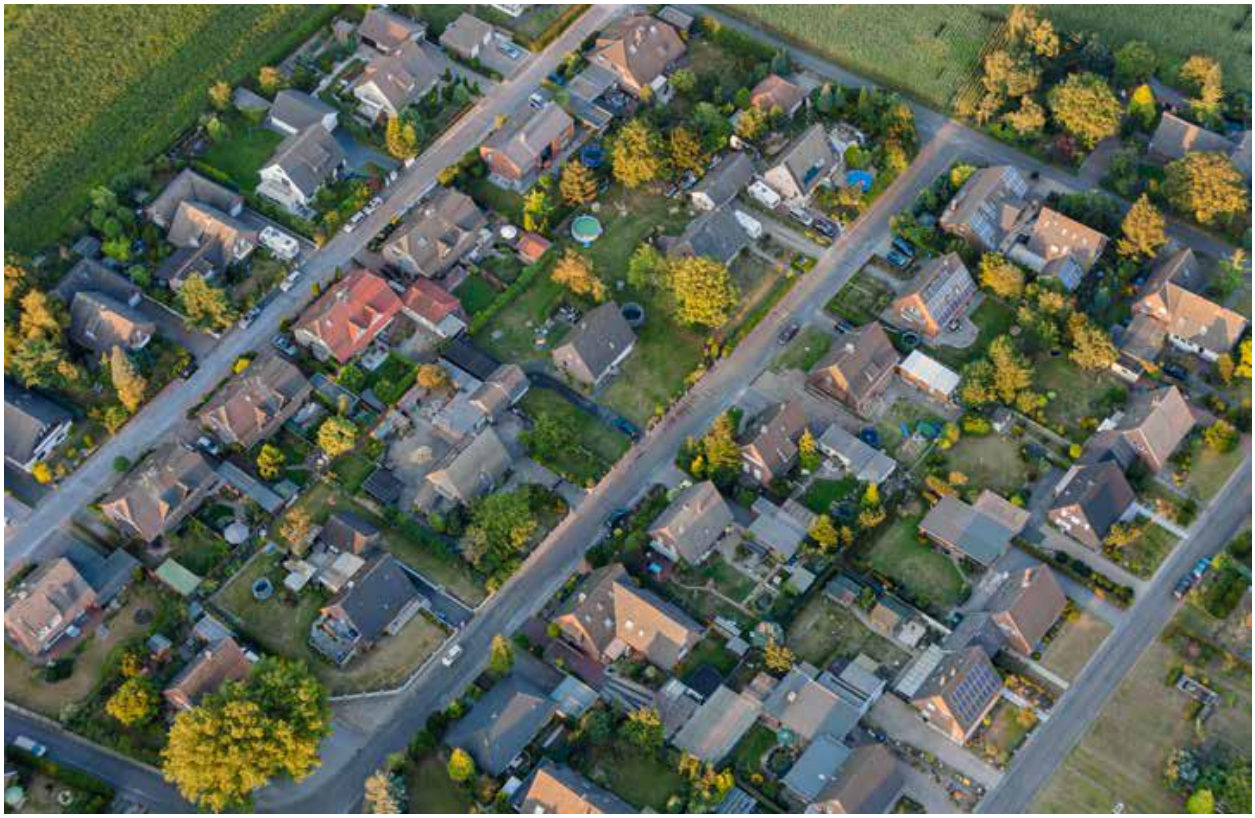
OPTIMISING WATER DISTRIBUTION

District Metered Areas Solutions

A district metered area (DMA) is defined as a discrete part of a water distribution network. It is usually created by closing boundary valves or by permanently disconnecting pipes to neighbouring areas. Water flowing in and out of the DMA is strictly controlled and metered in order to calculate the accurate water balance for each DMA. Based on the IWA Water Balance, the NRW can be monitored to secure fast action and be the basis for planning the activities based on the highest return of investments in the future optimization of the water distribution Network.



Typical design of DMA is to divide a large open system into a series of DMAs, it is essential to close valves to isolate a certain area and install flow meters. This process can affect the system's pressures, both within that particular DMA as well as its surrounding areas. By using a hydraulic model to simulate the flow and pressure the water utility can design the supply system to all customers so it is not compromised in terms of pressure and supply hours.

