Piping Vibration Analysis & Practical Engineering Solutions

Energy Milestones Corporation

Advancing Professionals to the next level

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info@energymilestones.com

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Overview

This course provides a thorough review of a wide variety of causes of process plant piping vibration from the point of view of an engineer who must identify the cause of vibration, determine if vibration is excessive, and correct the problem if it is. It provides background on the fundamental causes of piping vibration, how to identify the source of vibration, rules of thumb and simplified methods for evaluating vibration severity, and methods of treatment. A wide variety of causes of vibration is covered to enable participants to properly assess the various piping vibration problems that can occur in piping systems.

Course Objectives

At the end of this course, the participants will be able to:

- Identify and evaluate different types of fluid-induced vibrations and their impact on piping system integrity.
- Apply signal processing and data acquisition techniques for effective vibration monitoring and diagnostics.
- Interpret vibration data to differentiate between common fault conditions such as imbalance, misalignment, resonance, and mechanical looseness.
- Provide an integral, analytical/test approach to solving field vibration problems with an emphasis on piping vibration issues
- Provide a common language that supports a clear understanding for both the analyst and the test engineer of what each needs to solve vibration problems

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Course Content

1. Introduction
   - General vibration facts and plant vibration issues

2. Optimum Vibration Problem Resolution Strategy
   - Root cause determination approach; Integration of analysis and test

3. Signal Processing
   - FFTs, windowing, filtering, digital integration, averaging, overlap and order tracking

4. Basic Vibration Theory
   - Terminology: sine waves, amplitude, frequency, phase.
   - Single DOF Parameters: stiffness, damping, and mass, Governing EOM
   - Multi-degree-of-freedom system characteristics: mode shape and frequency

5. Vibration Test Fundamentals
   - Test specifications: frequency range, measured parameters, sensor locations, sensor types
   - Instrumentation concerns: linearity, range, bandwidth, installation, uncertainty analysis
   - Data acquisition: digital vs. analogue. Digital DAQ issues: amplitude resolution and aliasing

6. Data Analysis Techniques
   - Data analysis: time history, frequency spectrum; Data statis tics: peak, peak-to-peak, RMS

7. Vibration Causes and Data Interpretation
   - Imbalance: static, dynamic; Misalignment: parallel and angular; Bent or bowed shaft
   - Resonance and Critical speed; Damaged bearings; Gear problems; Fluid induced vibration

8. Case Studies

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Targeted Audience

This course is directed towards engineers responsible for operating piping systems. However, designers of new piping systems will also find the broad coverage of potential vibration problems a time-saving briefing on the variety of vibration problems that can occur in piping systems.

Course Methodology

Facilitated by an experienced professional trainer, this training course will be conducted as a highly interactive workshop session. A variety of training methodologies and facilitation techniques will be employed before and during the course, as applicable. These methods are aimed at enhancing individual and group interaction while maximising learning. Some of these methods are:

- Online Pre-post Test
- Colourful Visual Aids
- Gamification
- Self-Assessment Instruments
- Simulations
- Case Studies
- Videos
- Group Exercises & Discussions
- Role plays
- Indoor & Outdoor games