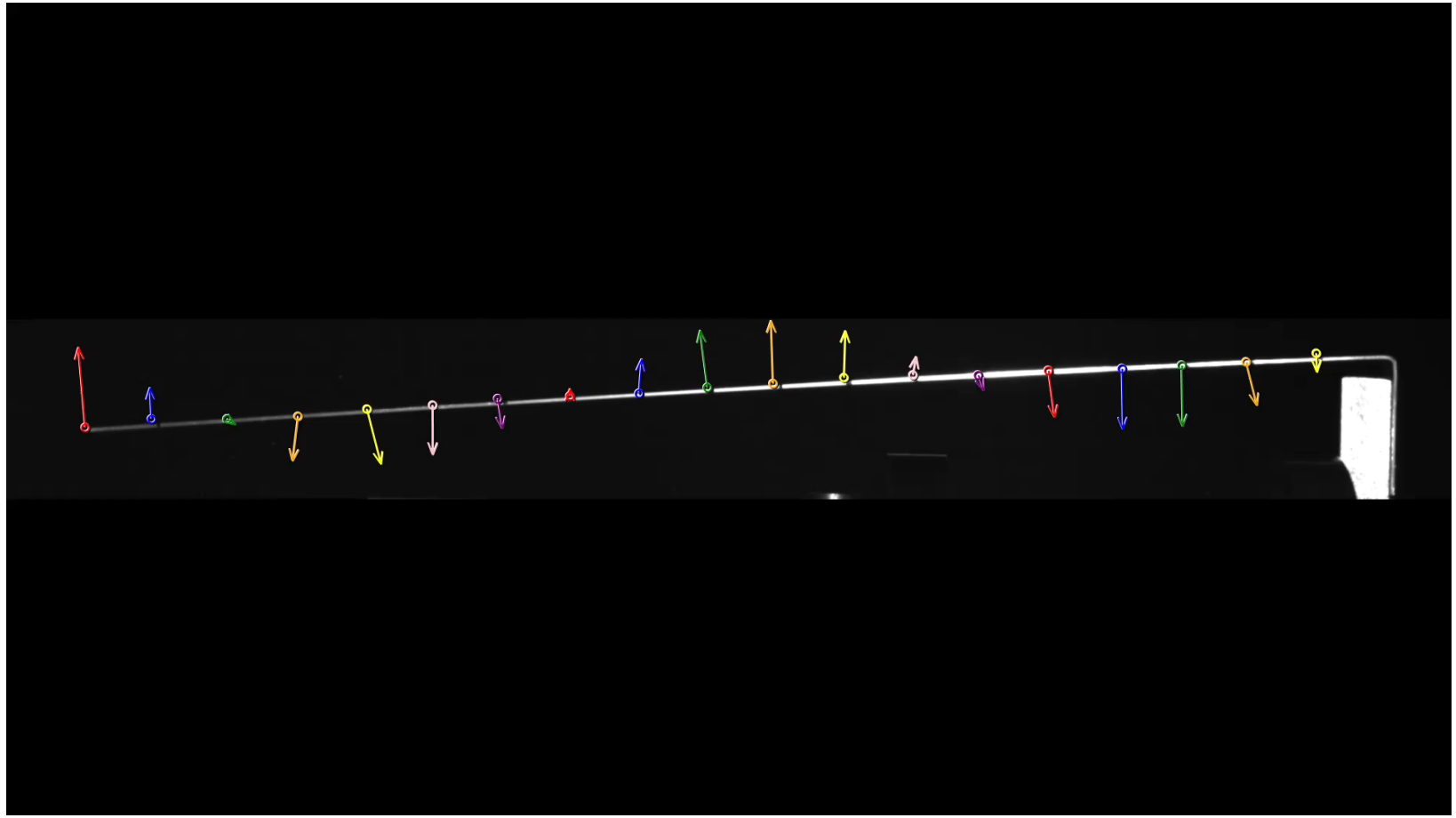
Motion Vectors



Recent Advancements

- Live Visualizations
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- **Transient ROIs**
- Transient Amplification
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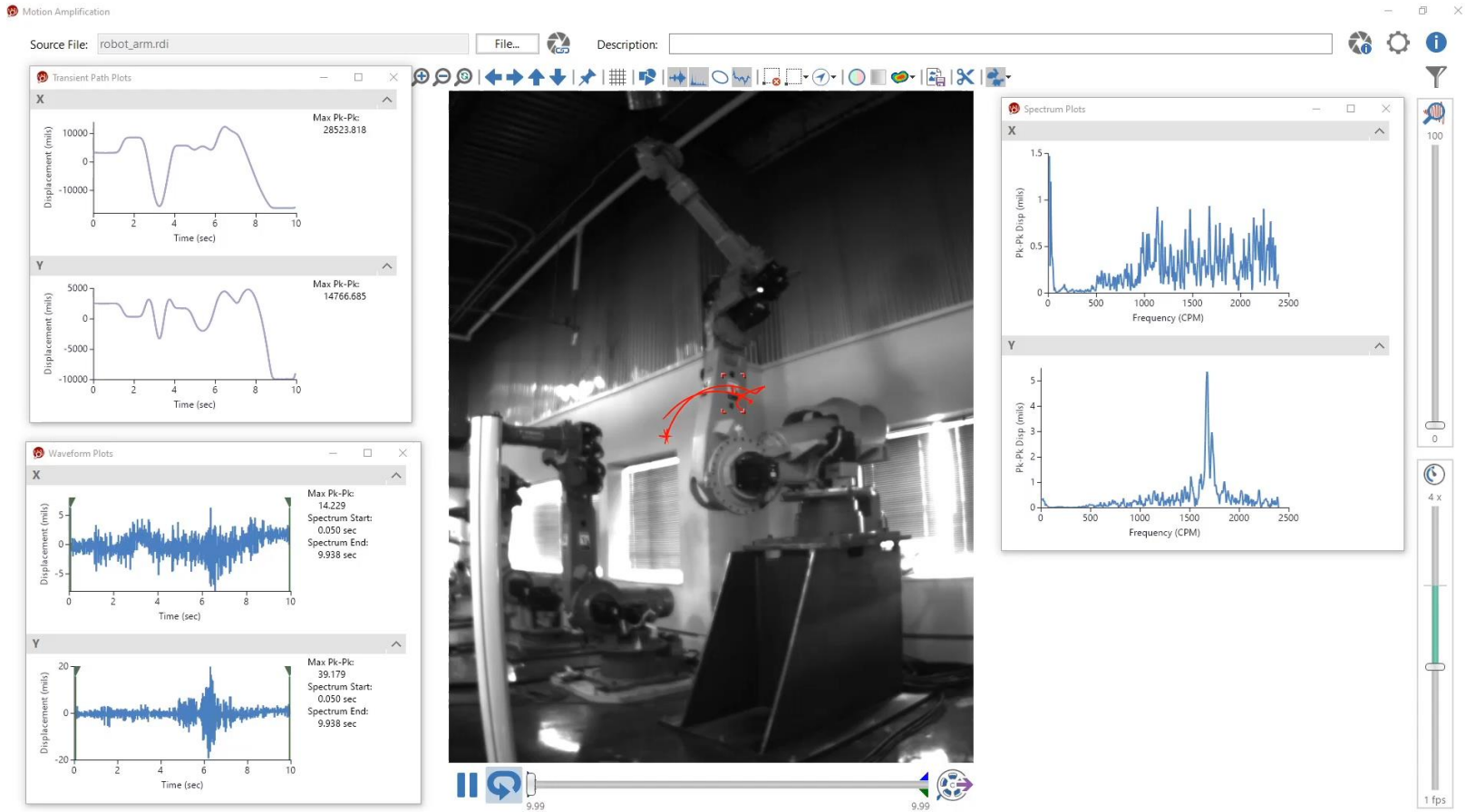
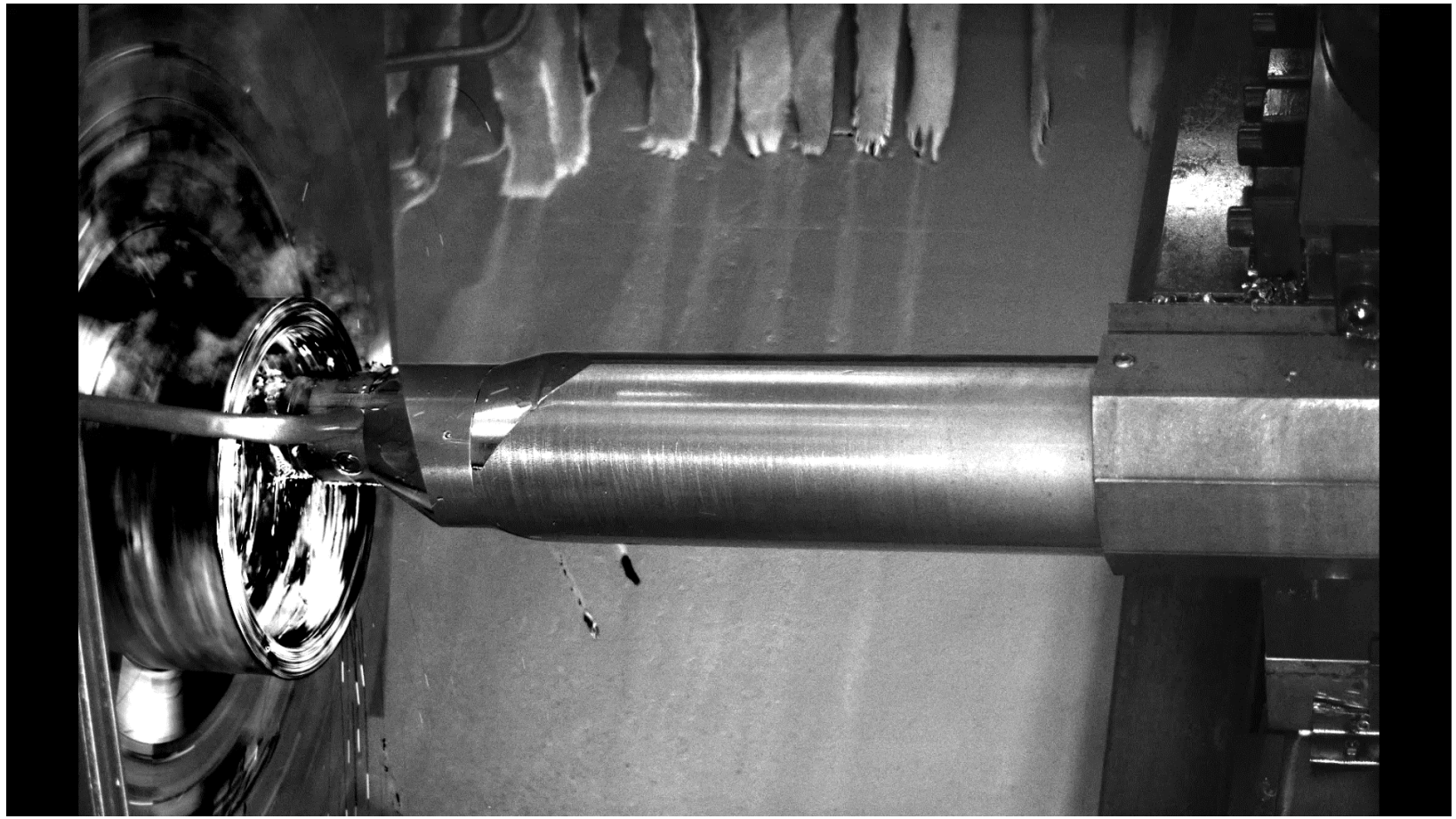
Transient ROIs