Establishing a DMA

The design of a series of DMAs is very subjective, and it is unlikely that two utility engineers working on the same network would come up with the same design. The engineer typically uses a set of criteria to create a preliminary DMA design using a network model and tested in the field.

These criteria include:

- Size of DMA (e.g. number of connections—generally between 500 and 2,500)
- Number of valves that must be closed to isolate the DMA
- Number of flow meters to measure inflows and outflows (the fewer meters required, the lower the establishment costs, and more accurate reading.)
- Ground-level variations and thus pressures within the DMA (the flatter the area the more stable the pressures and the easier to establish pressure controls)
- Location of visible structure that can serve as logical boundaries for the DMA, such as rivers, drainage channels, railroads, highways, etc.

The water utility should initially establish larger zones of 5,000 or more connections. It can subsequently subdivide them into DMAs and sub-DMAs of 1,000 or fewer connections for those DMAs with high NRW and long lengths of pipework.

1. Intake & treatment plant
2. District meter measures flow into district e.g.
3. 500-2,500 connections
4. Sub district meter measures flow into smaller area
5. Source meter measures total input
6. Inlet with bulk meter

The DMA Structure

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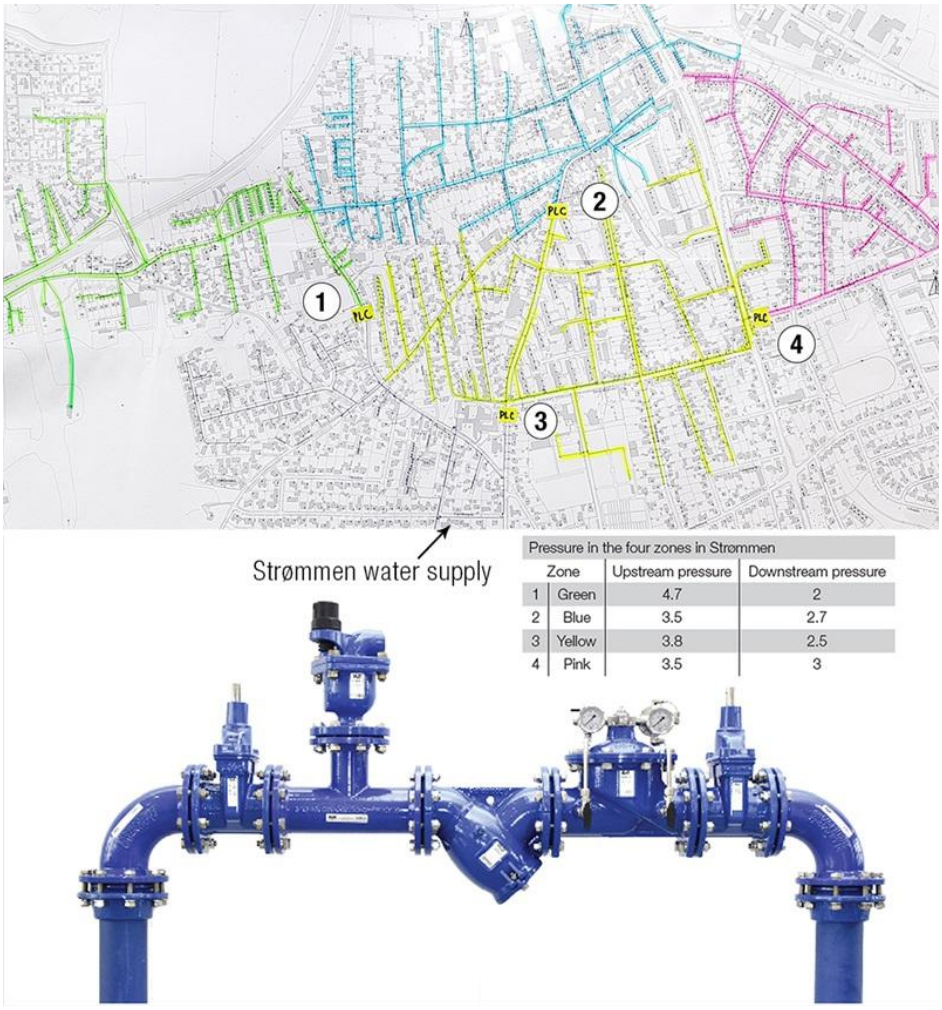


