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WE035:
Water System Networking & Pumping Stations

Training Description:

Water distribution systems use interconnected elements such as pipes, pumps and service reservoirs to convey treated water from one or more sources to customers spread over a wide area. Given that capital costs and ongoing maintenance and repair costs of these systems are often enormous, the need for more economic and efficient designs is very important. Water distribution systems are composed of three major components: pumping stations, distribution storage, and distribution piping. These components may be further divided into subcomponents, which in turn can be divided in sub-subcomponents. For example, the pumping station component consists of structural, electrical, piping and pumping unit sub-components. The pumping unit can be divided further into sub-subcomponents: pump, driver, controls, power transmission. The exact definition of components, subcomponents and sub-subcomponents depends on the level of detail of the required analysis and to a somewhat greater extent, the level of detail of available data. In fact, the concept of component-subcomponent-sub-subcomponent merely defines a hierarchy of building blocks used to construct the water distribution system.

The water distribution system operates as a system of independent components. The hydraulics of each component is relatively straightforward; however, these components depend directly upon each other and as a result effect the performance of one another. The purpose of design and analysis is to determine how the systems perform hydraulically under various demands and operation conditions. All engineers like to think that they produce good, safe designs that are operationally efficient and cost effective. However, it is rare for a designer to have the time to consider more than a handful of solutions to a problem. In the planning phase of a project there are often many alternatives to each individual component of a scheme. The number of different designs for a complete scheme can thus be extremely large, if not infinite. Even with detailed design, there are usually far too many possibilities for each to be considered and evaluated.

This state-of-the art course is designed to provide participants with a good overview of the latest methods, materials, techniques and tools for water system networking and pumping stations. The course will present an up-to-date overview of the current water network design procedures and develop basic guidelines to be followed in both the design and the redesign of water networks and pumping stations. The course treats the water network design problem in a comprehensive and systematic framework, starting with objectives and elaborating on various technical design features. It will show how to apply the fundamentals of various disciplines and subjects to produce a well-integrated pumping station that will be reliable, easy to operate and maintain and free from design mistakes. In a field where, inappropriate design can be extremely costly, there is simply no excuse for not taking expert advice from this course. Further, the course will tackle the Industry-specific issues and problems that engineers face every day.

It will cover design, installation, operation, maintenance, retrofitting and rehabilitation of water network system and pumping stations.

Training Objectives:

By the end of the training, participants will be able to:

- ✓ Design and analyze water distribution systems and pumping stations
- ✓ Understand the principles of pressurized flow & water distribution systems hydraulics
- ✓ Select proper valves for water distribution systems and pumping stations
- ✓ Describe the performance of centrifugal pumps

- ✓ Identify the different types of pumps and the selection criteria for each application
- ✓ Demonstrate knowledge of the procedure for installation of pumping stations
- ✓ Learn variable-speed pumping and identify pump-driver specifications
- ✓ Aware of the problem of vibration and noise in pumping station and learn the methods of vibration correction and elimination
- ✓ Learn the proper methods for operation, maintenance and rehabilitation of existing water distribution systems and pumping stations
- ✓ Illustrate the process of retrofitting existing water pumping systems
- ✓ Understand the importance of reliability analysis of water network systems and learn the methods of improving system reliability and availability

Training Designed for:

This course is intended for Mechanical Engineers, Superintendents, Supervisors and Foremen, Civil Engineers, Superintendents, Supervisors and Foremen, Water Engineers, Superintendents, Supervisors and Foremen, Engineering Managers, Designers and Consultants as well as Utility Managers, Engineers, Superintendents, Supervisors and Foremen.

Training Program:

DAY ONE:

- ❖ Introduction
  - Background
  - Historical Aspects of Water Distribution
  - Modern Water Distribution Systems
- ❖ Hydraulics of Pressurized Flow
  - Introduction
  - Importance of Pipeline Systems
  - Numerical Models: Basis for Pipeline Analysis
  - Modeling Approach
  - System Capacity: Problems in Time and Space
  - Steady Flow
  - Quasi-Steady Flow: System Operation
  - Unsteady Flow: Introduction of Fluid Transients
- ❖ System Design: An Overview
  - Introduction
  - Distribution System Planning
  - Pipeline Preliminary Design
  - Piping Materials
  - Pipeline Design
  - Distribution and Transmission System Valves
- ❖ Hydraulics of Water Distribution Systems
  - Introduction
  - Steady-State Hydraulic Analysis
  - Unsteady Flow in Pipe Network Analysis

- Computer Modeling of Water Distribution Systems

DAY TWO:

