Ten ACS 1000 variable speed drives, each of 3500 kW (4690 hp), control pumps at the Changi influent pumping station in Singapore. The Changi Water Reclamation plant will initially treat 176 million gallons of used water per day.

PUB, Singapore’s national water agency
PUB, the national water agency in Singapore manages Singapore’s water supply, water catchment and used water in an integrated way.

The Deep Tunnel Sewerage System (DTSS) and Changi Water Reclamation Plant
The DTSS was conceived by PUB as an efficient and cost-effective solution to meet Singapore’s long-term needs for used water collection, treatment and disposal.

The Changi Water Reclamation Plant is at the heart of the DTSS. It will treat 176 million gallons of used water per day. Provisions have been made to allow it to be expanded to treat 528 million gallons of water per day.

Used water is pumped to the influent pumping station, which consists of two giant shafts, each 35 meters in diameter and 70 meters deep. Each pump shaft has five pumps, which can each pump 88 million gallons of water per day. This is enough to fill an Olympic-sized swimming pool in five minutes.

Highlights
Soft starting of motors with 11 m long shafts
Elimination of water hammer
Flow regulation of used water inflow
Integration with automation system
Challenge
The used water that flows into the Changi Water Reclamation Plant needs to be regulated to match the sewage inflow to the treatment capacity.

Also, a soft starter is required for the pump motors. The motor shafts are 11 m long. If the motors are started direct-on-line (DOL), the torsional stress may cause the shafts to break.

Solution
ABB supplied ten ACS 1000 medium voltage variable speed drives to control the pumps of the influent pumping stations. Controlling the pumps’ flow and pressure with variable speed drives, ensures they operate at best efficiency under a variety of flow conditions, considering the actual demand.

Efficient flow regulation
By controlling the pump motors with variable speed drives, pump speed can be matched to the used water inflow and treatment capacity.

Reduced energy consumption
The regulation of the used water inflow using variable speed drives instead of other motor control methods improves the system performance and reduces the energy consumption.

Customer satisfaction
Based on the drives’ performance and their smooth system integration into the customer’s process, another eight, 1800 kW, ACS 1000 medium voltage variable speed drives have been ordered for the effluent pumping stations.

Benefits
Soft starting
Due to the long motor shafts, DOL start is not possible. The ACS 1000 act as soft starters reducing the stress on the motors. During the starting process, the ACS 1000 progressively increases the motor speed and smoothly accelerates the load to its rated speed.

No water hammer
Water hammer occurs when the flow of water in a pipe is stopped suddenly, causing a shock wave to ripple through the water. The impact on the structure of the pipes can lead to damage, which, over time, can result in burst pipes.

The ACS 1000 reduces sudden stops and starts which lead to water hammer.

Reduction of maintenance cost and longer lifetime of equipment
The smooth starting and soft stopping protects the mechanical and electrical equipment, thus prolonging its lifetime and reducing maintenance cost.

ACS 1000 variable speed drives controlling the pumps.

ACS 1000 key data

<table>
<thead>
<tr>
<th>Inverter type</th>
<th>Three-level Voltage Source Inverter (VSI)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Power range</td>
<td>Air cooling: 315 kW - 2 MW</td>
</tr>
<tr>
<td></td>
<td>Water cooling: 1.8 MW - 5 MW</td>
</tr>
<tr>
<td>Output voltage</td>
<td>2.3 kV, 3.3 kV, 4.0 kV, 4.16 kV</td>
</tr>
<tr>
<td></td>
<td>(optional: 6.0 kV - 6.6 kV with step-up transformer)</td>
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<tr>
<td>Maximum output frequency</td>
<td>66 Hz (optional: 82.5 Hz)</td>
</tr>
<tr>
<td>Converter efficiency</td>
<td>Typically &gt;98%</td>
</tr>
<tr>
<td>Type of motor</td>
<td>Induction motor</td>
</tr>
</tbody>
</table>

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Acknowledgement is made to:

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www.pub.gov.sg