Pressure in the four zones in Strømmen

Zone		Upstream pressure	Downstream pressure
1	Green	4.7	2
2	Blue	3.5	2.7
3	Yellow	3.8	2.5
4	Pink	3.5	3

These structure include:

- VALVE CHAMBER (DMA INLET)
- DISTRICT METERED AREA
- PIPE MAINS (LARGE DIAMETER)
- PIPE MAINS (SMALLER DIAMETER)
- DMA BORDER VALVES (CLOSED)

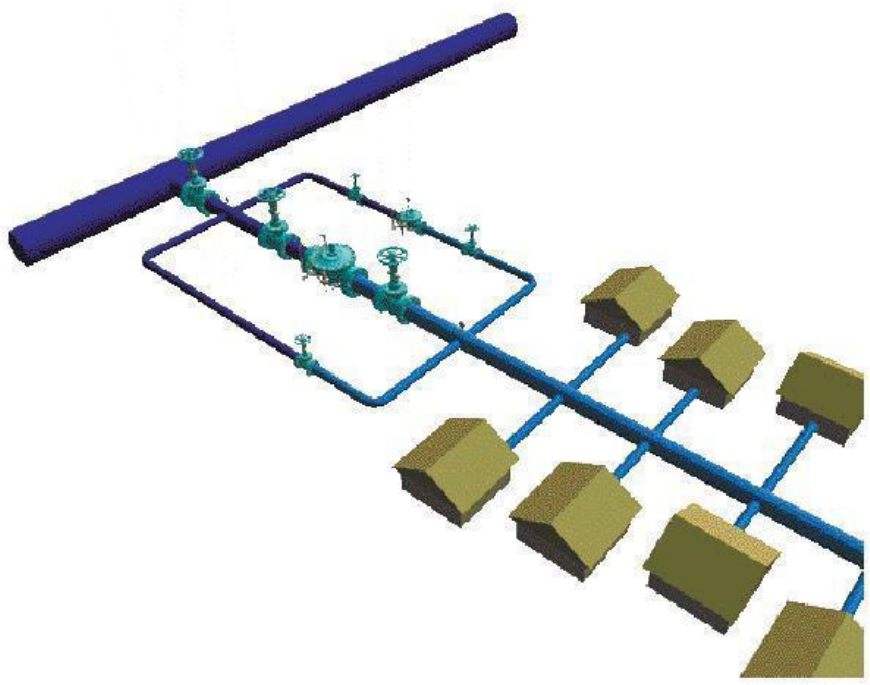
The DMA Model

NETWORK MODELLING WITH COMPUTER SIMULATION OF THE FLOW AND PRESSURE IN A DISTRIBUTION SYSTEM REQUIRES SPECIALIZED COMPUTER SOFTWARE

The model is developed based on GIS registration of all elements in the system and calibrated by comparing the simulated flows and pressures with real flow and pressure data recorded onsite. Adjustments are made to the model to ensure that the simulated and the real data correlate, thus creating a calibrated hydraulic network model. The calibrated model is used for DMA design and enables analyses of system pressures and flows without affecting supply to Customers.