Recent Advancements

- Live Visualizations
- Motion Vectors
- Transient ROIs
- **Transient Amplification**
- Motion Map

Transient Amplification



Recent Advancements

- Live Visualizations
- Motion Vectors
- Transient ROIs
- Transient Amplification
- **Motion Map**

Motion Map


Motion Amplification
Source File:
dirty water test 2.rdi
File...
Description:
Attention
Pedestrian Access
100
0
4 x
1 fps
0.908
4.991

Pump Case Studies

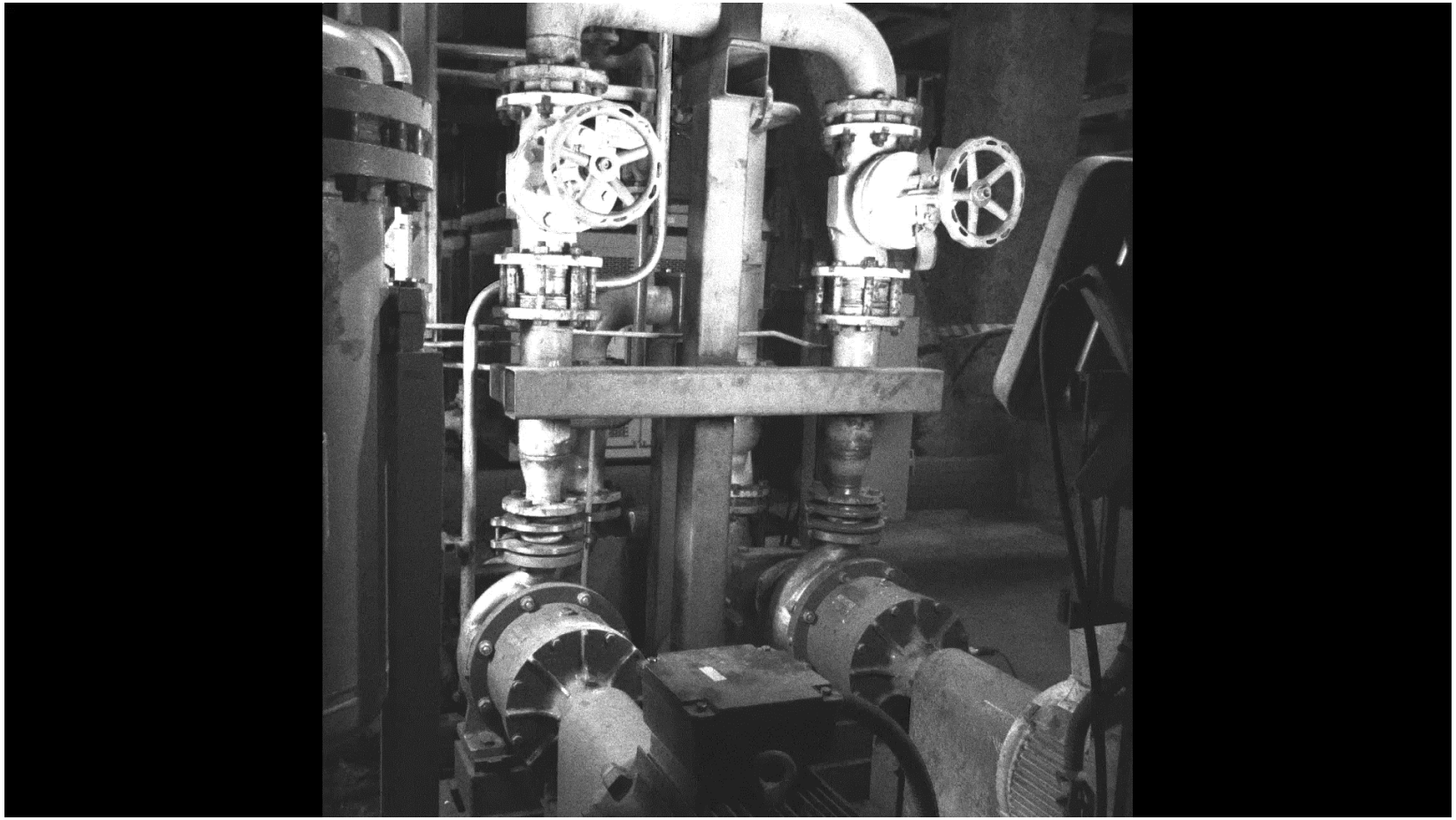
Case Study: Motor Stator Pump

Company: AGL Loy Yang
Location: Latrobe Valley, Victoria, Australia Service
Provider: Optical Motion Technologies (OMT)
Problem: Excessive Vibration Levels

