Rotating Equipment, Vibration, & Dynamics

Our structural dynamics and rotating equipment team combines field testing, data analysis, and advanced modal, stress, and fatigue analysis to provide practical and actionable recommendations to solve complex vibration problems with rotating machinery, piping, and structures.

Consulting Service Areas

Piping Vibration FFS Evaluation & Remediation

We conduct onsite field vibration and strain-gauge testing to identify the root cause and energy source of the piping vibration and/or noise levels vibration and help clients understand the risk. Our team of experts leverages their knowledge in piping and structural vibration analysis, flow-induced vibration, process flow regime, computational fluid dynamics (CFD) assessments, and ASME B31 piping design to provide fast, accurate, and complete solutions when remediation is necessary.

Piping Systems: Small-Bore Piping Surveys & Vibration Risk-Based Inspection (VRBI)

We address the risk of vibration fatigue in small-bore piping, especially on systems with reciprocating compressors which is a common cause of loss of containment. Our team conducts visual inspections to acquire and analyze vibration measurements, uses their field experience to survey facilities and operating units, and provides onsite support during commissioning of new systems or during rate increases. We identify small-bore piping designs, screen for active vibration risks, prioritize risks, and provide recommendations, enabling clients to make informed decisions regarding remediation.

Rotating Machinery: Advanced Vibration Diagnostics, Troubleshooting, & Root Cause Failure Analysis

We use a variety of advanced diagnostic tools, such as motion video amplification (MAV), advanced transient analysis for start-ups and coast-downs, operating deflection shape (ODS) analysis, experimental modal analysis (EMA), and rotor dynamic computational analyses to identify and diagnose problems. We can support all onsite diagnostic and root-cause investigation needs as well as condition monitoring assessments using System1.

Rotating Equipment: Reliability & Maintenance Optimization

We support and optimize existing reliability programs by helping our clients identify the most critical assets, develop spare parts lists, create predictive and preventative maintenance templates based on criticality and machinery type, customize inspection and test plans for new and existing equipment, and create customized reliability best practices tailored to help retain and share knowledge across the enterprise.

Acoustic-Mechanical Pulsation Analysis

An acoustic-mechanical pulsation analysis includes API 618 DA3 for the design, remediation, and in-service assessment of positive displacement machinery. We have developed advanced dynamic FEA simulations and computational acoustic analysis to provide new design evaluations for original equipment manufacturers (OEMs) and owner-users, as well as in-service assessments of critical machinery. We also conduct field testing using high-speed pressure transducers for root-cause analysis to verify and validate our models.

Case Studies

Acoustic-Mechanical Study for a Piping System

Industry:
Refining

Type of Asset:
Hydrogen Recycle Compressor in Hydro-processing Unit

Location:
USA

Issue:
During an outage at the refinery, it was noted that the piping system change did not have an acoustic-mechanical study done as part of the design, which resulted in a pressure boundary failure.

Solution:
We performed a root-cause assessment and identified acoustic pulsation and mechanical resonances in the piping system. We designed structural and piping modifications to help the client manage risks of future failures and conducted a survey of the unit to identify any additional unknown risks and small-bore bracing designs.

Result:
The client was able to manage future risks with the upgraded piping supports and installed new orifice plates on the compressor to reduce the root-cause of the energy throughout the unit. This helped prevent future failures and improved the overall reliability of the hydroprocessing unit.

Piping Vibration Study to Improve Reliability

Industry:
Mining

Type of Asset:
Metal Processing Refinery

Location:
Canada

Issue:
A metal processing refinery had a history of small-bore failures in the nickel carbonyl compressor system which posed a substantial risk due to the high-consequence process.

Solution:
We performed a piping vibration survey and risk assessment on the nickel carbonyl unit. Our team of three mechanical engineers conducted the onsite survey of the entire unit, identified high-risk connections based on design, screened for and prioritized active vibration issues, and developed custom bracing plans to manage future failures. Additionally, the team identified a mechanical resonance in a major structural floor beam caused by the fluid forces of a nearby reboiler vessel. After conducting an FFS assessment of the structure, modifications were recommended to detune the structure and improve its mechanical integrity.

Result:
The survey helped identify and mitigate multiple unknown, high-probability failure vibration issues. An action item list was developed with priorities assigned, allowing the plant to prioritize maintenance activities and improve overall equipment reliability.

Applying API 618 Principals to a Reciprocating Compressor

Industry:
Midstream

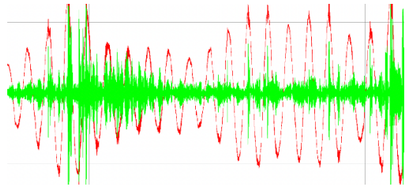
Type of Asset:
Compressor OEM

Location:
South America

Issue:
The high-speed compressor original equipment manufacturer (OEM) required assessment of a new design.

Solution:
We provided a full API 618 acoustic-mechanical design approach Level 3 analysis of the packaged high-speed reciprocating compressor.

Result:
We resized the suction bottles to better manage and reduce the need for excessive pressure drop of the added orifice plates. During the design stage, the team also identified piping supports that required stiffening and provided solutions to detune mechanical natural frequencies and improve separation margins. These recommendations helped ensure the compressor design was optimized to meet performance and safety requirements.



> THE TEAM WENT ABOVE AND BEYOND TO ASSIST WITH OUR VIBRATION STUDY. THEY COMPLETED THE WORK IN A TIMELY MANNER, KEPT ME INFORMED, AND DELIVERED A **GREAT FINAL PRODUCT.**

Vibration Clamp Design, April 2024

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