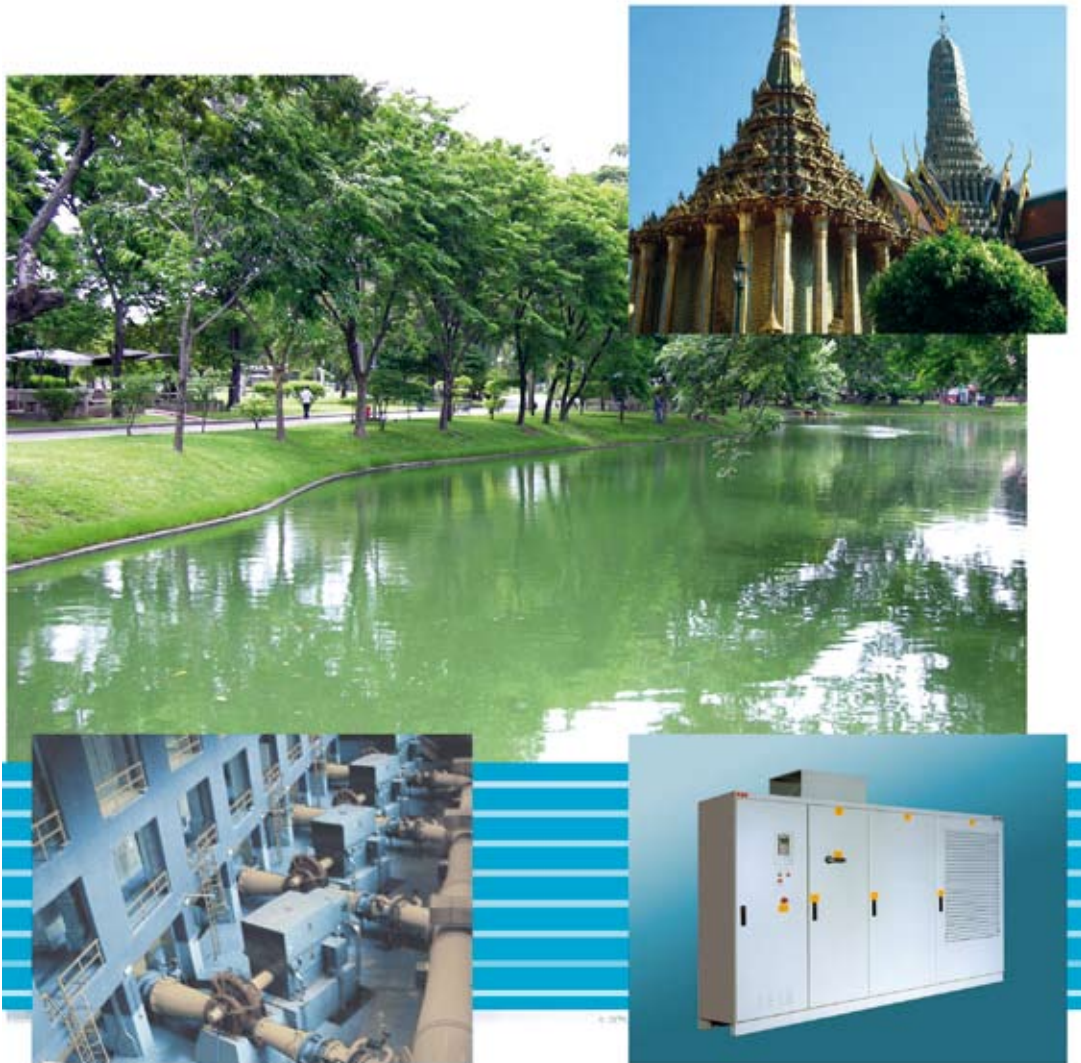


# ABB drives in urban water cycle

Metropolitan Waterworks Authority, Bangkok



**ABB**

# Providing tap water for 11 million people

The Metropolitan Waterworks Authority (MWA) of Thailand is responsible for providing tap water to 11 million people in Greater Bangkok. It owns and operates one of the world's biggest water treatment plants, more than 30 pumping stations and a distribution network of more than 24'000 kilometers of pipelines. As of 2005, 35 ABB drives, totaling nearly 50 MW, are installed at MWA's facilities to enhance the performance of these pumping stations and reduce energy consumption and environmental impact.