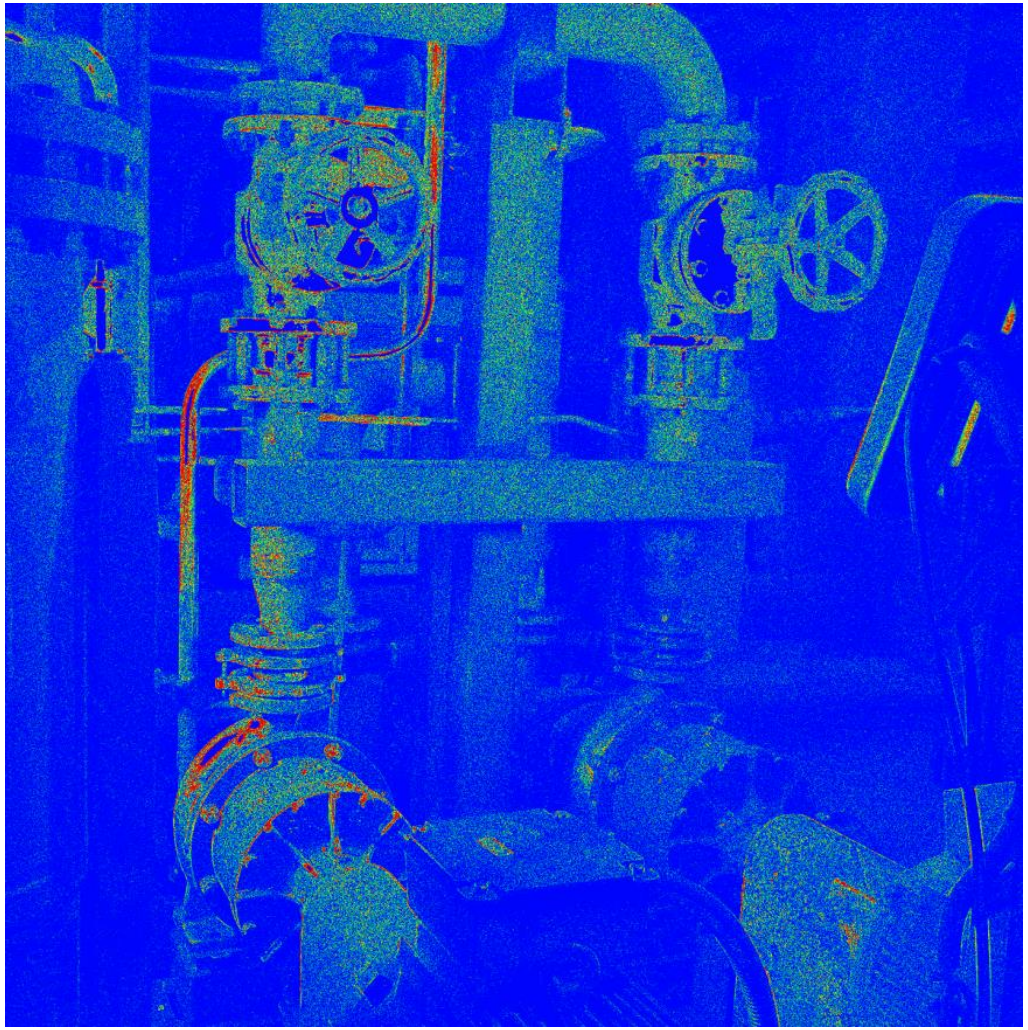
- $120,000 USD in repairs over 11 years
- 500 Man-hours expended
- Problem still existed
- Process completed in less than 1 hr.
- Root Cause Identified

- Camera revealed issues in the structural integrity of pump base frame
- Majority of Repair Complete through fillet welds interior to base – Client confident the problem is now understood
- Prior to this study additional repairs were planned that would not have addressed the problem
- Camera allows for a quick Root Cause look – quickly isolating issues

