OPTIMISED WATER DISTRIBUTION

The reliable solution for reduced leakage loss and energy costs

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BUILDING ON A PROVEN TRACK RECORD

RELIABLE AND COST-EFFECTIVE WATER DISTRIBUTION
GRUNDFOS OFFERS SUPPORT IN THE PLANNING, DESIGNING AND COMMISSIONING OF PUMPING SYSTEMS, AND WE DELIVER THE TECHNOLOGY THAT CAN MEET OUR CUSTOMERS’ OBJECTIVES.

With our high-efficiency pumps, IE3 motors and plug-and-play controls, we can go further than most to bring water to life in a financially and environmentally sustainable way. Our insight can be applied to addressing the key issues of safeguarding water resources, meeting consumer needs and ensuring cost-effective infrastructure.

Over the years Grundfos has pioneered numerous innovations that have become or are becoming industry standards. Grundfos will continue to be at the forefront in promoting and facilitating energy efficiency and sustainable technology. It is these innovations that will enable water distribution infrastructure to meet future challenges and regulations.

Our commitment is to provide optimised water solutions to ensure the reliable and efficient supply of clean safe water that households and businesses depend on.

THE GRUNDFOS DEMAND DRIVEN DISTRIBUTION SOLUTION ENSURES COMPLETE, INSTANT CONTROL AND UNBEATABLE EFFICIENCY, WHILE REDUCING LEAKAGE LOSS, ENERGY COSTS AND MAINTENANCE WORK.
The key issue of reducing and controlling non-revenue water (NRW) in distribution networks is many faceted with no single cure. Central to a typical strategy is to minimise losses through existing leaks and reduce the risk of new leaks.

Pressure management is now well recognised as being essential to effective leakage management. In addition to pressure management, the International Water Association (IWA) also recommends active leak control, speed and quality of repairs, and infrastructure management.

Grundfos’ contributions lie within pressure management and infrastructure management, as presented on the following pages. We have developed systems to support pressure management systems, and these are integrated in our pumping solutions.

**Cut water leakage loss by up to 20%**

With unique pressure control, the Grundfos DDD multi-pump controller automatically reduces surplus pressure in the water mains. Both leakage losses and energy costs are reduced significantly as a result.

**Start with the pump first**

When you start replacing pipes, you also reduce water loss and friction loss, resulting in increased pressure in other parts of the network. It is therefore important to be able to manage pressure from the pump. So before you start digging up the streets to repair leaks, make sure you have the right pumps and controllers first. If you have variable flow, an analysis of patterns will reveal the potential benefits of optimising your pump systems.

“**45 MILLION CUBIC METERS (OF DRINKING WATER) ARE LOST DAILY THROUGH WATER LEAKAGE IN THE DISTRIBUTION NETWORKS — ENOUGH TO SERVE NEARLY 200 MILLION PEOPLE.”**

*World Bank 2006*

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**GRUNDFOS**

**DDD CONTROLLER**

- Proportional pressure control
- Gradual ramp-up/ramp-down
- Cascade operation of up to six pumps
- Monitoring and control with mobile communication

**FIG. 1** – With application-optimised software, the DDD controller offers complete monitoring and control of up to six split case or end-suction pumps from Grundfos.
In high flow periods, friction loss in the mains is relatively high. The loss is correspondingly low when flow drops in off-peak periods of the day. If the pump discharge pressure remains constant regardless of flow, the difference in friction loss will result in excess pressure in the system. This increases leakage loss during off-peak periods.

The Demand Driven Distribution system compensates for excessive system pressure by automatically adapting the setpoint to the actual flow. This is unique to Grundfos’ DDD controller, and is made possible because the controller has been designed and programmed specifically for Grundfos pumps.

Example of the savings

If the pressure loss in the pipe system is 2 bar during high flow periods, the pump discharge pressure must be set to 6 bar in order to deliver a tap pressure of 4 bar. However, in a low-flow situation, the pressure loss in the pipe system may only be 1 bar. If the setpoint remains fixed at 6 bar, this would increase tap pressure to 5 bar. The surplus 1 bar in the system increases leakage loss and represents excess energy consumption, hitting your cost level in two ways.