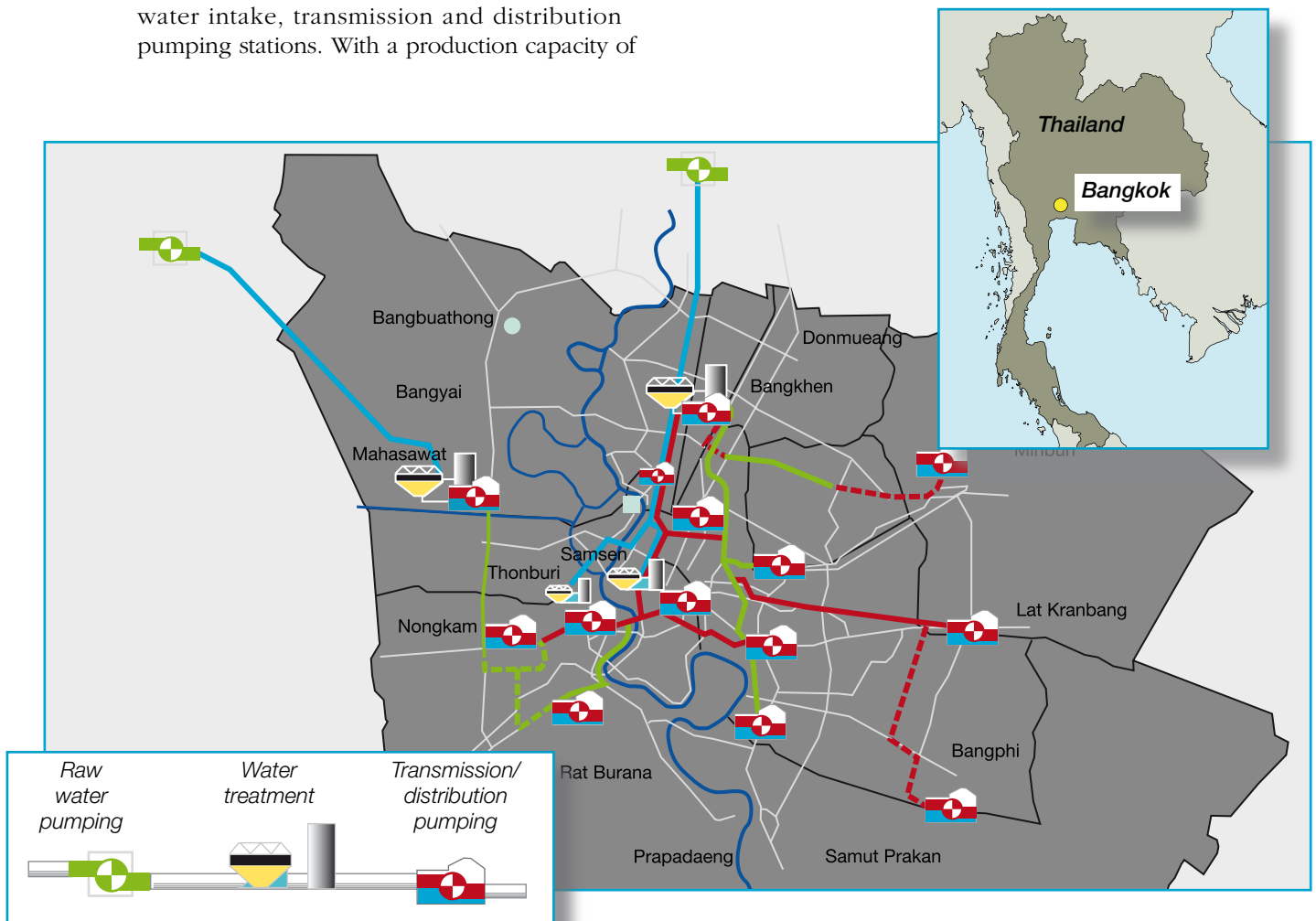
MWA is a state-owned enterprise producing and delivering tap water to about 11 million people in Bangkok and its suburbs Nonthaburi and Samut Prakan.

At present, it has a total production capacity of about 5.4 million cubic meters/day covering a service area of 1855 km<sup>2</sup>.