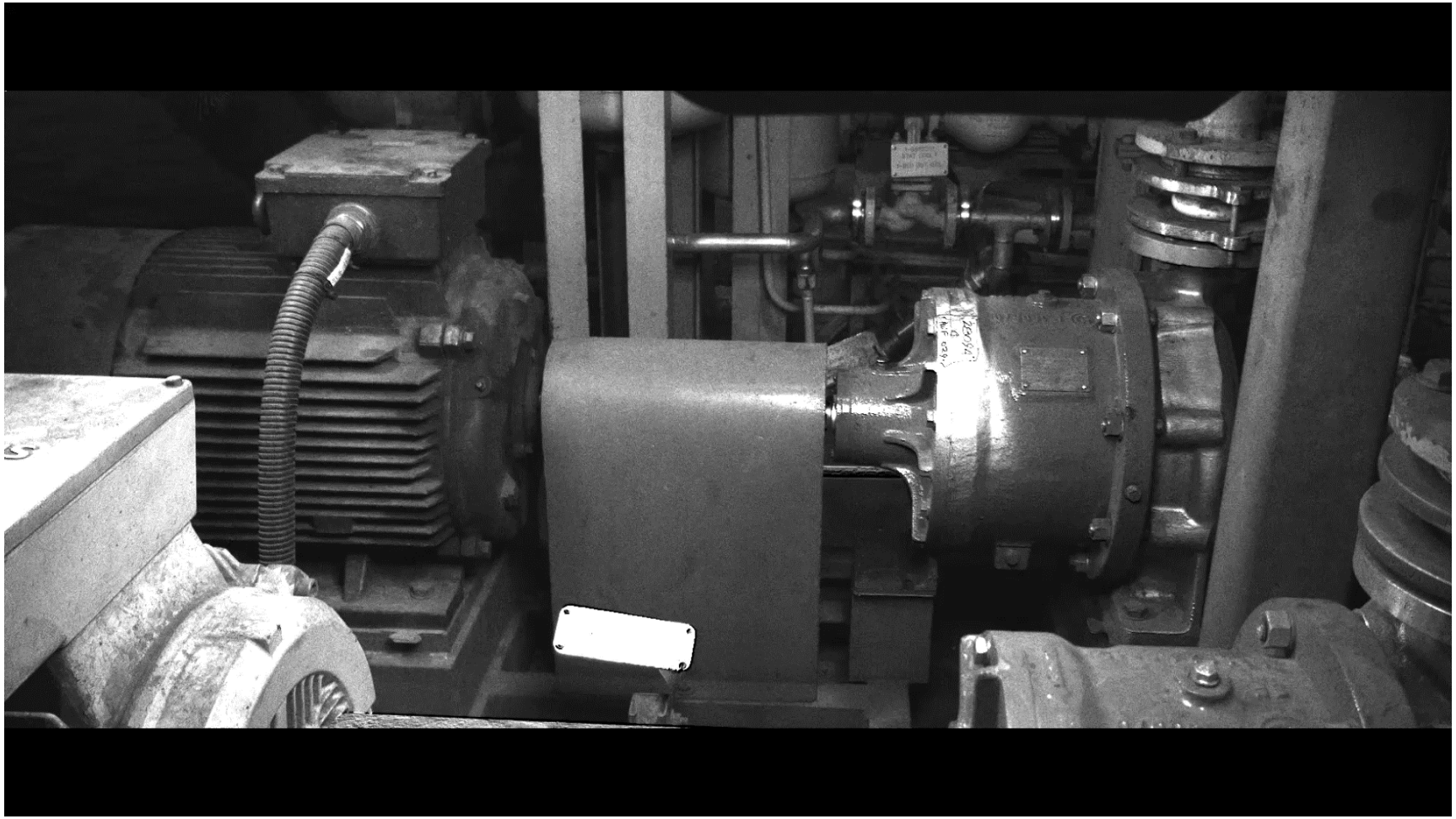
Case Study: Motor Stator Pump



Case Study: Motor Stator Pump



Case Study: Motor Stator Pump



Case Study: Motor Stator Pump

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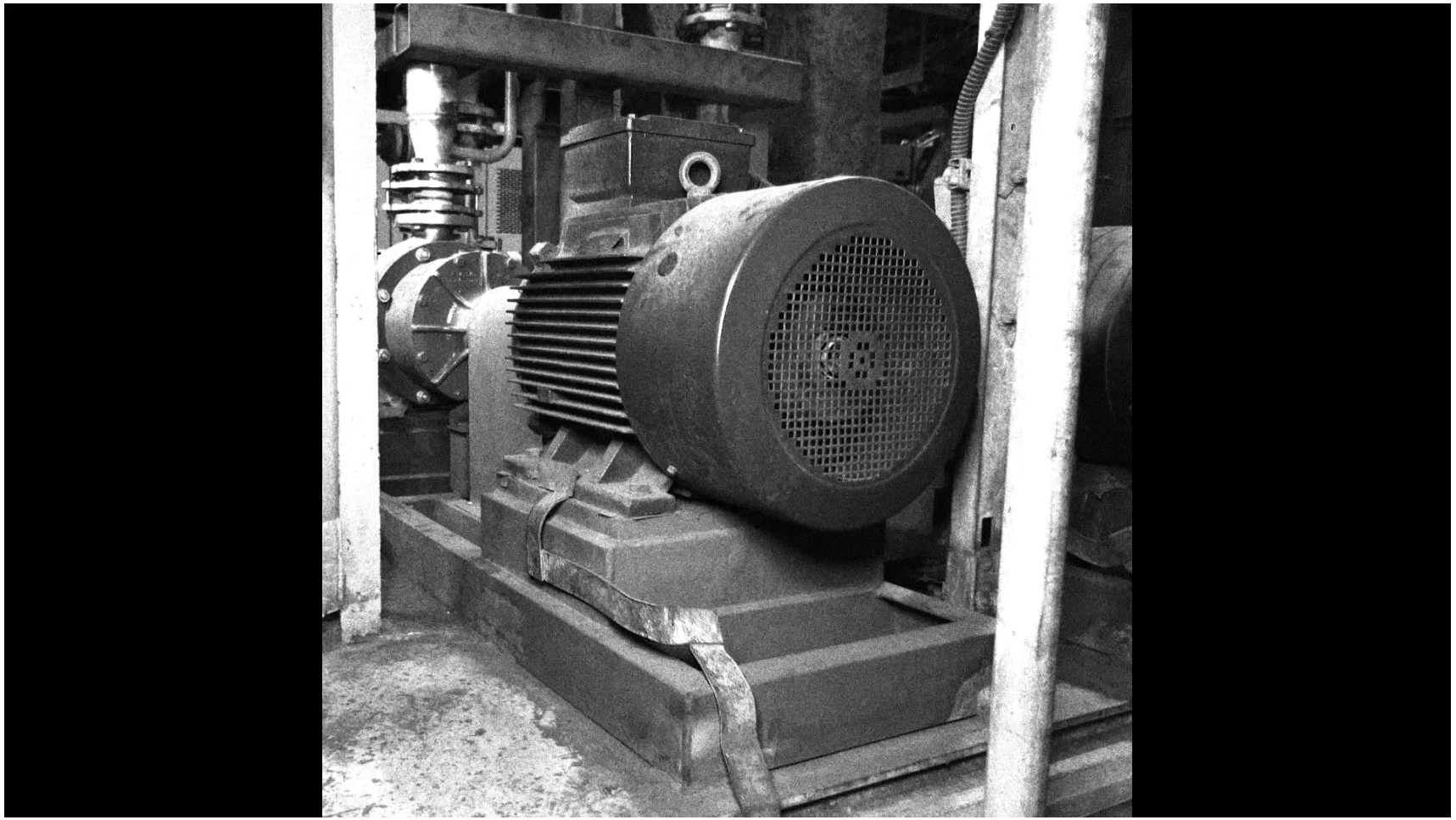

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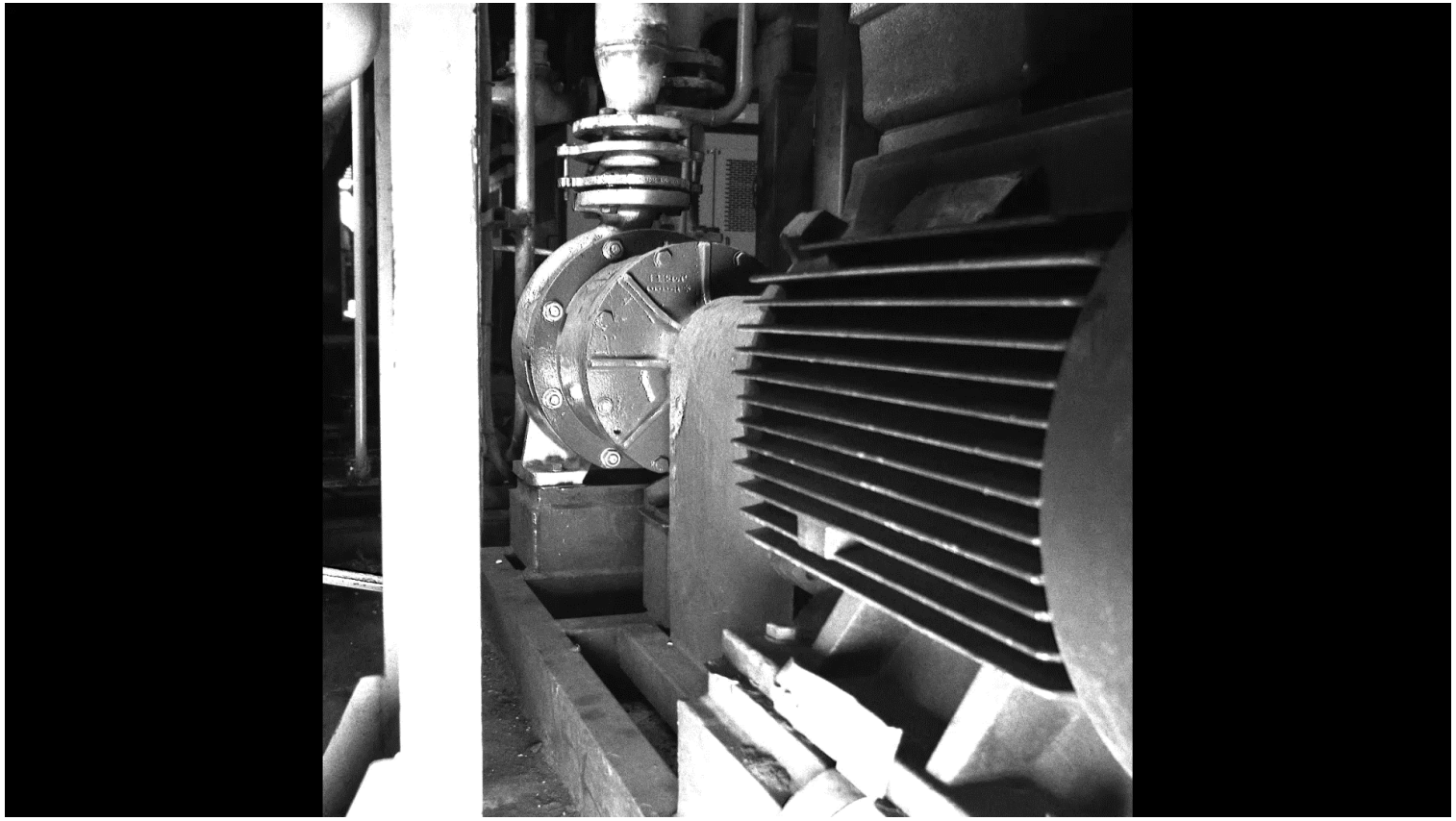

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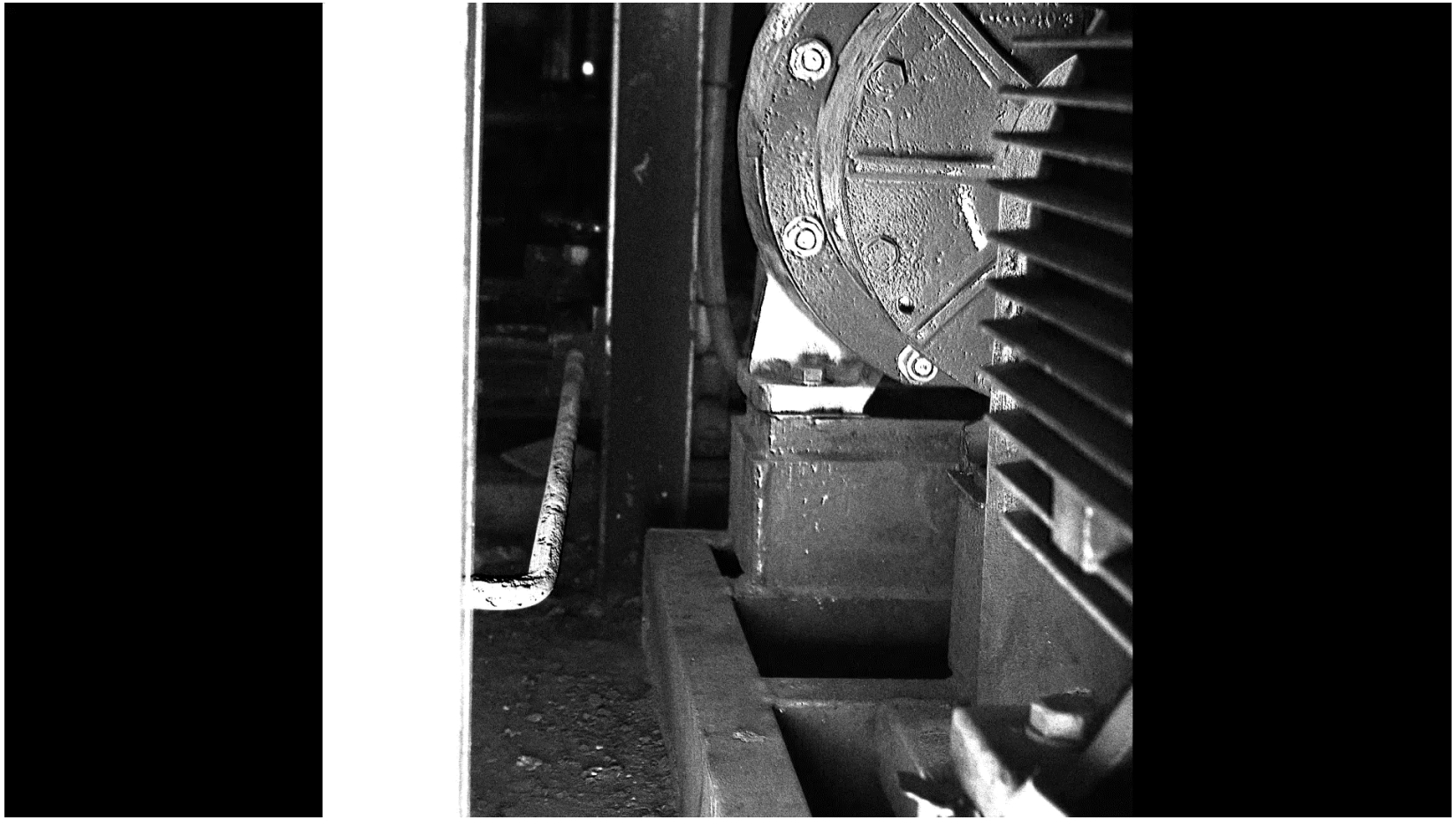