To compensate for this excess system pressure, the pressure function in the DDD controller automatically reduces pump discharge pressure to 5 bar so tap pressure at the consumer remains a constant at 4 bar.

In this example an average reduction in pressure of 15% can be obtained by constantly adapting the pressure to the actual demand. This would reduce water loss by 10%.
PRESSURE MANAGEMENT PAYS WELL

Reduce surplus pressure
The surplus system pressure that arises in low flow situations is a major cause of water loss through existing leaks. The pressure functionality built into the Grundfos DDD controller is a unique tool for reducing this surplus.

The DDD controller monitors system conditions, detects the increase in system pressure and reduces the setpoint accordingly. For the consumer there is no change in tap pressure. But for the operator, leakage is reduced significantly, and a considerable cost saving is achieved.

Beat water hammer
An important contributing factor behind new leaks is water hammer. Caused by sudden momentum changes in a pipe system, this phenomenon can be reduced or eliminated by lowering fluid velocities, reducing pump size or by gradual ramp-up/rampdown.

*A big pump has a big water hammer effect; this is a factor of the pump’s inertia. Smaller pumps reduce the risk of water hammer. The purchase price and operating costs are also lower.*

To fight water hammer, Grundfos can assess the options for each distribution network by analysing system conditions and consumption patterns. Our recommendations are held up against the economic level of leakage and the resources available to maintain a viable pressure management strategy.

“THERE IS A TRIPLE BENEFIT TO DEMAND DRIVEN DISTRIBUTION: LEAKAGE IS ELIMINATED. EFFICIENCY IS OPTIMISED – PEOPLE DO NOT WASTE TIME CHASING LEAKS, FINDING THEM, REPAIRING THEM AND LISTENING FOR THEM. AND FINALLY ENERGY CONSUMPTION IS REDUCED.”

*Simon Johnson, Water Modelling at Thames Water, UK*
The highly variable flow rates that characterise water distribution networks are an important factor affecting cost-efficiency and water leakage loss. To be sure that consumer needs are met at any given time, a tendency in system design has been to size pumps based on maximum demand. Pumping stations are then typically equipped with one duty and one standby pump, each of them able to meet 100% demand. However, far more time is spent pumping at low flows. Regardless of whether flow is regulated by a valve or Variable Frequency Drive, the efficiency of such a single pump solution will fall quickly as flow decreases.

Instead of two “100% pumps”, the optimal solution is to install three or more smaller pumps in parallel controlled by the DDD controller. Grundfos systems can be expected to deliver a hydraulic efficiency of more than 80%. The multi-pump controller automatically maintains the best efficiency point by cascade operation and speed control. Our experience shows that installing such a system results in a lower initial capital investment, lower energy consumption and lower leakage loss. The lower inertia in the smaller pumps also reduces the risk of water hammer.

To design systems based on this principle, Grundfos uses load profiles based on 24-hour consumption patterns. The load profile gives an overview of how much a pumping system operates at a specific flow rate on a daily basis, and the system adjusts its performance accordingly.

“ONCE YOU HAVE INVESTED IN IT, IT IS A HUGE SAVING TO START WITH AND THEN IT CONTINUES FOREVER.”
Malcolm Farley, Principal Consultant, Aqua2

The estimate of savings and assumptions are as follows:

**Estimate of savings**

- Initial investment: 20%
- Operating costs: 30%
- Leakage loss: Up to 20%

**Assumptions**

- Duty point: 900 m³/h at 40 m
- Existing pumps: 1 x 100% duty + 1 x 100% standby (2 x 160 kW)
- Replacement pumps: 3 x 50% in cascade (3 x 75 kW, variable speed + DDD Controller)
IT’S NEVER TOO LATE TO OPTIMISE

CUT ENERGY CONSUMPTION BY 50%

Many system designers claim that as much as 50% of the pump energy consumption can be saved. This claim is substantiated by the many pump audits Grundfos has performed around the world.

When discussing energy efficiency, the long-standing experience that Grundfos brings to the table is a unique asset. We can illustrate how optimising energy consumption also has a positive impact on the reliability, overall performance and life-cycle costs of a distribution network.

