

Energy efficiency and leakage detection

Business Line Water & Infrastructure

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Overview

- A key issue of the Italian water sector is for sure non-revenue water: the need is clearly to **reduce leakages** as an average in Italy and in particular in some areas of the Country where statistics show a big room for improvement. This presentation shows a method to localize and manage leakages for water distribution companies
- The Italian water sector also seems to agree about the fact that the second cost they have after staff cost is the cost of energy. **Energy efficiency** is the second problem addressed by this presentation, illustrating one idea to contain energy consumption by means of software applications



Leakage detection and localization

Overview

- Enables operators to monitor and manage losses throughout the water distribution system
- Reduce non-revenue water levels, energy costs and possible damages of bursts
- More robust by usage of flow measurements or statistical methods



Leakage detection and localization solution

Customer benefits

- It is a software solution that can be connected to any control system
- Can be used based on already available measurement hardware including flow, pressure and noise field measurements
- Scalable module architecture for leakage detection and leakage location for multiple use cases and water supply networks
- Can be single server or redundant application
- Needs a wide range of 3rd -party interfaces for data acquisition

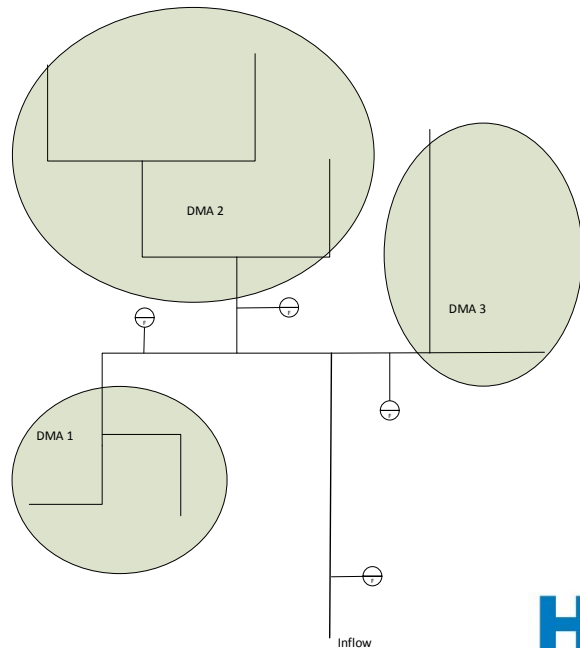


Leakage detection and localization solution

Methods based on analysis of data from installed measurements

- Requires measurement of all inflow into every DMA
- Statistical analysis of flow data
- Leak location at DMA level

General DMA schema, total inflow and flow into each DMA is measured, no unknown inflows to the system

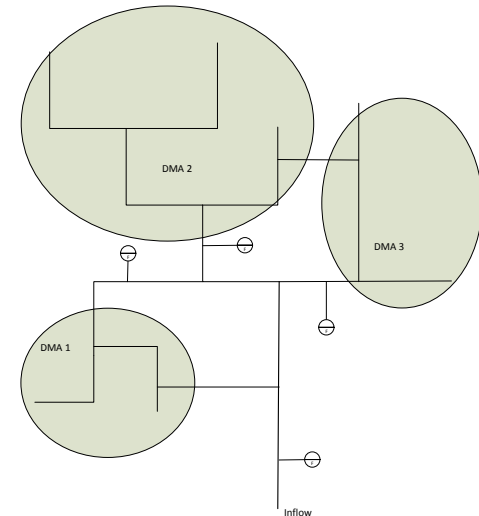


Leakage detection and localization solution

Virtual DMA

- Flow measurements will distributed within the network at optimal locations (main pipes)
- Statistical analysis of flow data
- No perfect separation of zones
- Requires some “structure” within the network
- Leak location at virtual DMA level

Virtual DMA schema, no perfect separation of zones but roughly known flow regime and direction



Leakage detection and localization solution

Noise Observation

- Statistical analysis of noise changes
- Detects noise patterns caused by leakages
- Can locate leakages by correlation
- Leak location within down to 5 meters depending on network structure and number of sensors
- Requires high number of transmitters for networks with many branches for accurate leak location

Energy efficiency for water transportation/distribution

Overview

- Energy efficiency can start from optimizing a single pump, monitoring its energy consumption in real time and adapting its operations
- Going a step forward, a further optimization possibility is to optimize a group of pumps by selecting automatically those to be operational to have the lowest impact on energy consumption
- A similar concept can be applied to a whole network instead of a single group of pumps: this is what is going to be described briefly in the following slides



