

Top level lift control via a 220 metre cable

A case study from Emotron





220 m



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Only Emotron and Otis were willing to accept the challenge of modernizing this lift. One of the difficulties that kept competitors from even considering the project was the 220 metre cable connecting the motor and the converter. What's more, the client wished to keep the original DC motor. The lift is now up and running, taking anyone who dares up the tower of Duisburg Stadtwerke for a dizzying view.

Up to 180 metres at 3 m/s

The tower of the Duisburg Stadtwerke has been a landmark of this German city since 1967. It is actually the 200 metre tall chimney of the municipal power plant which generates electricity and district heating. The chimney consists of three flue gas conduits with a central lift shaft in the middle. The lift operates at a speed of 3 metres per second, carrying visitors up to an observation platform at 180 metres. The lift also takes Stadtwerke employees to five additional maintenance platforms and the adjoining main building. To reach the lift's machinery room they need to proceed through a steep spiral staircase from the observation platform.

Keeping the lift and gearless DC motor

Since the lift is the only way of reaching the platform, an evacuation lift is provided to release people from the lift car and return them to ground level. This is a complicated and expensive measure, which makes it very important for the main lift to function reliably. This was one of the reasons for modernizing the installation and bringing the lift up to the latest technical standard.

Another reason was the difficulty involved in finding replacement parts for the old controller dating from the 1980s. The municipal services department consequently decided to fit a new DC converter while retaining the lift, the winch and the gearless DC motor.



The choice of drive solution was a fully digital DC drive from Emotron, developed especially for modernizing high-speed lifts while retaining the original DC motor.

Converter and motor 220 metres apart

The project was complicated by the fact that the motor is located in the machinery room at the top of the tower but the DC converter is in the basement at the foot of the lift shaft. This requires a motor and encoder cable measuring no less than 220 metres. However, the operators can conveniently carry out troubleshooting, maintenance and repairs despite the machinery room being difficult to access. Not placing the converter in the machinery room also avoids exposing the electronics to the wind and weather. When modernizing the lift installation, the lack of space in the small machinery room also made it hard to fit in an additional switchgear cabinet.

Digital DC drive for modernizing lifts

While these difficult circumstances kept a number of competitors from even considering the project, Otis Elevator Company took on the challenge. Otis is one of the world's leading lift manufacturers, with 2.1 million installations in more than 200 countries. They hired Emotron to plan and commission the new equipment for this particular project. The Emotron product range for lift control includes frequency inverters of up to 132 kW and digital DC drives of up to 90 kW. The choice for the Duisburg Stadtwerke was an Emotron GSV 5445, a fully digital DC drive developed for modernizing high-speed lifts while retaining the original motor. It has a compact

design and offers very accurate speed and position control using the latest IGBT technology. The motor windings are protected against a rapid increase in voltage, which makes the drive suitable for refurbishment. All common encoder types can be used.

Cable length made signal transfer a challenge

The most difficult challenge proved to be bringing the 1 volt rotary encoder signals point-to-point to the bottom without losses. To handle this, Emotron chose a solution from Wachendorff Automation, known for their resilient and robust encoders that are ideal for safety-relevant applications. The Wachendorff standard models had been successfully used in installations with cable lengths of up to 150 metres, although in this case a special design was required.

An optimized sine wave encoder with 2048 increments was designed, in order to ensure a precise determination of the speed of the car in the lift shaft. The experts from Wachendorff, working closely with Emotron's R&D department, also managed to transport the signal reliably over the 220 metre distance, even under considerable disturbing influences. The rotary encoder operates at a supply voltage of 15 volts, instead of the customary 5 volts, and is terminated with special resistors.

The project team behind the challenging modernization consisted of (from left) Kai Nagel (Wachendorff Automation), Christian Grewing and Robert Sweniarski (Otis Elevator Company), Götz Benczek and Josef Krebs (Emotron) and Raphael Rumpf (Duisburg Stadtwerke).



Project team

Otis Elevator Company	Contractor, supplier of lift, winch and motor
Emotron	Planning, commissioning, supplier of DC converter
Wachendorff Automation	Rotary encoder for motor
K.A. Schmersal	Safety switching equipment, shaft copy system
KW-Aufzugstechnik	Lift PLC and cabinet

Technical facts

DC converter	Emotron GSV 5445-200/200, digital DC lift drive
Motor	DC gearless motor Otis 104HT 15 kW (max. 54 kW)
Maximum speed	3 m/s
Maximum load	675 kg
Motor/encoder cable	220 metres
Winch data	286 rpm, roping 2:1, pulley 410 mm, Ua=235 V, max. 230 A

The lift takes the Duisburg Stadtwerke maintenance staff to the top platform at 180 metres. From there, they need to proceed through a steep spiral staircase to reach the lift's machinery room.

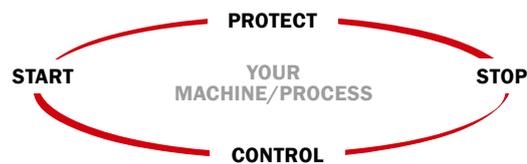
Dedicated drive

Emotron develops products for starting, protecting, controlling and stopping machines and processes driven by electric motors. Our drive is to create measurable benefits for our customers through reliable, cost-efficient and user-friendly solutions. By focusing on selected applications, such as pumps, cranes and lifts, we can offer functionality optimized for specific needs.

Since 1975 we have established a solid position as an innovative and pioneering company. Research and development takes place at our head office in Sweden and at our subsidiaries in Germany and the Netherlands. Germany is also the location for the Emotron technical centres for lift and crane solutions. We have sales offices in Sweden, Germany, the Netherlands, China and Latin America, as well as a worldwide network of distributors and service partners.



Products for your specific needs



Our complete product portfolio offers optimum solutions for your specific needs. The products are all based on the same technology platform and can easily be integrated in complete solutions. Wide power range, high protection class and compliance with global standards mean they fulfil the highest demands.

- *Shaft power monitors* – protect your process from damage and unplanned downtime.
- *Softstarters* – ensure smooth starts and safe stops.
- *Variable speed drives* – minimize energy consumption and wear.



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