MWA owns and operates four water treatment plants in Bangkok - Bangkhen, Mahasawat, Samsen and Thonburi - and more than 30 raw water intake, transmission and distribution pumping stations. With a production capacity of

about four million cubic meters/day, Bangkhen is one of the world's biggest water treatment plants. It provides about 70% of Bangkok's water supply.

MWA uses variable speed pumps for different processes in the water cycle – raw water intake, water treatment, water transmission and water distribution. As of 2005 it has more than 35 ABB drives, of which 30 are medium voltage drives.



Overview of MWA's water treatment plants and pumping stations in Greater Bangkok, Thailand

# Raw water intake

The source of Bangkok's drinking water is the Chao Phraya river and the Maeklong river. The raw water pumping stations at MWA's four water treatment plants Bangkhen, Mahasawat, Samsen and Thonburi, extract raw water from these raw water sources.

## Challenge

MWA's raw water pumping station Mahasawat has two pumping stations with a total of eight pumps. Previously, they were controlled mechanically using valves, which proved inflexible and did not allow MWA to quickly react to fluctuations in water demand. When the river's water quality deteriorated and the risk increased that garbage, sucked in from the river, could damage the pumps, MWA had to take a decision - either to install filters and related equipment or to incorporate variable speed drives.

## Solution

After a thorough analysis, MWA decided to install ABB's ACS 1000 variable speed drives. An investment in variable speed drives did not only prove to be less expensive than the plant's upgrade with filters and related equipment, but also offered other advantages.

## Benefits

### Adjustment of suction pressure

In raw water pumping stations, the speed of the pumps need to be adjusted to prevent garbage being sucked in if the water level is too low. With variable speed drives, the water flow can be easily adjusted to fluctuations in water demand and to the reservoir's water level.

## Installation

Two ACS 1000 (480 kW each) and three Samistar (570 kW each) drive systems.

## Benefits

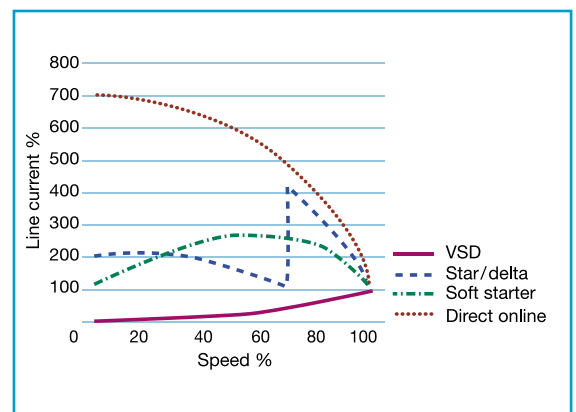
- Adjustment of suction pressure
- Soft starting/stopping
- Longer lifetime of motors and pumps
- Reduced maintenance cost

## Soft starting/stopping

Depending on the reservoir's water level, the fixed-speed motors had to be started/stopped several times per day. However, a direct-on-line (DOL) started electric motor can cause starting currents of up to seven times the nominal current. With the introduction of variable speed drives, the starting current is smooth and there is no need to stop the motor when the reservoir's water level is low. This results in less stress on motors, pumps and mechanical parts, a reduction of maintenance costs and a longer lifetime of the equipment.



Raw water intake canal and vertical motor and pump at MWA's Mahasawat plant



Typical line current with different starting methods

# Water treatment

MWA owns and operates four water treatment plants in Bangkok – Bangkhen, Mahasawat, Samsen and Thonburi. With a production capacity of about four million cubic meters/day, Bangkhen is one of the world's biggest water treatment plants.

## Challenge

Many processes in water treatment plants depend on some kind of speed control in order to function properly and efficiently.

MWA's Bangkhen water treatment plant has 18 clarifying basins, each with a capacity of 200'000 cubic meters/day. It is based on the solid contact sedimentation water treatment process, where a constant water flow is required by the process. Raw water flows into clarifiers where chemicals are added to clarify the water. The waste particles, also called floc, sink down to the bottom of the clarifier where a layer of sludge is formed.

To allow the floc to settle, the water needs to flow slowly into the clarifier, i.e. the water flow needs to be controlled. After separating most floc, the water is filtered as the final step to remove remaining particles and unsettled floc.