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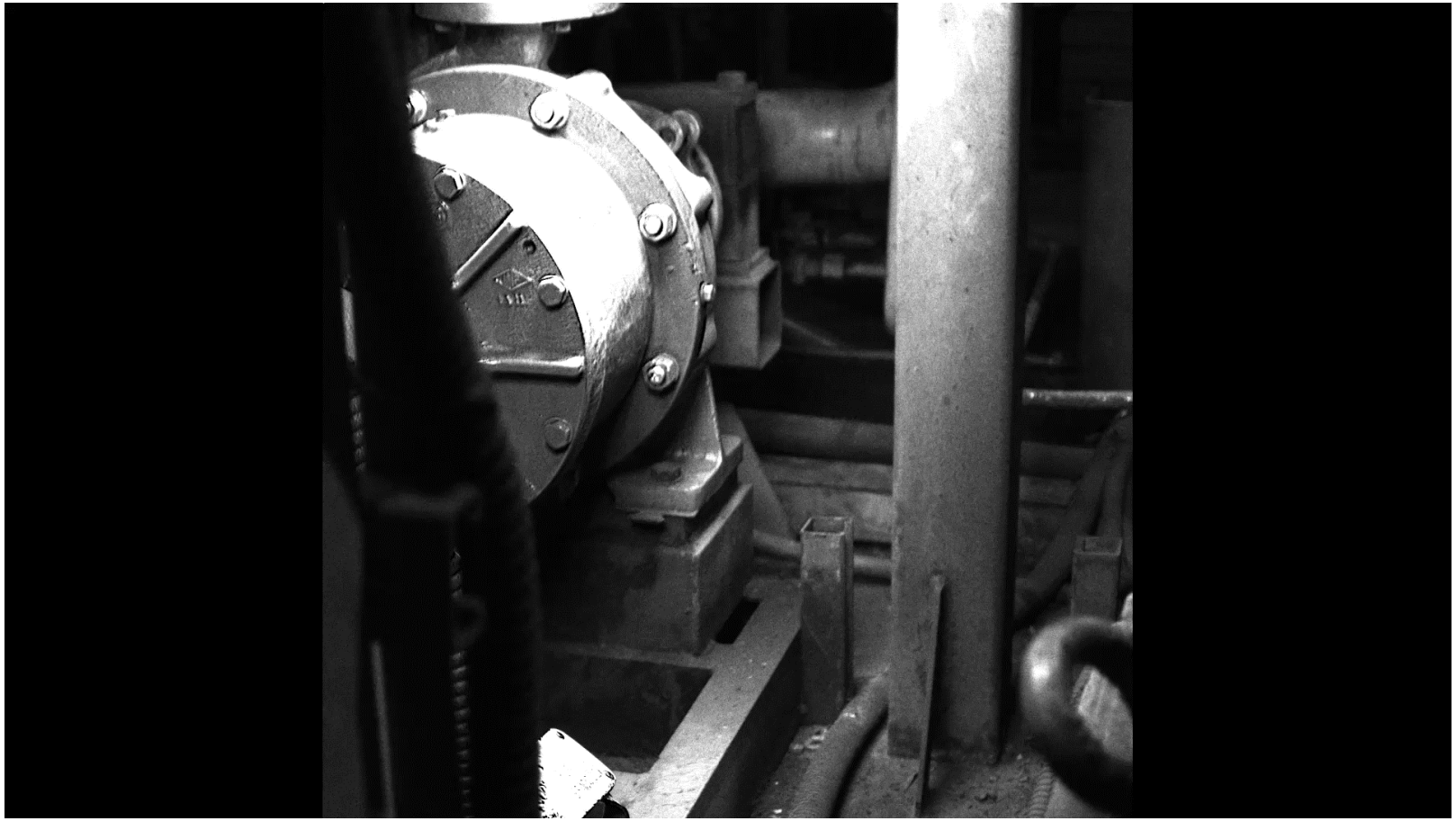
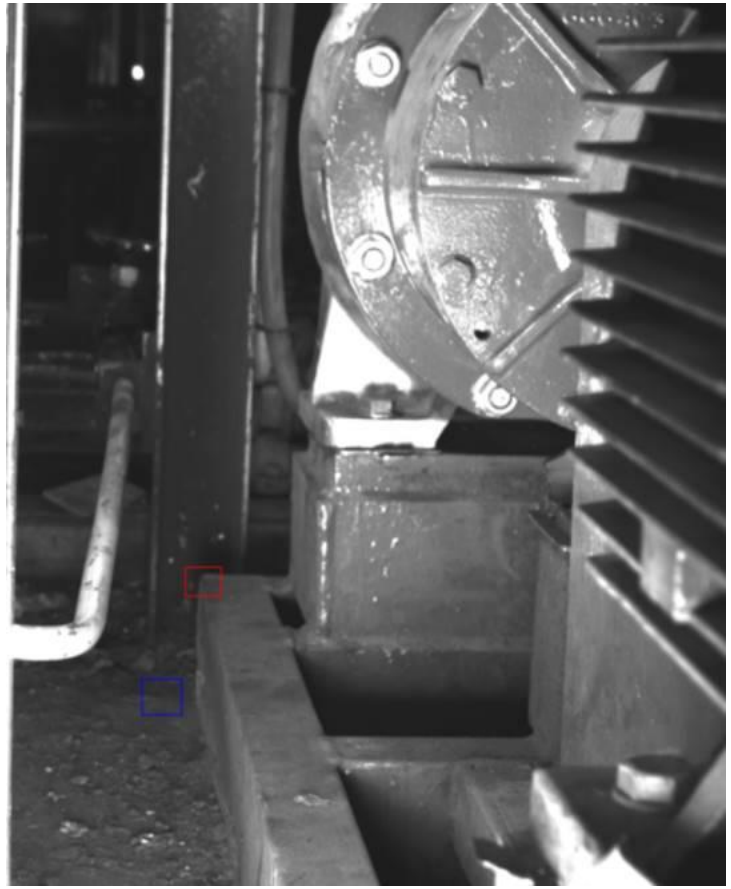


Case Study: Motor Stator Pump

- Main indicator was that there was relative motion (soft foot) between the steel motor/pump frame and the common skid steel base plate
- “There was simply insufficient weld to secure the motor/pump frame properly to the skid base plate”
- ~2 mils Pk-Pk (Red Box on motor/pump frame) vs ~0.4 mils Pk-Pk (Blue Box on skid base plate)
- Root Cause Issue Identified
- Vibration reduced from 0.55 in/s to 0.15 in/s
- This is before realignment- expected to improve more.