Energy efficiency water transportation/distribution systems

Benefit

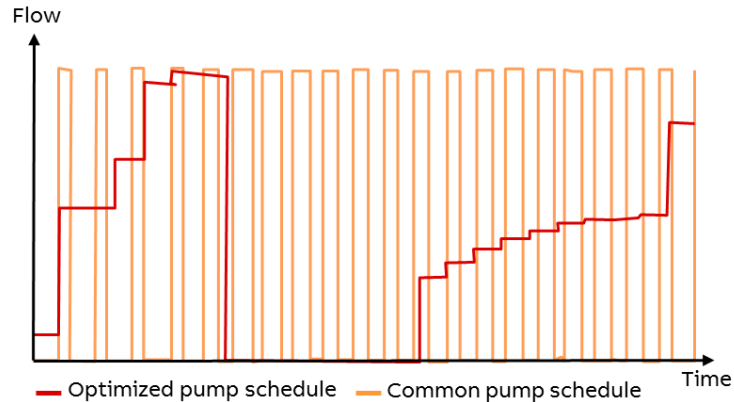
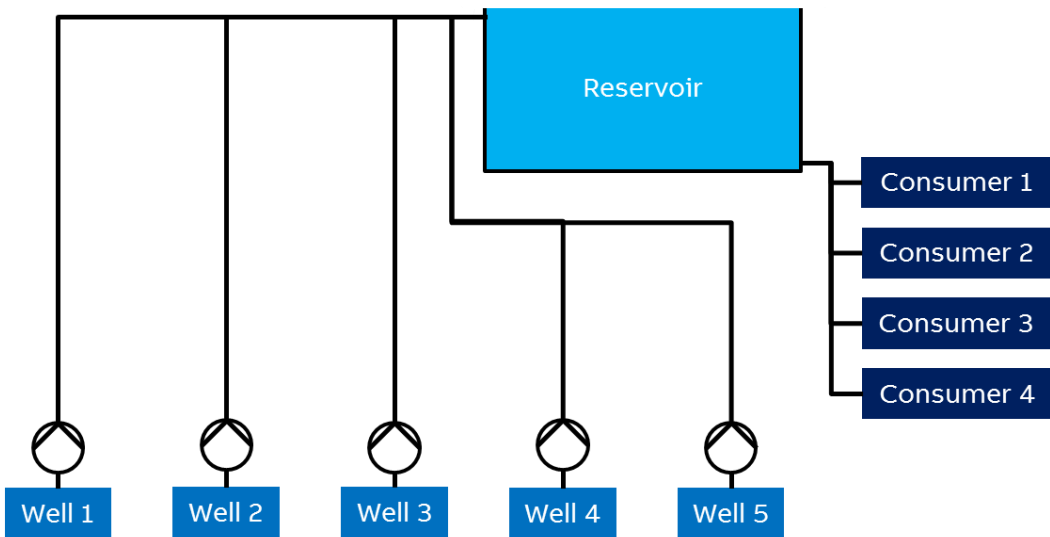
Higher level optimization to minimize total electrical power costs for water pipeline networks including

- Several pumping stations
- Producers and consumers
- Storage



Energy efficiency water transportation/distribution systems

Simple example



Energy efficiency water transportation/distribution systems

Scenario

Hydraulic models include e.g.

- Pipe (lengths, diameters and pressure loss)
- Node elevations, producers and demands
- Reservoirs (dimensions, capacities, elevations, initial, bottom and top water levels)
- Supply pumps and booster pumps (hydraulic characteristics)
- Control valves (pressure and flow control valves)
- Pressure zones, pressure regulating valves



Energy efficiency water transportation/distribution systems

Optimization targets

Operational data e.g.

- Water treatment plants (capacity “minimum / maximum daily production” and elevation)
- Pumping stations capacity and design head (pump curves, i.e., head-flow curve and power/ efficiency -flow curves, control rules)
- Electricity tariff(s) for all pumps / pumping stations
- Reservoirs and storage tanks (initial water levels, control rules)
- Control valves (control rules)



Operating constraints e.g.

- Normal maximum and minimum water levels in reservoirs
- Maximum and minimum daily production of water treatment work plant
- Maximum and minimum allowable pressures in the mains or distribution pipes
- Patterns of demand which must be satisfied
- Power supply limitations
- Constraints on the combinations of pumps, which can be run together
- Maximum and minimum time of the pump operation, ON/OFF time
- Maxi- & minimum speeds for variable speed pumps

Energy efficiency water transportation/distribution systems

The software finds a schedule with optimal flow set points for all pumping stations to minimize total electrical power costs

Constraints, limits, component characteristics