By analysing pumping needs in relation to consumption patterns and periodical variations, we can determine the optimal pump configuration to meet the utility’s objectives for cost-efficiency. Our recommendations cover the size and number of pumps, the viability of frequency control, suitable motor protection, pipe materials, etc. The desired outcome is financially and environmentally sustainable energy consumption, trouble-free duty and low service costs with a minimal need for specialised knowledge. Lifecycle cost calculations are a natural part of our offering and freely available in our online sizing tool WebCAPS.

A Grundfos Pump Audit is an exceptional and well-proven tool that enables the water supplier to prioritise investments in energy reduction.

The Grundfos Pump Audit is a relatively simple process of measuring flow and energy consumption. There is no need to dismantle or modify the installation in any way. Data is recorded over a period of time, and the subsequent analysis shows the pump efficiencies and energy consumption of the existing system. Grundfos then recommends design improvements, quantifying the energy saving, CO₂ reduction and the payback time. The step-by-step process is well-documented, and the subsequent report gives clear economic and ecological implications of investments in energy optimisation. It is most common for a pump audit to identify improvements with payback times of only 6-24 months.

“A THINK IT IS PRETTY INTERESTING THAT WE ARE LOOKING AT A PAYBACK TIME OF 1-2 YEARS. USUALLY THE PAYBACK TIME IS 3-4 YEARS. THIS IS DEFINITELY SOMETHING CLIENTS WOULD LIKE”.

Matteo Bellinello,
Director at International Business Development, Studio Galli Ingegneria

A PUMP AUDIT IS A STEP-BY-STEP PROCESS TO IDENTIFY POTENTIAL ENERGY-SAVING INVESTMENTS. PAYBACK TIMES ARE MOST COMMONLY 6-24 MONTHS.
INTEGRATED SOLUTIONS
BOOST EFFICIENCY

Made for each other
The hydraulics, motors and electronics on Grundfos systems are specifically developed for pump operation. Motors are optimised to the pump’s duty range, typical pump functionalities are built into pump controllers, and communication interfaces are pre-programmed for data exchange to and from central SCADA systems.

Control and monitoring systems
In recent years, control and monitoring systems have increased the potential for improving both efficiency and reliability. However, integrating the many isolated components involved has at times proven complex and costly. Grundfos has addressed this problem by engineering integrated drives and monitoring and control units that are dedicated specifically to pumping systems.

The external variable speed drive (Grundfos CUE), multi-pump control (DDD controller) and internet-based supervision (Grundfos Remote Management) are recent examples. The key has been to integrate components to offer complete systems that are pre-engineered to work together. Interface issues that require expensive programming are replaced by simple commissioning procedures that offer step-by-step guidance that anyone can follow. Specialised functionalities have been developed and optimised for pumping systems.

To enable communication with a central SCADA system or supervisory controller, Grundfos monitoring and control systems include plug-and-play communication interfaces for Profibus DP, Profinet IO, Modbus RTU, Modbus TCP, GENIbus, cellular networks and other systems.

Monitoring and control specialists from Grundfos can contribute to finding the right solution based on your objectives for a given set-up.
Clean, safe water to the door
A dedicated project engineering team specialises in designing and implementing turnkey water disinfection projects internationally.

- Complete disinfection and dosing systems
- Complete measurement and control systems

Disinfection systems for the network
Although the objective is the same – to provide safe, clean water – the methods used to do so are numerous both at central treatment plants and in secondary treatment throughout the mains network. Chlorine-based water disinfection methods are the most common, but no single method can meet all needs. Local regulations are probably the one factor that has most bearing on which system we recommend. The availability of raw materials and the costs of energy and chemicals also have a decisive influence.

Chlorine gas – proven and effective
Gas chlorination systems under full vacuum, such as Grundfos’ Vaccuperm, are the proven ways of meeting the challenges of storing and handling chlorine while ensuring effective disinfection.

Chlorine dioxide – no change in taste or smell
Grundfos’ Oxiperm Pro ClO2 generators are well suited for secondary disinfection in the network. Chlorine dioxide does not change the taste or smell of the water. It is less corrosive than hypochlorite in the water pipeline, and is effective against biofilm and microorganisms exhibiting chlorine resistance.