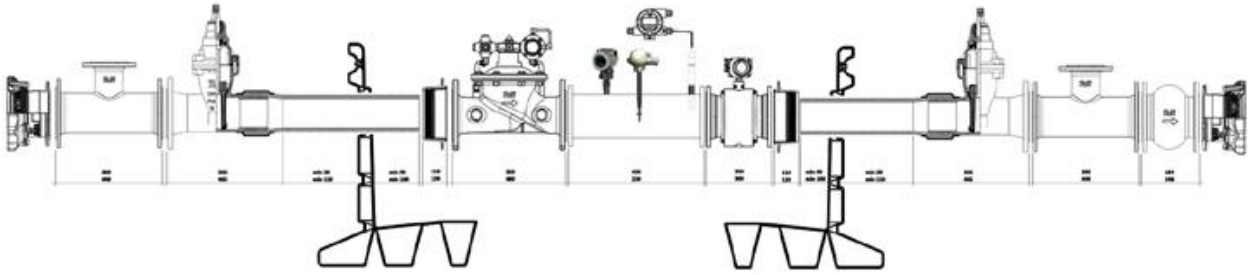
Each DMA has one or two inlets with an inlet chamber. The inlet is designed to be the supply connection to a DMA from the main pipe system. It is important that the inlet has a dimension so the supply can take place with sufficient pressure to the consumers at any time and consumption.

The inlet chamber includes valves and equipments to control the supply and to monitor the flow and pressure for NRW management.



‘AVK-ACMO’ PFCMD - Pressure cum Flow Control Monitoring Device

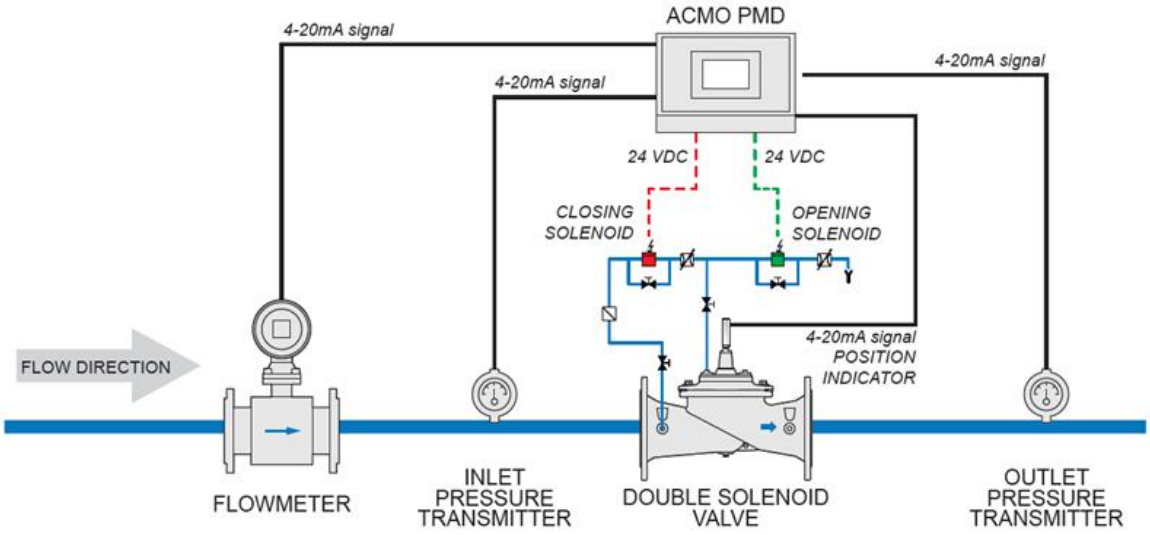
For each DMA, we develop a detailed operations instruction to assist future teams in managing the water distribution. The operations instruction includes access to GIS registration of the pipe network; flow meters, pressure control valves, and boundary valves, together with the information from the billing database for each DMA.



The Pressure & Flow Control and Monitoring Device (PFCMD) is a hydraulic control valve with one or more control functions as per the requirements such as

- Anti Draining of System
- Constant downstream pressure to a Variable higher upstream pressure
- Sustaining maximum set Flow.

All functions are performed irrespective of change in upstream pressure or demand. Functions can easily be added or removed in a modular way. The valve shall be compatible with remote control device.