## Solution

MWA uses variable speed drives to regulate the raw water flow into the clarifiers as well as for the plant's auxiliary processes, such as backflushing of the filters.

## Installation

Eight ABB industrial drive systems for motors between 110 and 315 kW.

## Benefits

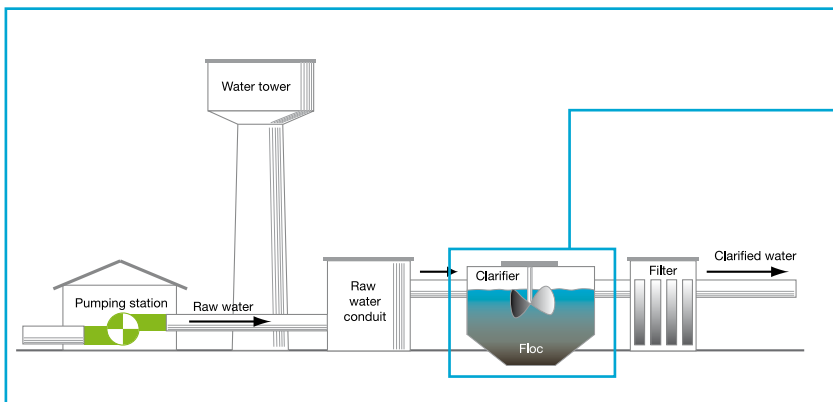
- Constant and smooth water flow
- Regulation of water flow according to demand

## Solid contact sedimentation process

Variable speed drives ensure a smooth and constant raw water flow into the clarifier. As MWA's water treatment plants have raw water towers, which regulate the water pressure to some extent, it is sufficient to control about 20 – 25% of the raw water flow with variable speed drives.

## Backflushing process

Backflushing describes the process of cleaning the filters. To remove embedded particles, water is passed quickly upward through the filter, opposite the normal direction. Variable speed drives are used to regulate the pressure of the water which is used for cleaning the filters.



Solid contact sedimentation water treatment process



Clarifier at MWA's Bangkhen water treatment plant



# Water transmission

Four water transmission pumping stations at Bangkhen and Mahasawat transfer the water from MWA's water treatment plants to the distribution pumping stations.

## Challenge

Supply of treated water as well as water consumption varies greatly during a day. Consequently, pumps transferring water from the water treatment plant to the distribution pumping stations often run at partial load. This results in enormous energy costs.

## Solution

By controlling the flow and pressure of the transmission pumps with variable speed drives, pumps will operate at best efficiency under a variety of flow conditions, considering the actual demand.

## Benefits

### Energy savings

A pump, controlled by a variable speed drive, running at half speed, consumes only about one-eighth of the energy compared to one running at full speed.

### Soft starting/stopping

Variable speed drives also act as soft starters reducing the stress on the pump system. If pumps are stopped, the water in the pipelines flows back with full force, which can cause pump damage. However, if the pumps are slowly stopped with variable speed drives, water hammering can be avoided. This results in a longer lifetime of the pumps.

## Installation

Four ACS 1000 and two MEGADRIVE-CASCADE drive systems (2200 kW each).

## Benefits

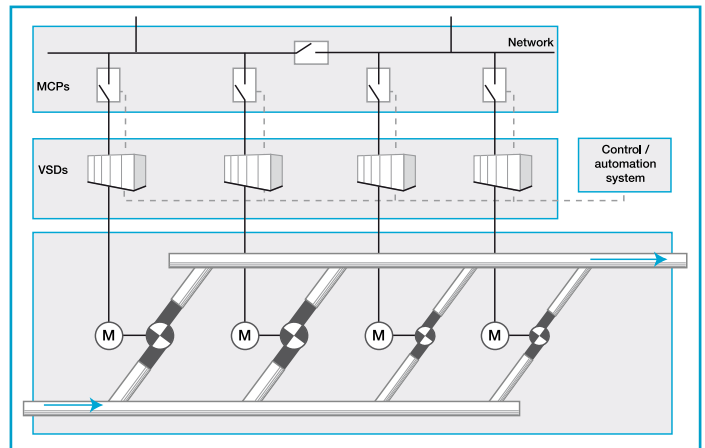
- Energy savings
- Adjustment of water flow
- Soft starting/stopping
- Adjustment of pump pressure and flow rate when operating pumps in parallel

## Adjustment of pump pressure when operating pumps in parallel

In some of MWA's pumping stations, high-pressure/power pumps are operated together with low-pressure/power pumps. To ensure optimal water flow and minimize stress on pumps variable speed drives are used to regulate the pressure.



