



Piping Vibration Analysis & Practical Engineering Solutions in Process Plants

Potential PDH: 16

Description:

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 that must identify the cause of vibration, determine if vibration is excessive, and correct the problem if it is. It provides a background on fundamental causes of piping vibration and 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 are covered in order to enable the participant to properly evaluate the variety of piping vibration problems that can occur in piping systems. The causes of vibration, where possible, are discussed with respect to very basic energy and momentum principles that enable the participant to understand what is happening within and to the piping system. Screening and simple vibration limits are provided. Many actual examples of typical plant piping vibration problems that the Becht has encountered in the energy industry are reviewed to illustrate the concepts covered. In addition, participants are encouraged to bring examples of troublesome vibration problems they have experienced or are experiencing in their plants for class discussion.

Outline:

1. Introduction
 - General Definitions
 - What we are Trying to Prevent
 - Vibration Types
 - When to Solve Problems
2. Mechanical Vibration
 - Single Degree of Freedom System
 - Displacement, Velocity and Acceleration
 - Damping
 - Multiple Degrees of Freedom
 - Simplified Vibration Analysis
 - What to do with Calculated Stress
 - Screening Criteria



- 3 Acoustic Resonance
 - What is it?
 - System Effects
 - EI Guidelines
 - API 618
 - Fixing Problems
 - Example
4. Reciprocating Pumps
 - General
 - Pump Discharge
 - Pump Suction
 - Fixing Problems
 - Example
5. Surge
 - What is it?
 - Surge Pressure
 - Surge Wave Velocity
 - Slow Closing Valve
 - Thrust Forces
 - Vapor Column Collapse
 - Solutions to Problems
 - Examples
6. Slug Flow
 - General
 - Slug Flow Force
 - Examples
 - Corrective Measures
7. High Frequency Vibration
 - General
 - Acoustic Resonance
 - Acoustic Fatigue
 - Vortex Shedding
8. Earthquake \emptyset General
 - Earthquake experience
 - Analysis
9. Other Sources of Vibration
 - Cavitation





- Flashing
 - Flow turbulence
 - Noncondensable gases
 - Wind
 - Pressure relief valves
 - Expansion Joints
 - Mechanical Excitation
10. More Rigorous Analyses
- OM-3 Requirements
 - Types of Computer Analyses
11. Solving Problems During Design
- EI Vibration Guidelines
 - Other Guidance
12. Solutions to Vibration Problems
- Piping Restraints
 - Other Treatments
 - EI Guidelines – corrective actions
 - Severe Cyclic Conditions
13. Practical Examples
- Important Sources of Vibration
 - Essential Service Water
 - Cumene Piping
 - Steam & Feed Water Piping
 - Cogen Plant Cooling Water
 - Furnace Outlet Line
 - Low Frequency Field Vibration
 - Thick Stock Pump
 - Process Condensate
 - Cavitating Venturi
14. Final Exam

Subject Matter Expert (SME):

Don Frikken is an internationally recognized authority in piping design. Now employed by Becht Engineering, Don had been with Solutia, Inc. and Monsanto Company for 34 years; working on a wide



range of activities including piping and mechanical design, project engineering, and engineering standards. Don's principal specialty is piping design, including design of complex piping systems, piping flexibility analysis, selection of piping components including valves, development of piping standards and specifications, and developing and teaching numerous piping seminars and workshops.

He is an ASME Fellow and is active on various ASME standards committees. He is a member and past Chair of the ASME B31.3 Process Piping Code committee, a member and past Chair of the B31 Standards Committee, which oversees all B31 Piping Code committees, a member of the B16 Standards Committee, a past member of the ASME Board of Governors, and a past member of the Council on Standards and Certification, which oversees ASME's codes and standards development.

Don has received many awards, including the ASME Melvin R. Green Codes and Standards Medal, which recognizes outstanding contributions to the development of documents used in ASME programs of technical codification, standardization and certification; the ASME B31 Forever Medal for Excellence in Piping; and the ASME B16 Hall of Fame Medal. Don graduated with a bachelor's degree in mechanical engineering from Kansas State University and has a master's degree in civil engineering from the University of Missouri-Rolla.