‘AVK-ACMO’ PFCMD VALVE FOR REMOTE CONTROL AND MONITORING

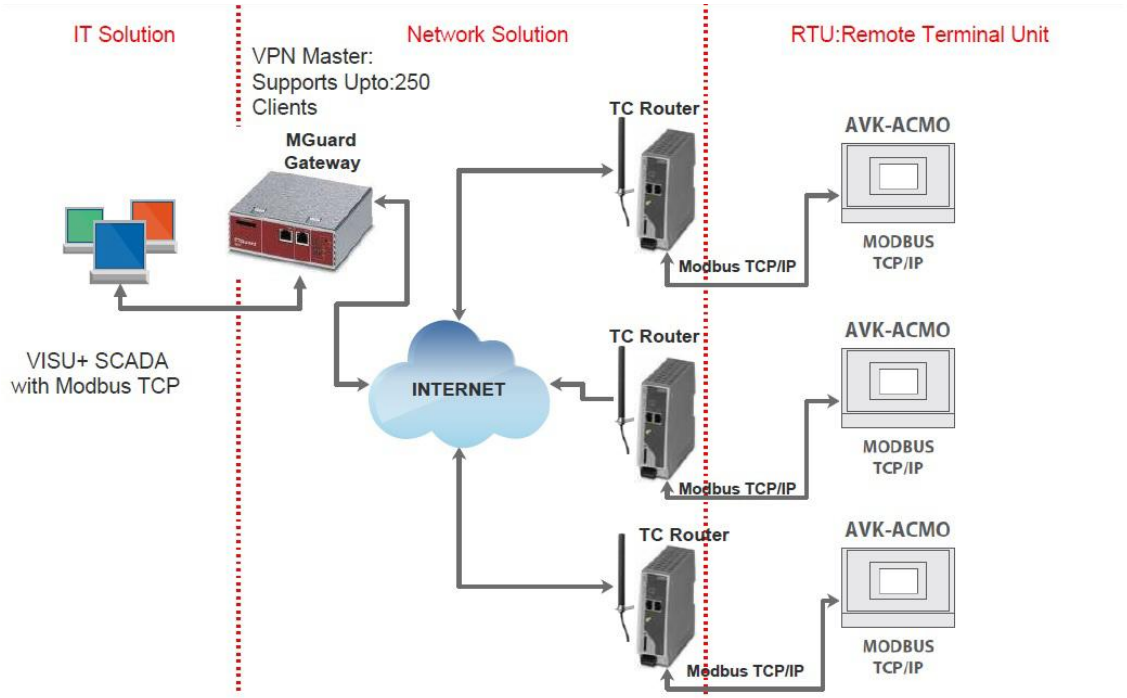
The valve is with rapid-action spring and diaphragm for fast opening and closing action to facilitate stable and accurate control of pressure, flow and level. Valve has Low head loss at high flow rates. Valve has precision modulate composite construction. The valve is strong, lightweight and corrosion proof surfaces, which resist cavitation damage, thus increasing service life and reducing operation & maintenance cost. Valve has linear flow, low turbulence to minimize cavitation and allow high flow velocities with low noise and vibration.

Valve has single or double-chambered construction for Drip-tight closure, even when command pressure is lower than line pressure. Valve has “Soft closure” feature to prevent water hammer. The valve is a single or a Multi-valve modular configuration, full redundancy enabled. Valve top chamber can be removed for maintenance which reduces downtime and and allows maintenance work to be done without halting water flow.

‘AVK-ACMO’ AUTOMATION SYSTEM FOR REMOTE CONTROL AND MONITORING

The proposed Automation System is able to control and monitor the required parameters from Control Centre with the help of license free radio frequency and GPRS system.

The Remote-Control Center will provide a management tool for controlling the all Outlets in the water network. Remote control station will be web based application so that user can monitor and control each Outlet from any place with the help of internet connection.



System configuration:

1. The Remote-Control Centre shall able to configure system's parameters for optimal operation.
2. The user shall able to define all field Units and their associated configurations,
3. The user shall be able to define all software application functionality and download (send) the data to the field units, for them to perform the on-site function.
4. The user will be able to upload the existing data from the field units to monitor the entire system.
5. The Control Centre shall provide the ability for the user to "zoom in" to the level of single element characteristics (i.e. Input/Sensor, Output/Pump etc.) at each site.

