Fundamentals of calculation and selection of centrifugal pumps

Scope

Centrifugal pumps like all rotating equipment, are the most sensitive equipment in a plant. Proper selection and sizing are of paramount importance as they play a vital role in the performance and reliability of the plant.

Fundamentals of calculation and selection of centrifugal pumps course is designed to provide you with a complete understanding of the construction details and the functioning of centrifugal pumps.

Course Objectives

Upon completion of the course, participants will be able to:

- Identify different types of pumps, including centrifugal and positive displacement pumps;
- Recognize the advantages and the limitations of each type of pump;
- Construct system curves;
- Perform NPSH calculations;
- Provide guidelines and best practices for operation, maintenance and troubleshooting of pumps.

Training Methodology

The duration of the seminar is five days. In the first four days, the theory will be covered with lectures, instructor led discussions exercises and videos. There will be also demonstrations of actual pump parts, such as impellers, bearings mechanical seals and shafts.

Who Should Attend:

This course is primarily designed for:

- Petroleum, Chemical, Process Mechanical and project Engineers;
- Operation, technical service and maintenance professionals;
- Technical professionals responsible for piping system inspection.

Duration: Five days

Course instructor: Mr. George Loizou

George is a Mechanical Engineer with more than 36 years of experience mainly in the Oil and Gas Industry. George holds an M.S. Degree from The Pennsylvania State University. He is a member of SMRP, a Certified Maintenance and Reliability Professional (CMRP), member of the Cyprus Scientific and Technical Chamber and of the Institution of Mechanical Engineers of UK and certified trainer by HRDA Cyprus.

George worked as Head of Mechanical Maintenance at the Cyprus Petroleum Refinery Ltd, Engineering Manager and Terminal Manager at Cyprus Petroleum Storage Company Ltd.

Course Outline

- **Day 1**
  - Course Overview
  - Quiz
  - Introduction
    - Historical Perspective
    - Pump Types
    - Pump Categorization
    - Pump Classification to API 610
    - Pump Standards and Selection
    - Pump Applications
  - Basic Fluid Mechanics
    - Basic Terms
    - Fluid properties
    - Kinematics of Fluid Flow
    - Pressure Drop Calculations
    - The Hazen and Williams formula
    - The Darcy and Weisbach formula
    - System Curves
    - Exercises
  - Quiz

- **Day 2**
  - Centrifugal Pumps
    - Introduction
    - Flow within the Impeller
    - Head Net Positive Suction Head
    - Pump Characteristic Curve
    - Pump Efficiency
    - Hydraulic Power
    - Specific Speed
    - Suction Specific Speed
    - Cavitation
    - Recirculation and Air Entrainment
    - NPSH Calculations
    - Axial and Radial Thrust
    - Control of Centrifugal Pumps
    - Variable speed drives
    - Minimum Flow Rate
    - Heat generation
    - Pumps Operating in Series
    - Pumps Operating in Parallel
    - Exercises
  - Quiz

- **Day 3**
  - Components of Centrifugal Pumps
    - Casing
    - Stuffing Box
    - Bearing Bracket
    - Impeller
    - Wear Rings
    - Shaft
    - Couplings
    - Auxiliary Components
  - Bearings
    - Bearing Types
    - Rolling Element Bearing Classification
    - Bearing Fits
    - Mounting of Bearings
    - Axial Location of Bearings
    - Plain Bearings
    - Magnetic Bearings
    - Bearing Lubrication
    - Bearing Life
    - Bearing Failures
  - Shaft Sealing
    - Packed Stuffing Box
    - Mechanical Seals
      - How Mechanical Seals Work
      - Balanced/Unbalance
      - API 682 Seal Arrangements
  - Quiz

- **Day 4**
  - Pump Installation
    - Pump Foundations
    - Pump Setting and Levelling
    - Shaft Alignment
    - Piping arrangements

- Pump Overhaul
  - Tools Required
  - Disassembly
  - Shop Measurements
  - Reassembly
  - Impeller Adjustment
  - Inspection of Seal Faces
  - Inspection of Bearings
- Pump Operation and Monitoring
  - Start Up Procedure
  - Pump Piping
  - Shut Down
  - Operating Checks
  - Pump and System Monitoring
  - Performance Check
  - Vibration Analysis
  - Exercises
- Materials Selection
- Quiz

➢ **Day 5**

- Rotary pumps
  - Rotary VS Centrifugal Pumps
  - Comparing 4 Types of Rotary Pumps
  - Gear Pumps
  - Lobe Pumps
  - Vane Pumps
  - Positive Displacement Pump Characteristics
  - Pump Selection Guide
  - Operating procedures of rotary pumps
  - Rotary pump troubleshooting
- Reciprocating pumps
  - Air operated diaphragm pumps
  - Piston Pumps.
  - Plunger pumps
  - Diaphragm Pumps
  - The Metering Pump
  - Characteristics of Pulse Flow
  - Pulsation dampeners
  - Reciprocating pump troubleshooting
- Other types of Rotodynamic pumps
  - Axial Flow Pumps
  - Mixed Flow Pumps
  - Sump pumps
- Pump Drives
  - Motors
  - Diesel Engines
  - Gearboxes
- Quiz
- Course Evaluation
- Presentation of certificates