- ❖ Pump System Hydraulic Design
  - Pump Types and Definitions
  - Pump Hydraulics
  - Concept of Specific Speed
  - Net Positive Suction Head
  - Corrected Pump Curves
  - Hydraulic Considerations in Pump Selection
  - Application of Pump Hydraulic Analysis to Design of Pumping Station Components
  - Implications of Hydraulic Transients in Pumping Station Design
- ❖ Hydraulic Transient Design for Pipeline Systems
  - Introduction to Water hammer and Surging
  - Fundamentals of Water hammer and Surge
  - Hydraulic Characteristics of Valves
  - Hydraulic Characteristics of Pumps
  - Surge Protection and Surge Control Devices
  - Critical Parameters for Transients
  - Design Considerations
  - Negative Pressures and Water Column Separation in Networks
  - Time Constants for Hydraulic Systems
  - Case Studies
- ❖ Optimal Design of Water Distribution Systems
  - Overview
  - Problem Definition
  - Mathematical Formulation
  - Optimization Methods
  - Applications
  - Summary
- ❖ Water-Quality Aspects of Construction and Operations
  - Introduction
  - Disinfection of New Water Mains
  - Disinfection of Storage Tanks
  - Cross-Connection Control
  - Flushing of Distribution Systems

DAY THREE:

- ❖ Water Quality
  - Introduction
  - Water-Quality Processes
  - Water-Quality Monitoring
  - Water-Quality Modeling
  - History
- ❖ Hydraulic Design of Water Distribution Storage Tanks
  - Introduction

- Basic Concepts
- Design Issues
- Location
- Tank Levels
- Tank Volume
- Other Design Considerations

❖ Quality of Water in Storage

- Introduction
- Water Quality Problems
- Chemical Problems
- Mixing and Aging in Storage Facilities
- Monitoring and Sampling
- Modelling
- Design and Operational Issues
- Inspection and Maintenance Issues

❖ Computer Models/EPANET

- Introduction
- Use of a Computer Model
- Computer Model Internals
- EPANET Program
- Conclusion

DAY FOUR:

❖ Water Quality Modeling-Case Studies

- Introduction
- Design of Distribution Systems in the United States
- Water Quality in Networks
- Hydraulic and Water-Quality Models
- Early Applications of Water-Quality Modeling
- Evolution of Water Quality Modeling
- Modeling Propagation of Contaminants
- Current Trends in Water-Quality Modeling
- Summary and Conclusions

❖ Calibration of Hydraulic Network Models

- Introduction
- Identify the Intended Use of the Model
- Determine Estimates of the Model Parameters
- Collect Calibration Data
- Evaluate the Results of the Model
- Perform a Macro-Level Calibration of the Model
- Perform a Sensitivity Analysis
- Perform a Macro-Level Calibration of the Model
- Future Trends
- Summary and Conclusion

- Operation of Water Distribution Systems
  - Introduction
  - How Systems Are Operated
  - Monitoring of System Performance with SCADA Systems
  - Control of Water Distribution System
  - Linking of SCADA Systems with Analysis and Control Models
  - Use of Central Databases in System Control
  - What the Future Holds

DAY FIVE:

- Optimization Models for Operations
  - Introduction
  - Formulations for Minimizing Energy Cost Minimization
  - Formulations to Satisfy Water Quality
  - Solution Methods and Applications for Water-Quality Purposes
  - Optimal Scheduling of Booster Disinfection
- Maintenance and Rehabilitation/Replacement
  - Introduction
  - Preview of the Chapter
  - Unaccounted-for Water
  - Pipe Breaks
  - Hydraulic Carrying Capacity
  - Maintenance Information Systems
- Reliability Analysis for Design
  - Failure Modes for Water Distribution Systems
  - Practical Aspects of Providing Reliability
  - Component Reliability Analysis
  - Review of Models Fore Reliability of Water Distribution Systems
  - Observations
  - Measure of Link Importance
- Course Conclusion
- POST- ASSESSMENT and EVALUATION

Training Requirement:

"Hand's on practical sessions, equipment and software will be applied during the course if required and as per the client's request."

Contents can be adapted to your specific wishes. It is therefore possible to focus on specific modules of the training course as per client's learning needs and objectives. Further, it should be forwarded to us a month prior to the course dates.

Training Certificate(s):

CMCT Internationally recognized certificate(s) will be issued to each participant who completed the course.

Training Methodology:

This interactive training course includes the following training methodologies as a percentage of the total tuition hours:-

- 30% Lectures, Concepts, Role Play
- 70% Workshops & Work Presentations, Techniques, Based on Case Studies & Practical Exercises, Gamification, Software & General Discussions
- Pre and Post Test

Training Fees:

TBA as per the course location - This rate includes participant's manual, hand-outs, buffet lunch, coffee/tea on arrival, morning & afternoon of each day.

Note: The 5% VAT (Value Added Tax), will be effective starting 01st of January 2018 as per the new regulation from the UAE Government. The VAT applies for all quotation both for local and abroad.

Training Timings:

Daily Timings:

07:45 - 08:00	Morning Coffee / Tea
08:00 - 10:00	First Session
10:00 - 10:20	Recess (Coffee/Tea/Snacks)
10:20 - 12:20	Second Session
12:20 - 13:00	Recess (Prayer Break & Lunch)
13:00 - 14:00	Last Session

For training registrations or in-house enquiries, please contact:
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