MWA's Bangkhen water transmission plant and water tower



Operating parallel pumps with variable speed drives

# Water distribution

**MWA owns and operates 14 water distribution pumping stations in Greater Bangkok, which deliver tap water to about 11 million people, covering a service area of 1855 km<sup>2</sup>.**

## Challenge

Most of MWA's water distribution pumping stations are more than 20 years old with controls such as Eddy Current Coupling (ECC) drives. Even though the pumps were operated with varying speed between 504–730 rpm, MWA had excess energy losses of almost 20% being caused by the outdated technology of the ECC drives. As electricity cost amounts to almost 50% of MWA's production cost, MWA was looking for ways to increase the efficiency of its pumping stations and to decrease its electricity cost.

## Solution

The ECC drives in two of MWA's distribution pumping stations were replaced with ABB's ACS 1000 variable speed drives. The pumps can now operate at best efficiency under a variety of flow conditions, considering the actual demand.

## Benefits

### Higher reliability

Compared to ECCs, variable speed drives have a much higher reliability. The availability of spare parts for ECCs is limited which decreases their reliability even further.

## Installation

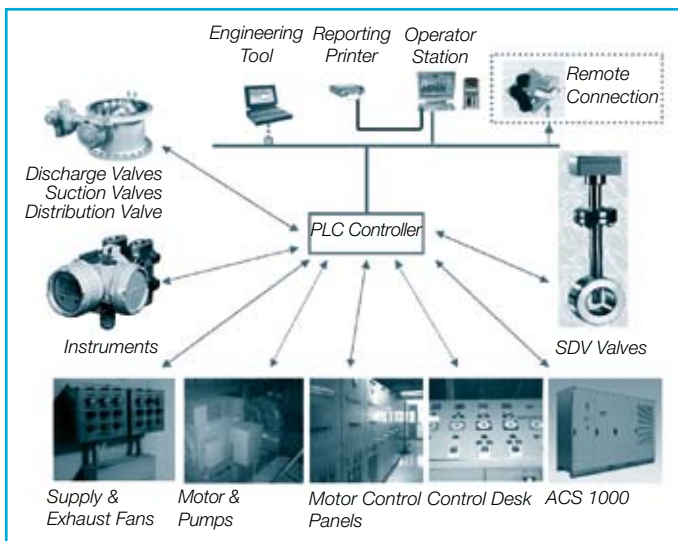
13 ACS 1000 (6 x 1200 kW, 7 x 900 kW), five MEGADRIVE-CASCADE (4 x 1200 kW, 1 x 1100 kW) and four Samistar (2 x 1200 kW, 2 x 1600 kW) drive systems.

## Benefits

- Energy savings of USD 10'000/month
- 15 – 20% system efficiency improvement
- Return on investment: 2 – 5 years
- Improved process control
- Increased system reliability
- Reduced maintenance cost
- Longer lifetime of motor and pump
- Integration with automation system
- Less environmental impact
- Reduction of noise level

## Energy savings

At MWA's Lumpini pumping station, for example, the electricity cost for four pumps amounts to USD 67'000/month during the summer. Within the first month of operation, the installation of the ACS 1000 contributed to energy savings of more than USD 10'000 per month, compared to the previous month with the same output with ECCs.



*Integrated automation system for monitoring and controlling the pumping equipment*



*Grand opening of the Lumpini water distribution pumping station after its successful upgrade*

### Reduced wear and tear

By controlling the pressure in the piping system with variable speed drives, the wear and tear of pipelines and water leakages are minimized.

### Wider range of speed control

With ECCs the pumps were operated within a limited speed range of 504–730 rpm, irrespective of the actual need. Now, with ACS 1000 drives, the speed can be controlled to precisely match the demand.

### Easy, fast and accurate control

Compared to ECCs, the control of pressure and flow is much easier, faster and more accurate with variable speed drives. Furthermore, system maintenance is minimized due to the replacement of the ECCs. Mechanical alignment was very complex with ECC whenever pump or motor were removed for maintenance.

