Leishear Engineering LLC

Course Description
Fluid Mechanics, Transients, and Dynamics in Piping Design

Number of Days: 5

For some, the term, *water hammer*, evokes images of broken and bent piping, multi-million dollar damages, the loss of water supplies to cities, and the deaths of individuals due to accidents. Water hammer may be defined as an extreme fluid transient, occasionally recognized by loud banging, or hammering sounds, sometimes associated with fluid transients, which are caused by flow rate changes and resultant pressure surges. Often *fluid transient* and *water hammer* are used interchangeably.

The primary purpose of this course is to provide practicing engineers with the analytical tools required to identify water hammer concerns and prevent equipment damage, personnel injury, and fatalities. The principles of pipe system design, with respect to fluid mechanics, valves, material properties, and pump operations are followed by basic structural piping design principles, water hammer theory, pipe system dynamics, and failure analysis.

Overall, this course integrates multiple engineering disciplines to teach the principles of troubleshooting pipe systems for fluid flow problems and pipe failures. Since this class provides an extensive study of different engineering topics, numerous class exercises will be performed to augment the presentation.

Each student will receive a copy of the book, *Fluid Mechanics, Water Hammer, Dynamic Stresses, and Piping Design* and a copy of the *Supplement to Fluid Mechanics, Water Hammer, Dynamic Stresses, and Piping Design,* by Robert Leishear.

You will learn to:

- Explain the fundamentals of fluid mechanics in pipe systems.
- Describe the fundamentals of water hammer.
- Explain material testing methods and material properties.
- Explain the fundamentals of pipe failures.
- Describe the fundamentals of dynamic pipe system response.
- Apply failure analysis techniques and corrective actions for pipe failures.

Special Requirements:

Students are **required** to bring calculators to the course.

Who should attend:

This class is intended for practicing engineers in the power and process piping areas, who are concerned with the design, performance, and safety of piping equipment and components; specifically, the identification, risk assessment, and prevention of water hammers in water, liquid, and steam piping systems.

Relevant industries include power companies and utilities, pressure technology, valve and pipe manufacturers, and petro/chemical processing facilities.

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Instructor:

Robert Allan Leishear, Ph.D., P.E., is an ASME Fellow and Consulting Engineer for Leishear Engineering, LLC. His studies and accomplishments focused on fluid flow, piping design, vibrations, failure analysis, and fluid machinery, as well as explosions in piping systems. He has extensive experience in research, design engineering, test engineering, and plant engineering. Dr. Leishear has taught troubleshooting courses on vibration analysis, pumps, piping and fluid mechanics to his colleagues to ensure safety and cut costs by preventing failures of plant machinery and piping systems. He has served on several ASME Committees, and is currently a member of the ASME B31.3 Committee Subgroup on Design, the ASME B31 Mechanical Design Committee, the ASME Section VIII Task Group on Impulsively Loaded Vessels, and the B31.3 Process Piping Committee. He earned his B.S. in Mechanical Engineering from the Johns Hopkins University, and both his Master's and Doctorate degrees in Mechanical Engineering from the University of South Carolina, where he is presently studying for a PhD in Nuclear Engineering. He has also written more than sixty research publications, which included an ASME text book on "Fluid Mechanics, Water Hammer, Dynamic Stresses, and Piping Design". From this work, he has earned a dozen corporate awards, several ASME Awards for Service, and the Mensa Copper Black Award for Creative Achievement.

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Course Outline

Fluid Mechanics, Transients, and Dynamics in Piping Design

Day One

- Fluid mechanics design for pipe systems, including Newtonian and Non-Newtonian fluids
- Pump curves, system curves, valve operations, and their effect on pipe system performance

Day Two

- Pump curves, system curves, valve operations, and their effect on pipe system performance (cont'd)
- Material properties.
- ASME B31.3, Piping design fundamentals and pipe stress calculations

Day Three

- ASME B31.3, Piping design fundamentals and pipe stress calculations (cont'd)

  Failure analysis of pipe system components, including material properties, failure theories, plastic deformation, fatigue, fracture mechanics, and fitness for service
- Fluid transients / water hammer

Day Four

- Fluid transients / water hammer (cont'd)
- Shock waves, structural vibrations, and structural dynamics in pipe systems

Day Five

- Shock waves, structural vibrations, and structural dynamics in pipe systems (cont'd)
- Exam