6. The user can able to monitor site conditions like inside panel temperature, Battery Voltages, GSM/Radio signal strength.
7. The user can able to monitor the Panel door status at central Management tools, accumulation reporting, historical trends views and Events/Alarms logging.
8. Interface to third party database and communication systems such as SMS, paging alarms and weather stations
9. Time based and/or Volume based Weekly Auto schedule will be stored into the controllers
10. Onsite Critical alarms and events are sent by email /SMS to user given email ID or mobile nos. Edit Mode. The same Remote-Control Centre SW package shall provide both functionality of what is known as Runtime Mode and Edit Mode (when changes to the runtime screens are needed).

Remote-Control Centre / Zonal Field Control Unit (ZFCU)

1. The ZFCU shall provide communication capabilities and interface between the Remote-Control Center and Field Control unit which is on the site.
2. The ZFCU shall have the ability to perform "regular" Field Control Unit's functionalities, such as monitoring sensors or activating pumps, in addition to its ZFCU functionalities.
3. As part of the Control Center a front end (FEP) is requested (HW and/or SW) enabling the communication between the Control Center and the Field Control Units.
4. The Control Centre shall be able to interface with various software applications (third party), such as weather stations, and other management SW packages.

The Remote-Control Centre shall be able to execute and support the following features:

1. Displaying the entire data of Field Control Unit such as, flow rate/accumulated flow, and total time of operation, balance time in the form of tables and graphical screens
2. Displaying Field Control Unit's events and alarms and ability to report them utilizing SMS technology.
3. Display the communication healthiness of field units.
4. The user shall be able to change valve operation timings, from the graphical screens
5. The user shall be able to operate valve from the graphical screens
6. Shall be able to call the Downloading and Uploading data from the Field Control Units
7. Shall allow the quantity of water as per the Demand set by the operator.
8. Shall have a program to design and display an event report for each WMD in the water network.
9. Shall have a program to calculate the predicted flow load, over the hydraulic system.
10. Shall have a program for displaying sensors data historical trends and alarms.
11. Shall have an Off-Line program for the Field Units in addition to the current runtime unit's program.

Field Control Units:

1. Shall have Logic board incorporating microcontroller/microprocessor and data storage components.
2. Shall run on solar power or long-life lithium battery.
3. Shall be with I/O port required for on-site sensor connection. I/O boards may be expanded/ replaced on-site. These may be inputs such as water meters, reservoir level, pressure meters, or general digital inputs, or outputs such as valves, pump starts, general relays, etc.
4. Communication Ports - enabling the Field Unit to communicate with the Remote- Control Centre, and/or each other, and on-site programming/diagnostic tool (such as laptop).
5. Shall be able to operate not only the local I/Os (on board I/O connections), but remote I/Os as well.
6. Shall be able to update the Remote-Control Centre database upon request (by the remote-Control Centre) or by exception. The Field Unit shall be able to report to the Remote-Control Centre every defined alarm which occurs in the field.
7. Shall be capable of functioning in a stand-alone mode (no Remote-Control Centre), as well as a part of a system with a Remote-Control Centre.
8. Shall be able to perform Store & Forward functionality - receive information from other sites, store it in memory, and then transmit (forward) the data to another site.
9. Shall be able to support both local I/O's and Remote I/O's modules. The remote I/O
10. Modules shall be equipped with radio technology, allowing the Field Unit full access and control, as if they are locally connected.
11. Shall be able to report by exception (known as burst) to the Control Center upon any Change-Of-State (COS)
12. Shall be equipped with a multi-tasking Operating System, specially designed for a real-time environment.

Radio / GPRS communication Network

The Radio/GPRS communication network shall be able to make the communication link between the remote-control Centre and DMA / WMD with conventional (865-867 MHz licenses free) frequency or using GPRS network.

The communication protocol shall be able to support multiple logical channels per physical port, enabling simultaneous Central-to-Field Control Unit and Field Control Unit -to-Field Control Unit sessions.

The communication protocol shall be able to support the following messaging methods:
Burst (also known as Contention) – this is transmission upon change of state.
Polling (also known as Interrogation) – automatically or manually request for data updating.
Report by Exception – the unit shall only report data that have changed since the last poll.

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