### Automation system

The variable speed drives have been linked to the automation system by modbus protocol. The variable speed drive data can now be monitored and controlled via the operator station.

### Increased lifetime of equipment

Variable speed drives act as soft starters, causing no starting current peaks. This means reduced stress on electrical and mechanical equipment.

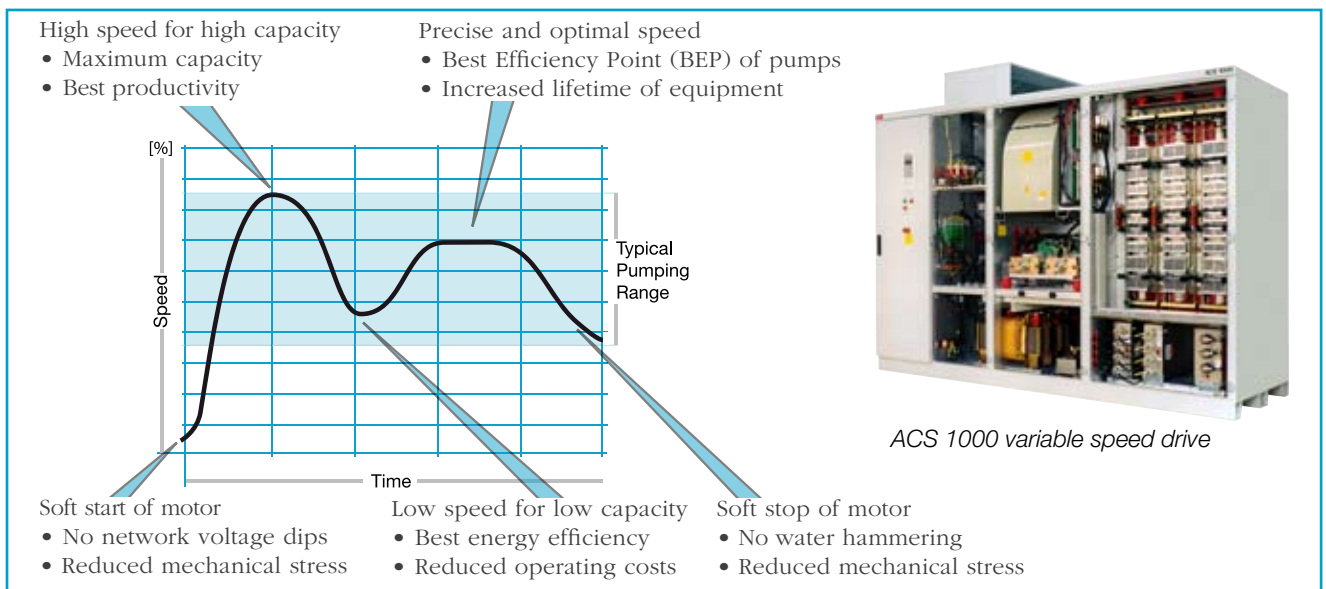
### Less environmental impact and reduced noise

The pumping stations' impact on the environment is reduced significantly since the installation of the ACS 1000 drives. Energy losses were reduced by almost 20%. Furthermore, the noise level of the pump system, which was more than 90 dBA with the ECC installations, is reduced to 75–80 dBA.

### Customer satisfaction

MWA states: “The outcome of this project exceeded our expectations. It was the pilot project for MWA to retrofit the existing eddy current coupling speed control with variable speed drives and to install an advanced automation system. The energy savings after installing the ACS 1000 medium voltage AC drives resulted in a very attractive payback on investment for MWA. The operator is also convinced of the advanced technology and the user-friendly automation system. We would like to take this opportunity to thank ABB for their excellent work.”

## Summary of variable speed drive benefits for pumping applications



*ABB is a leader in power and automation technologies that enable utility and industry customers to improve performance while lowering environmental impact. It offers the entire range of variable speed drives for applications in the power range from 0.12 kW to more than 100 MW.*

**ABB MV drives portfolio**

**ACS 1000, 315 kW – 5 MW, up to 4.16 kV**

**ACS 5000, 2 – 24 MW, up to 6.9 kV**

**ACS 6000, 3 – 27 MW, 3.0 – 3.3 kV**

**MEGADRIVE-LCI, 2 – 72 MW, up to 10 kV**



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