



# WE103: Water Network Systems & Pumping Stations

## Training Description:

Water network 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 network 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 network 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. This 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, this 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 network systems and pumping stations
- ✓ Explain 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
- ✓ Discuss variable-speed pumping and identify pump-driver specifications
- ✓ Identify the problem of vibration and noise in pumping station and learn the methods of vibration correction and elimination
- ✓ Employ proper methods for operation, maintenance and rehabilitation of existing water distribution systems and pumping stations
- ✓ Illustrate the process of retrofitting existing water pumping systems
- ✓ Discuss 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 utility managers, mechanical engineers, civil engineers, water engineers, engineering managers, design consultants, utility managers, superintendents, supervisors and other senior technical staff.

### 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.”

A copy of the EPANET Simulator on CD will be given to each participant. **Participants are encouraged to bring their own laptops for the practical sessions.**

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 Program:

#### DAY ONE:

- ❖ Pre-Test
- ❖ Introduction to Water Distribution System
  - Background, Historical Aspects of Water Distribution, Modern Water System Networking
- ❖ Hydraulics of Pressurized Flow
  - Importance of Pipeline Systems, System Capacity: Problems in Time & Space, Steady Flow
- ❖ Hydraulics of Water Distribution System
  - Steady-State Hydraulic Analysis, Unsteady Flow in Pipe Network Analysis, Computer Modeling of Water Distribution Systems
- ❖ Water Distribution System Design
  - Distribution System Planning, Pipeline Preliminary Design, Piping Materials, Pipeline Design, Distribution & Transmission System Valves

#### DAY TWO:

- ❖ Designing for Easy Operation & Maintenance

- Site Selection, Landscaping, Hydraulics, Mechanical Considerations, Electrical Considerations, Architectural Considerations, Standby Facilities, Specifications, Operator's Preferences
- ❖ **System Design for Water Pumping**
  - Types of Water Pumping Stations, Pumping Station Flow & Pressure Requirements, Raw Water Pumping from Rivers & Lakes, Raw Water Pumping from Aqueducts, Well Pumps with Elevated Tanks, Booster Pumping Station
- ❖ **Water Valves**
  - Isolation Valves, Sluice Gates, Shear Gates, Flap Valves & Stop Plates, Check Valves, Control Valves, Valve Actuators, Air & Vacuum Valves, Materials of Construction, Installation of Valves, Corrosion Protection
- ❖ **Performance of Centrifugal Pumps**
  - Classification of Centrifugal Pumps, Pump Application Terminology, Equations & Performance Curves, Pump Operating Characteristics, Cavitation, Pump Characteristic Curves, Pump Operating Curves, Pump Operating Ranges, Elementary Pump System Analysis, Practical Pumping System H-Q Curve Analysis, Complex Pumping System H-Q Curves

**DAY THREE:**

- ❖ **Types of Pumps**
  - Classification of Centrifugal Pumps, Construction of Centrifugal Pumps, Overhung-Impeller Pumps, Impeller-between-Bearing Pumps, Classification of Vertical Pumps, Construction of Vertical Pumps, Types of Vertical Pumps, Positive-Displacement Pumps
- ❖ **Pump Selection, Installation & Intakes**
  - Initial Screening, Final Selection, Considerations in Pump Selection, Installation, Pump Intake Basing
- ❖ **Variable-Speed Pumping**
  - Variable-Speed versus Constant Speed, Design Considerations, Pump Selection, Variable- & Constant-speed Pumps in Simultaneous Operation, Special Design Considerations, Analysis of Variable-Speed Booster Pumping, Minimum Discharge Rate, Operations in Booster Pumping, Simultaneous Operation of V/S & C/S Booster Pumps, Adjustable- & Variable-Speed Drives
- ❖ **Pump-Driver Specifications**
  - Comparison of Two Approaches to Writing Specifications, Methods for Specifying Quality of Equipment, Non-destructive Specifications, Operating Conditions, Mass Elastic Systems & Critical Speeds, Pump Testing, Shipping Major Pumping Units, Submittals, Information to be Provided, Seals, Pump Shafts, Pump Shaft Bearings, Vertical Drive Shafts, Electric Motors, Optimum Efficiency

**DAY FOUR:**

- ❖ **Installation of Water Pumps & Pumping Systems**
  - Pre-installation Procedures, Pump & Pumping System Bases
- ❖ **Vibration & Noise**
  - Problems of Vibration & Noise, Avoiding Vibration Problems, Troubleshooting Excessive Vibration
  - Introduction to Vibration & Calculation, Vibration & Noise Characteristics

- Applicable Codes, Equipment Vibration, Vibration Isolation Theory, Vibration Isolators, Piping Vibration, Vibration of Structures, Noise, Reducing Exterior Noise
- ❖ **Operating & Maintaining Water Pumps**
  - Checking for Efficient Selection of Water Pumps, Constant- or Variable-Speed Pumps, Proper Selection & Operation of Variable-Speed Pumps, Checking Pump Performance, Control Signals for Speed Control, Sequencing & Alteration, Maintaining Pumping Equipment at High Efficiency, Maintenance Schedules
- ❖ **Simulator (Hands-on Practical Sessions)**
  - Practical sessions will be organized during the course for participants to practice the theory learnt. Participants will be provided with an opportunity to carryout various exercises using the latest revision of EPANET and WATERCAD Simulators.

#### DAY FIVE:

- ❖ **Retrofitting Existing Water Pumping Systems**
  - System Evaluation, Graphical Description of Flow in an Existing System, Evaluation of Existing Procedures, Trimming the Pump Impeller, Changing to a Variable-Speed Pump, Evaluation of Existing Pumps & Motors, Evaluation of the Number of Pumps, Actual Generation of a System Head Area for an Existing System, Synopsis
- ❖ **Maintenance & Rehabilitation**
  - Unaccounted-For Water, Pipe Breaks, Hydraulic Carrying Capacity, Maintenance Information Systems
- ❖ **Reliability Analysis**
  - Failure Modes for Water Distribution Systems, Practical Aspects of Providing Reliability, Component Reliability Analysis, Review of Models Fore Reliability of Water Distribution Systems, Measure of Link Importance
- ❖ **Course Conclusion**
- ❖ **POST-ASSESSMENT and EVALUATION**

### 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 Certificate(s):

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

### Training Fees:

**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 01<sup>st</sup> 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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