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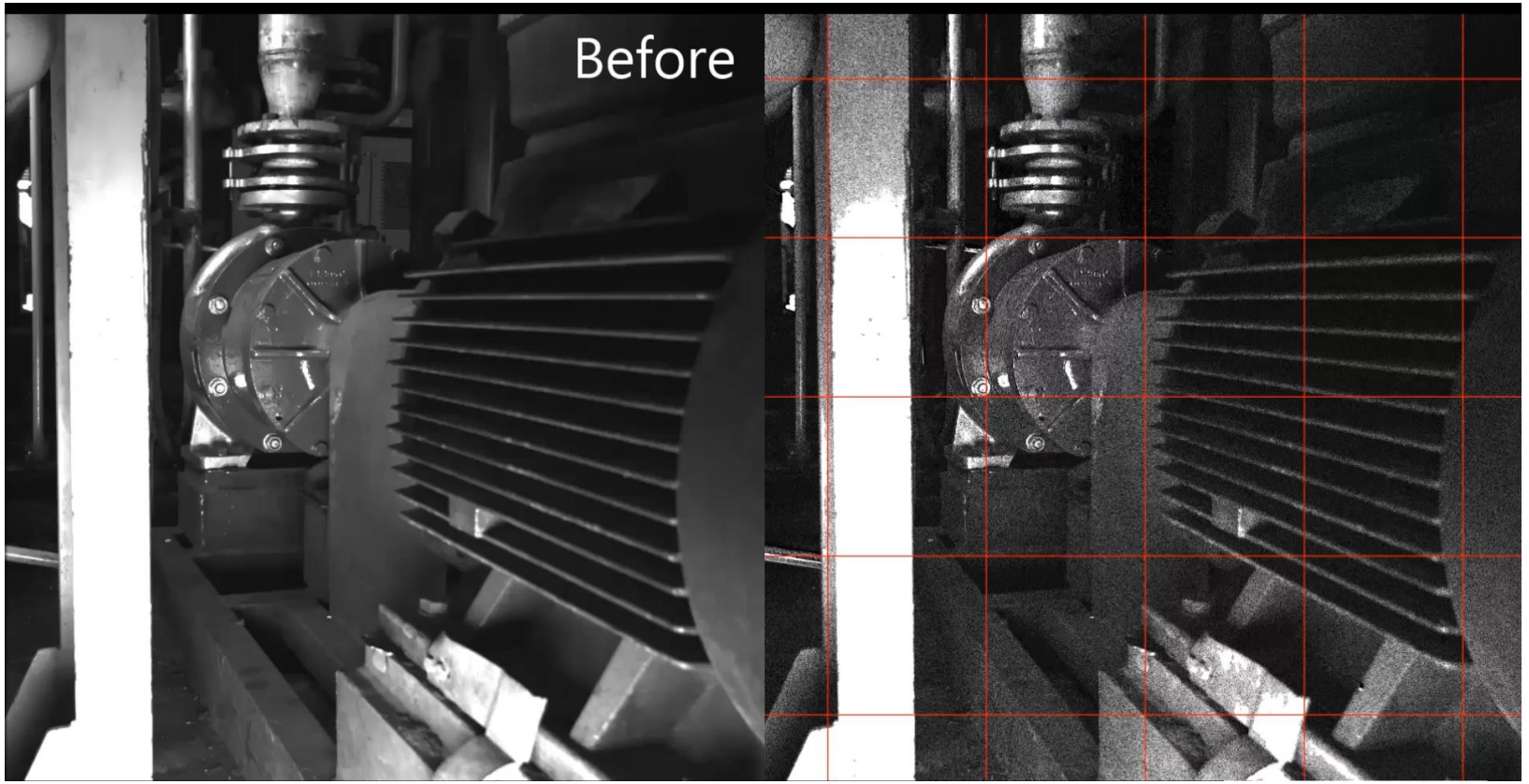
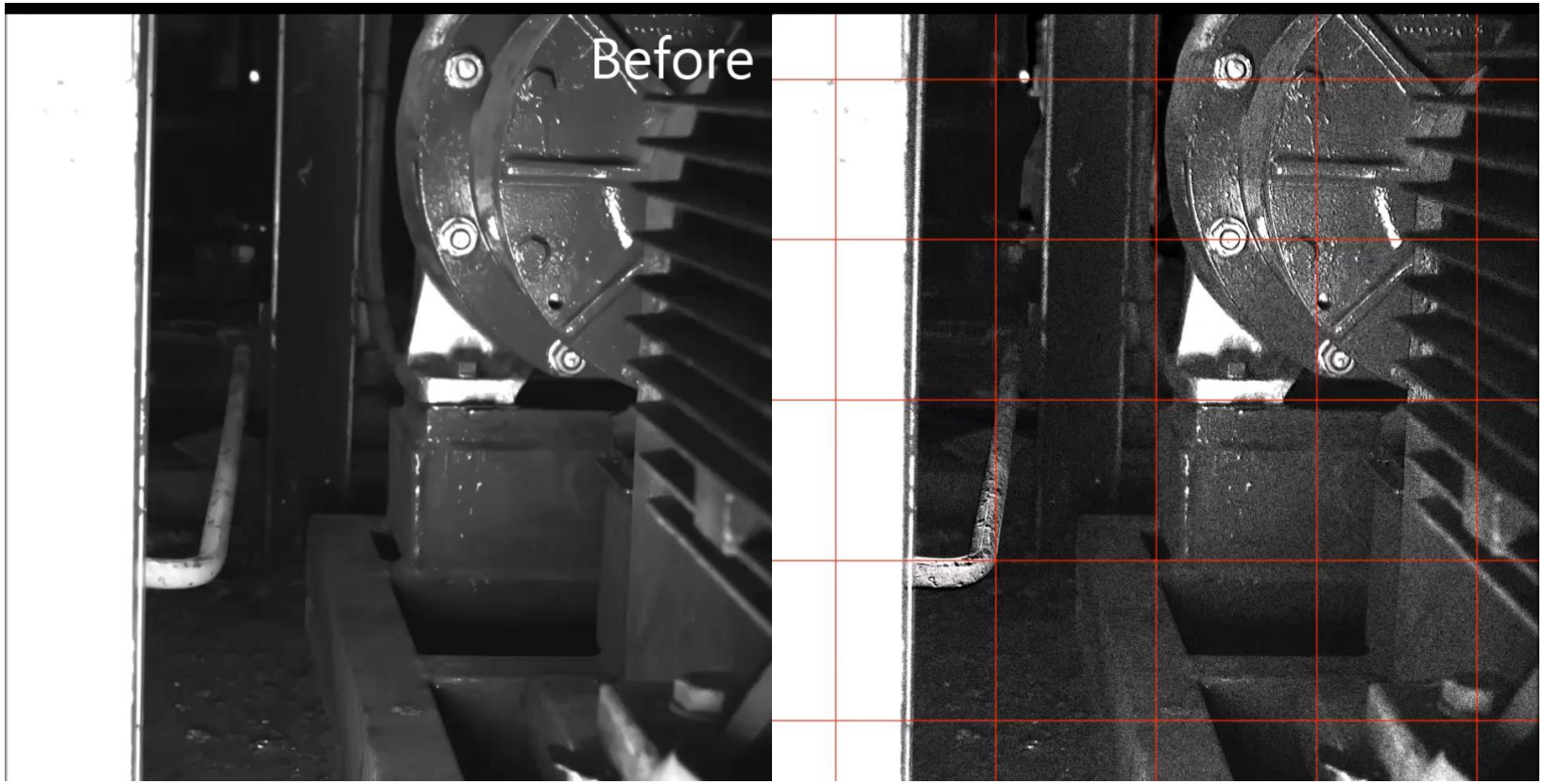
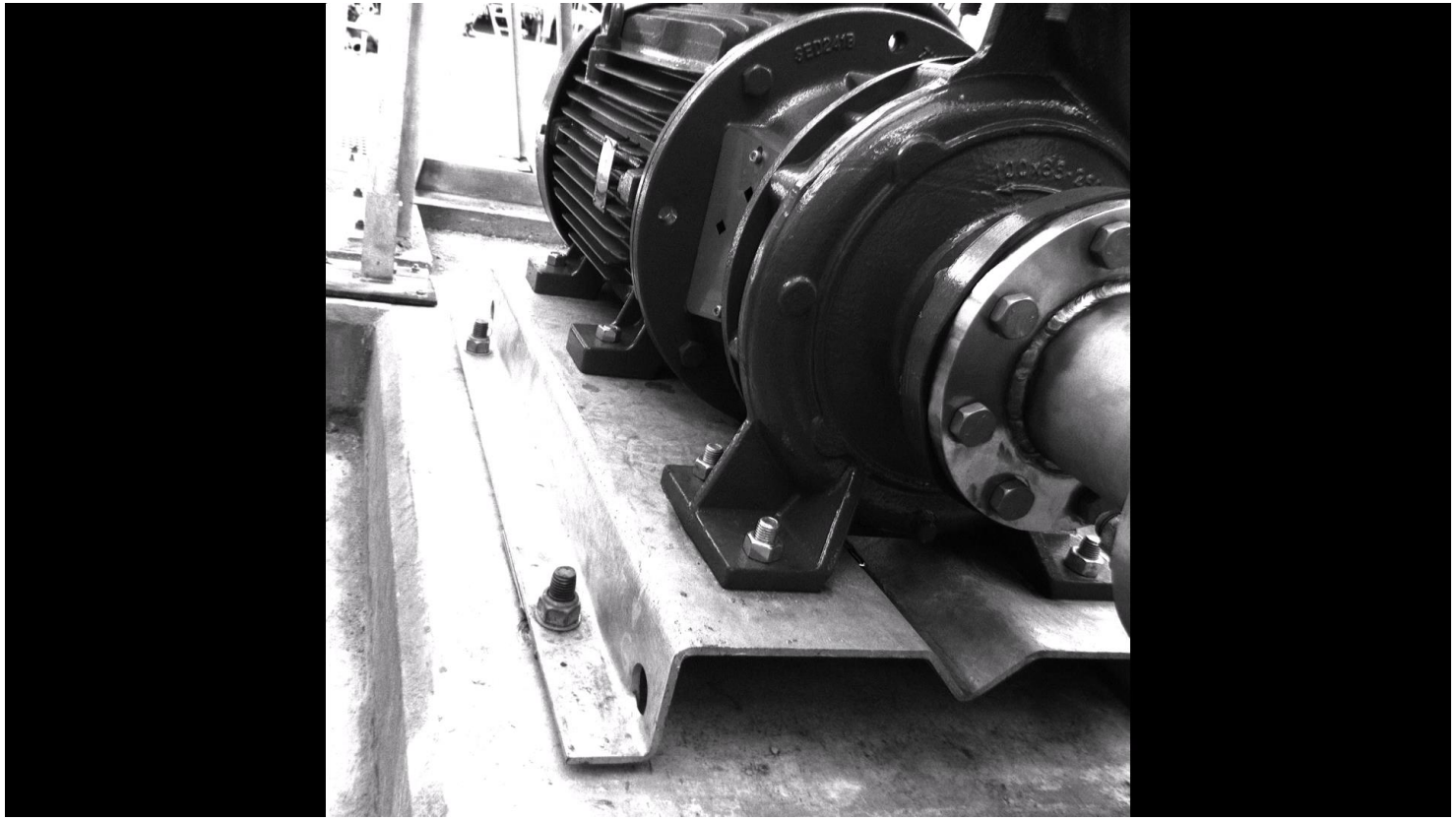


