CONCEPT

Water Distribution Network Design and Non-Revenue Water: EPANET Modelling and Leakage Control



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Introduction:

Water distribution network design decides whether customers receive steady pressure at every tap or whether mains burst, zones run dry at peak hour and leakage absorbs a large share of treated water. Many utilities still size pipes from rules of thumb, run uncalibrated models and manage non-revenue water without district metering. This Core Concept course trains network engineers and planners to estimate demand, calculate head loss, build and calibrate an EPANET model, size mains, zone pressure, set up DMAs and control real losses. Participants produce a Calibrated Network Model and NRW Reduction Plan.

Course Objectives:

- Estimate average, peak and fire-flow demands for a supply zone and allocate them to model nodes with diurnal demand patterns
- Calculate friction head loss with the Hazen-Williams and Darcy-Weisbach equations and select roughness values for different pipe materials and ages
- Build, run and calibrate an EPANET hydraulic model with pumps, tanks, reservoirs and valves against field pressure and flow readings
- Size distribution mains and design pressure zones, PRV stations, pumping and storage using steady-state and extended period simulation scenarios
- Design district metered areas and compile an IWA water balance to separate real losses, apparent losses and unbilled authorised consumption
- Prepare a Calibrated Network Model and NRW Reduction Plan combining active leakage control, pressure management and pipe renewal priorities

Target Audience:

- Network design and planning engineers who size mains, pumping stations and storage for new and expanding supply zones
- Hydraulic modelling staff who build, update and calibrate distribution system models
- Leakage and non-revenue water engineers who run DMAs, night flow analysis and leak detection programmes
- Network operations engineers responsible for pressure, valve operation and supply continuity
- Consultant and contractor engineers who prepare water network master plans and design reports for utilities and developers

Course Outline:

Day 1: Network Components, Layout and Demand Estimation

- Transmission Mains, Distribution Mains and Service Connections: Roles and Typical Materials
- Looped Versus Branched Network Topology and Isolation Valve Placement
- Per Capita Consumption, Land Use Demand Rates and Population Projection Methods
- Peak Hour, Maximum Day and Fire-Flow Design Factors
- Diurnal Demand Pattern Curves and Node Demand Allocation from Customer Records

Day 2: Pipe Hydraulics and EPANET Model Building

- Continuity and Energy Equations: Hydraulic Grade Line and Energy Grade Line
- Hazen-Williams C Factor Versus Darcy-Weisbach Friction Factor by Pipe Material and Age
- Minor Losses at Bends, Tees and Valves Using Loss Coefficients
- EPANET Network Objects: Junctions, Pipes, Pumps, Tanks, Reservoirs and Valves
- Importing GIS Pipe Data and Setting Elevations, Demands and Roughness in the.inp File

Day 3: Pipe Sizing, Pressure Zones, Pumps and Storage

- Pipe Sizing Criteria: Velocity Limits, Head Loss Gradient and Minimum Service Pressure
- Pressure Zone Boundaries and Pressure Reducing Valve Station Settings
- Pump Head-Flow Curves, System Curves, Operating Point and Variable-Speed Pump Control
- Storage Tank Sizing for Balancing, Emergency and Fire Reserve Volumes
- Extended Period Simulation with Tank Level Controls and Rule-Based Pump Scheduling

Day 4: Model Calibration, Water Quality and Non-Revenue Water Control

- Field Pressure Logging, Hydrant Flow Tests and Model Calibration Acceptance Checks
- Water Age, Chlorine Decay and Source Tracing Runs at Overview
- IWA Water Balance: Unbilled Authorised Consumption, Apparent Losses and Real Losses
- DMA Design: Inlet Metering, Boundary Valve Closure and Zero-Pressure Tests
- Minimum Night Flow Analysis, Infrastructure Leakage Index and Pressure Management Savings

Day 5: Network Model Lab and NRW Reduction Plan

- Lab: Building a Sample Supply Zone Model From GIS Extract to First Run
- Lab: Future Demand and Pipe Failure Scenarios With Reinforcement Options
- Active Leakage Control Programme: Acoustic Survey, Step Testing and Repair Time Targets
- Pipe Renewal Prioritisation by Burst History and Criticality, With Meter Accuracy Losses at Overview
- Calibrated Network Model and NRW Reduction Plan Presentation and Peer Review

Skills You Will Gain:

- Water Demand Forecasting
- Head Loss Calculation
- Hydraulic Model Building
- Model Calibration
- Pressure Zone Design
- Pump and Storage Sizing
- Water Balance Auditing
- Leakage Management

Why Attend This Course:

- Return with a Calibrated Network Model and NRW Reduction Plan built during hands-on EPANET lab sessions
- Justify pipe sizes, PRV settings and tank volumes to reviewers with simulation results rather than rules of thumb
- Separate real losses from apparent losses so leak detection crews and budgets go to the DMAs with the highest recoverable volume
- Compare network design and leakage practice with engineers from municipal utilities, consultancies, industrial estates and new city developments

Conclusion:

A water network performs well only when demand, hydraulics, operation and losses are analysed in one model. The one week move from network components and demand estimation, through head loss equations and EPANET model building, to pipe sizing, pressure zones, pumps and storage. They then cover calibration, water quality at overview, the IWA water balance, DMA design and night flow analysis, before a model lab produces a Calibrated Network Model and NRW Reduction Plan ready for a real supply zone.