Electrolytic chlorine generation – safe and simple
The hypochlorite generated electrolytically with Grundfos Selcoperm is not subject to the same rate of degradation as commercial hypochlorite. This gives greater dosing precision. Given the simple precursors (water and salt), the onsite generation process is also considered safer for operators to use.

“AS WELL AS THE ECONOMIC BENEFIT OF THIS SYSTEM, THERE IS ALSO A LARGE PUBLIC RELATIONS BENEFIT. WHEN YOU USE THIS NEW GREEN TECHNOLOGY AND AS A CONSEQUENCE ARE SUPPORTING ENERGY EFFICIENCY, CUSTOMERS LOOK AT YOU DIFFERENTLY”.

Stuart Trow,
Independent Utilities Professor
**CASE STORY: A FULL SYSTEM REFURBISHMENT**

**Time to put an end to leakage loss**

The deteriorating state of an elevated suction tank had pushed the issue of non-revenue water to the top of the agenda for a water authority in Malaysia.

Space limitations around a big-city pumping station made it impracticable to simply replace an old tank that was the cause of extensive leakage loss. Alternative solutions were called for, and Grundfos tended a proposal for direct pumping to consumers.

The solution was accepted, but there were conditions attached to ensure minimal disruption to water consumers. As required by the authority, Grundfos completed the refurbishment including the monitoring systems within two days.

**THE FACTS OF THE CASE**

| Total water demand: 30m l/day | Total pumping time: 24 hours/day | System pressure: 4 bar | Total pump capacity: 1860 m³/h with 50% safety factor | Budget: MYR 4 million |

**OTHER CASE HIGHLIGHTS**

- **DUNEA WATER COMPANY, THE NETHERLANDS**
  - Grundfos Demand Driven Distribution solution helped drive down both energy consumption and maintenance costs in a new booster station, required to supply 700 m³/h in case of emergencies.
  - **700 m³/h**

- **SK WATER, DENMARK**
  - Installing a Grundfos Demand Driven Distribution system helped SK Water reduce the pipe bursts in Korsør by 80%.
  - **80 %**

- **MUNICIPALITY OF PLOIESTI, ROMANIA**
  - Following the implementation of Demand Driven Distribution the leakages in the Ploiesti Nord Gageni water supply zone have been reduced by 150,000 m³ water per year just as energy consumption has been cut by 50,000 kWh.
  - **50,000 kWh**
Commissioning, service and spare parts
Our offering extends from the initial planning of water distribution projects to the end of a long service life. After installing and commissioning, we can actively ensure that our systems continue to live up to expectations.

Incorrect installation will cause pump parts to wear out prematurely and energy consumption to soar. Under the terms of a Grundfos Commissioning Agreement, we offer to install our systems and offer an extended warranty. We ensure correct alignment and wiring, and as documentation, we provide a full report, including operational data.

Customised service
Our service capability is based on a close-knit infrastructure of local service staff and 500 authorised service partners worldwide. These are well-trained people with a thorough knowledge of our technology. As well as being able to commission Grundfos systems, we also offer service agreements, pump audits and an assurance of readily available spare parts.

A service agreement is customised to cover the individual service needs for each pump in each given application. It would typically provide technical advice, training to operations staff and customised service solutions.

Our spare parts service is also customised to reflect each situation and is based on efficient global distribution. We have a variety of offerings, such as online spare parts ordering and support, specially designed service kits, and recommended spare parts list. Authorised local service partners have their own stock of commonly needed Grundfos parts immediately on hand.

YOUR GLOBAL PARTNER

A SERVICE AGREEMENT MEANS
- Rapid response time
- 24-hour hotline support from Grundfos Service Centres
- Warranties on all maintenance and repair work
- Reports after every service visit
- Discounts on spare parts – or on pump replacements

UNMATCHED ONLINE SERVICE
All technical documentation and service information is available – always updated – via our online tool WebCAPS:
- Service instructions
- Step-by-step service videos
- Interactive exploded views
- Sectional drawings