Case Study: Motor Stator Pump



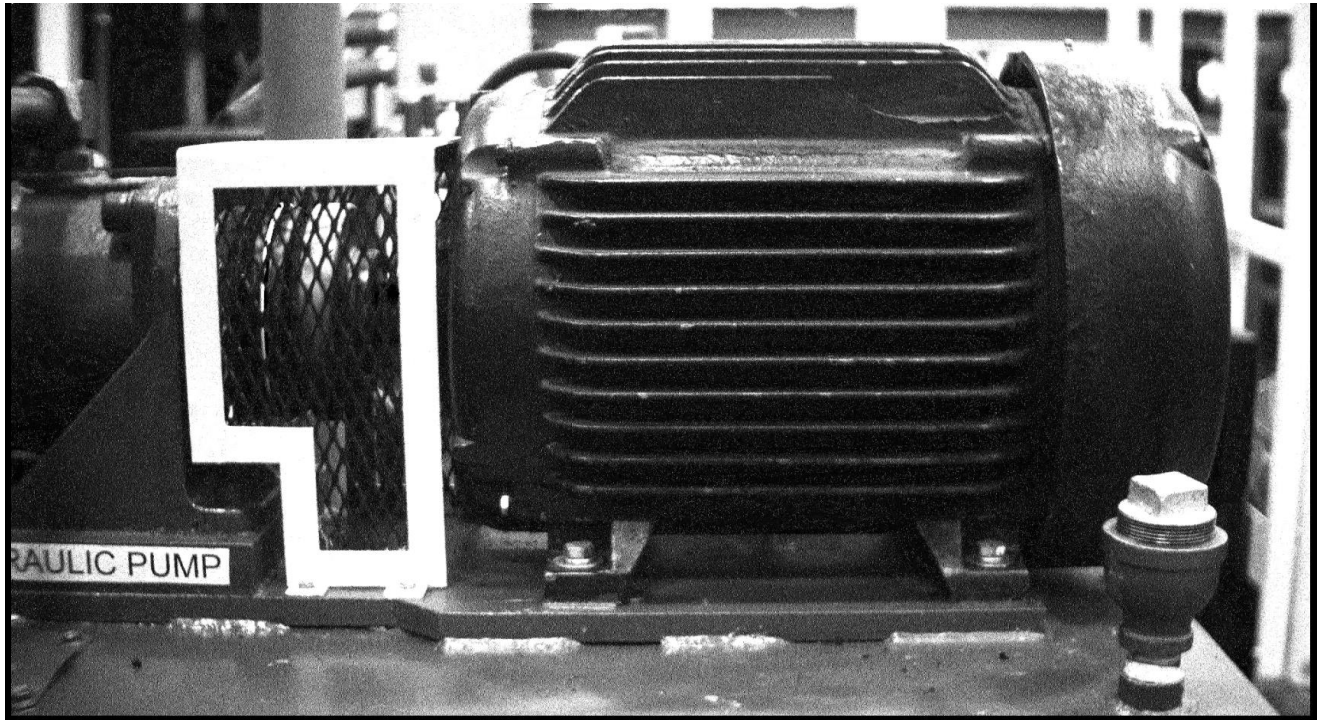
Case Study: High Pressure Spray Pump



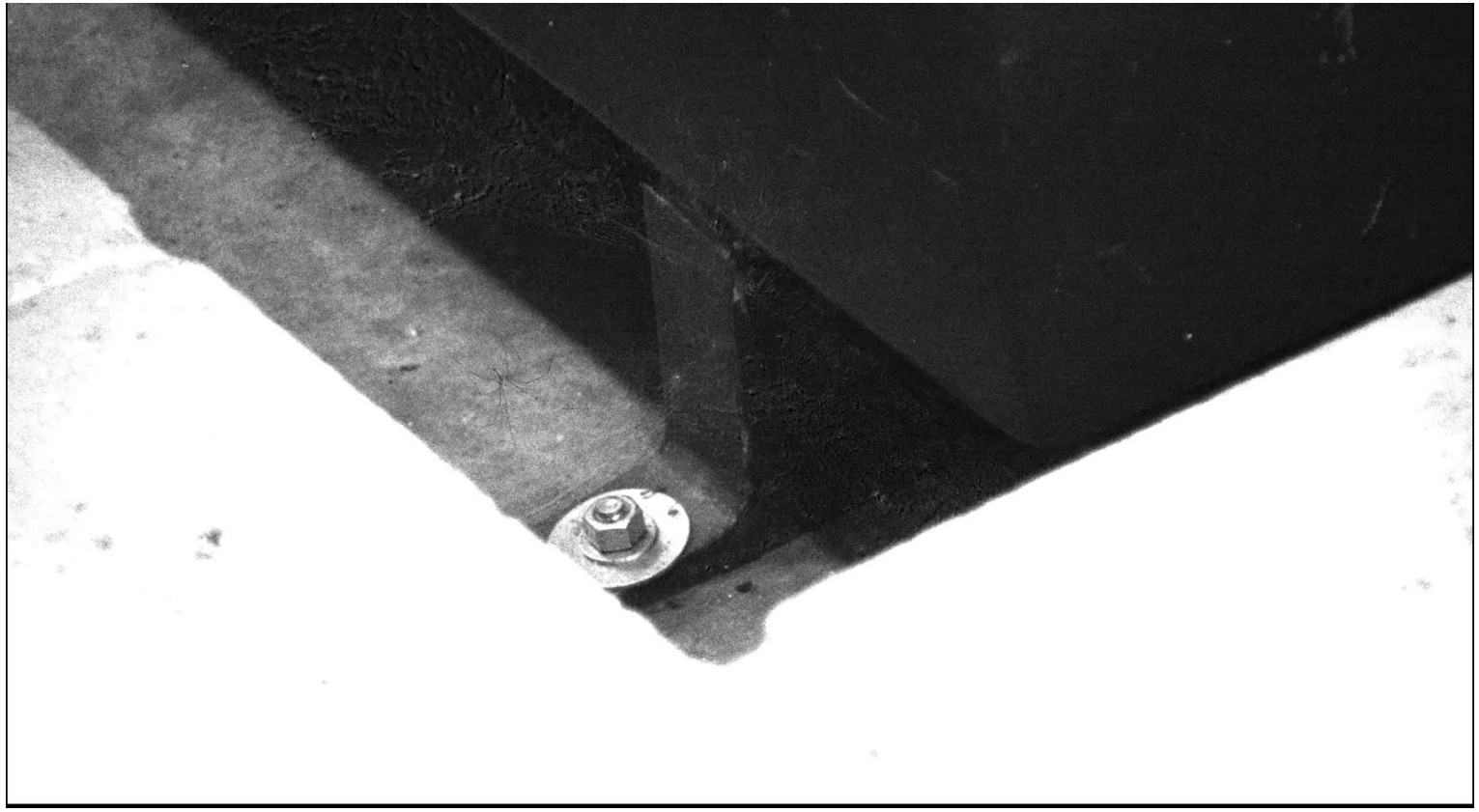
Case Study: Hydraulic Pump

- Operator knew of problem (High Vibration and Change in Audible Noise Levels)
- Could not determine root cause
- Motion Amplification process < 30 minutes.
- Issue identified as bolt drilled at an angle at install

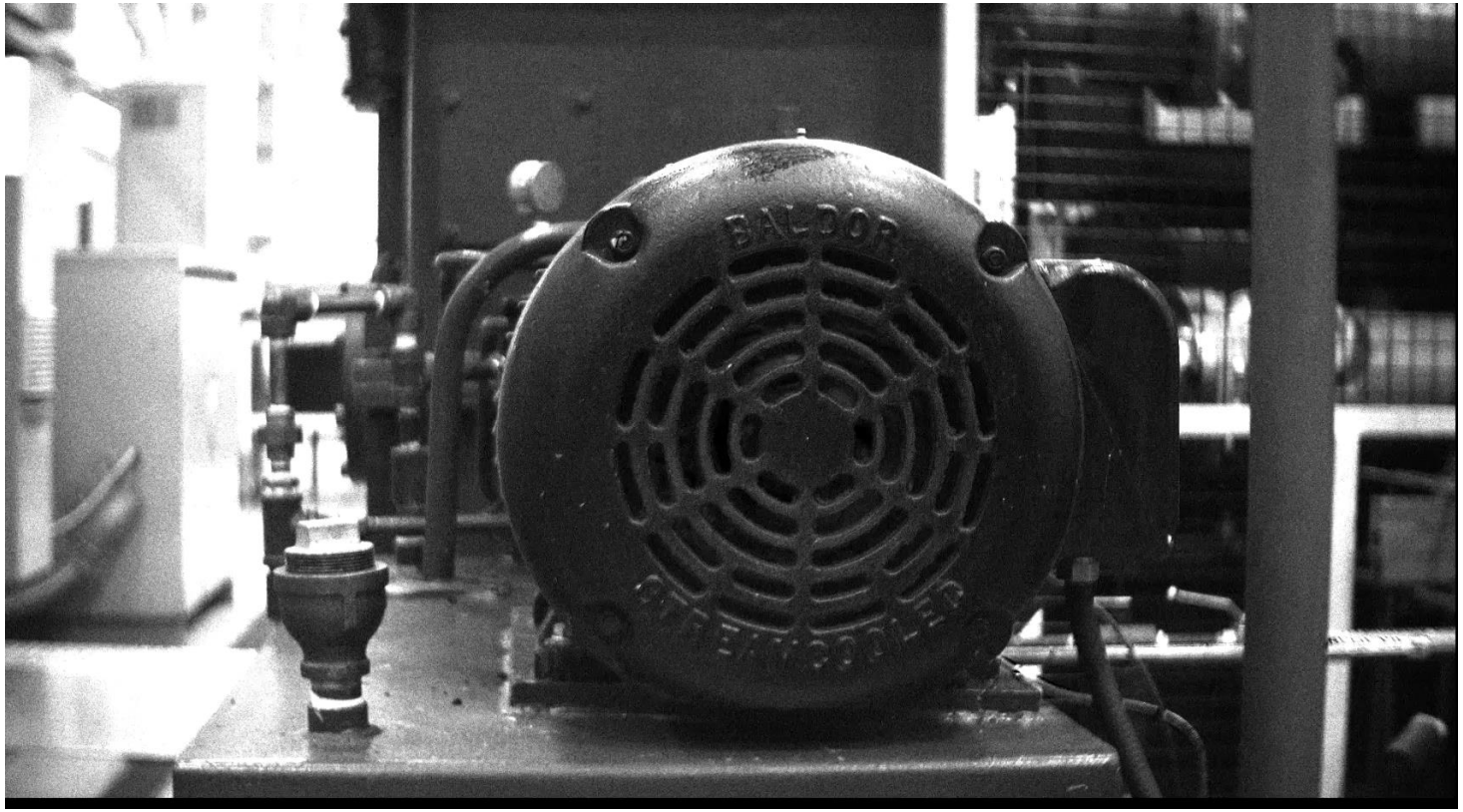
Case Study: Hydraulic Pump



Case Study: Hydraulic Pump



Case Study: Hydraulic Pump



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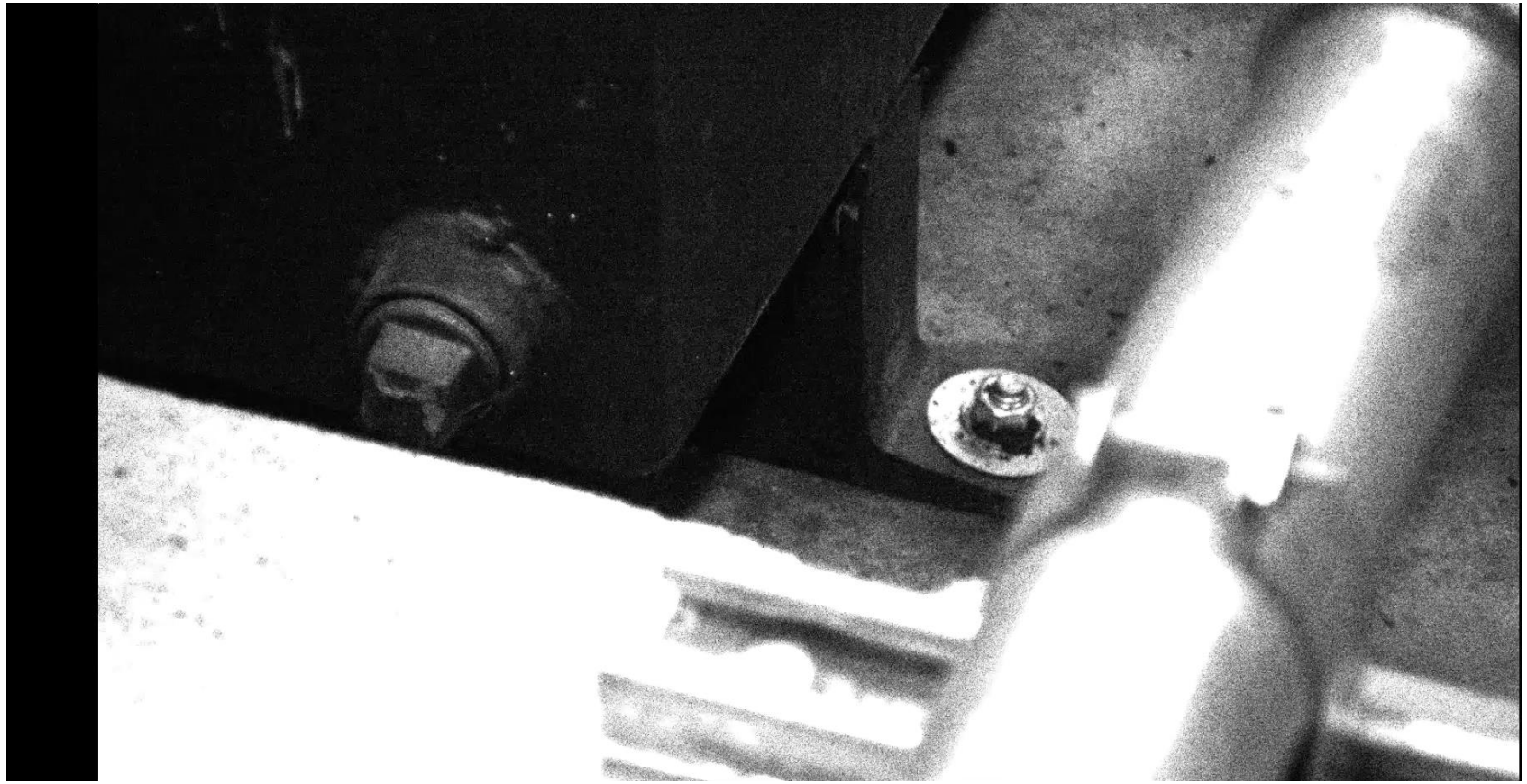

Case Study: Hydraulic Pump Solution

- Client confirmed the bolt was drilled at an angle during installation
- Allowed the bolt to work its way loose
- Client confirmed they intended to remove the bolt and redrill correctly.

Live Demonstrations

Case Study: Boiler Pump

Questions?

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