Dear Reader,

When it opened to ships in 1976, the ship lift at Scharnebeck, Germany, on the Elbe Lateral Canal, was the biggest twin boat lift in the world, negotiating an elevation difference of 38 metres. After more than 35 years in operation, the drive technology in the lift had to be thoroughly overhauled to ensure safety and availability.

SEW-EURODRIVE supplied the new motors and industrial gear units for the upgradation, from its finely graded product portfolio. What makes this project stand out is that standard gear units were specially adapted for the application. To know more about this fascinating project, do read the full article below.

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Drive technology TODAY

Customized solutions with standard components

▶ After more than 35 years of operation, the drive technology in the Lüneburg ship lift in Scharnebeck, Germany, has been updated. SEW-EURODRIVE supplied the new motors and industrial gear units from its finely-graded product portfolio. What makes this project stand out is that standard gear units were specially adapted for the application.

▶ The Elbe Lateral Canal – a straight route north

The 115 km Elbe Lateral Canal connects the River Elbe near Hamburg with the Mittelland Canal near Wolfsburg. A good 40 km south-east of Hamburg, it flows through Scharnebeck, a community with a population of 3000 in Lüneburg district. The waterway negotiates an elevation difference of 61 meters, climbing 23 meters at a lock near Uelzen and 38 meters at the Lüneburg ship lift. When it opened to ships in 1976 after eight years under construction, the lift was the biggest vertical twin boat lift in the world and cost 152 million deutschmarks. It is operated by the Uelzen Water and Shipping Authority, an agency of the Federal Ministry of Transport and Digital Infrastructure. The canal is 4.0 m deep with a water level that measures 53 m wide. It holds a total of 20.4 million m3 of water. In addition to the Lüneburg ship lift, the canal boasts a

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series of additional technological features such as the Uelzen lock, ports in Wittingen, Uelzen and Lüneburg, safety and barrage gates, pumping stations, and water drawing machines. The canal is crossed by 55 bridges and 10 tunnels pass below it. There are three canal bridges and 32 culverts and water ducts.

The Elbe Lateral Canal is used primarily to transport car parts, grain, salt, wood, and scrap metal, as well as raw materials for the energy industry such as petroleum and coal. Ship traffic varies depending on the prevailing economic climate, for example around 16 000 ships used the lift in 2013. However, natural events such as floods and ice during winter can also have a negative impact on shipping. A flood barrage facing the Elbe stops the canal being inundated when the water level in the river is extremely high.

The ship lift – a heavyweight lifter

The Lüneburg ship lift in Scharnebeck is a vertical twin boat lift and has two parallel shafts, in which two troughs move up and down independently of each other. The troughs have a usable length of 100 m and a usable width of 12 m and hold water to a depth of 3.50 m. They are each suspended by 240 steel cables that run over pulley wheels, each with a diameter of 3.40 m and weighing 4 metric tons. In other words, each pulley wheel is twice as tall as a person and heavier than 50 people. Each individual cable is 54 mm thick, 54 m long and weighs 800 kg.

The troughs can literally lift tons, because the total mass of the moving parts of a trough, including the water, is 12 000 metric tons – the equivalent of 14 complete high-speed trains, each pulling 16 carriages. One water-filled trough alone weighs 6000 metric tons and the counterweights also weigh 6000 metric tons. Because the weight of each water-filled trough is balanced out by a counterweight, a comparatively low drive power of 4 x 50 kW – generated by AC motors – is all that is required. However, drive power of 4 x 160 kW has been installed in the lift system for safety reasons.

Each trough takes around three minutes to travel the 38 m between the upper and lower levels, which equates to around 12 to 13 m/min, including slow stopping and starting phases. The total transfer time – including entering and exiting the lift – is approx. 20 minutes per ship.

Each trough is suspended by 240 steel cables that run over pulley wheels housed in four towers

The troughs are sealed by sectional gates at the front and rear. Each of these lifting gates is raised by two individually driven segment chains that run along the machine house to the left and right of the gate.

The brake brings the 75 kW drive safely to a stop.

The auxiliary drive is an AC asynchronous motor from SEW-EURODRIVE with a second shaft end.

The troughs – carrying a full load up and down

The troughs are sealed by sectional gates at the front and rear. Each of these lifting gates, along with the holding gate that seals the canal, is raised by two drive-coupled segment chains that run along a machine house to the left and right of the gate. Both gates are disengaged before the trough moves so that it is isolated and can be raised or lowered. Each trough travels between four towers that house the pulley wheels at the top.

A total of four machine houses, known as pylons, are located in front of the towers on the higher, southern side of the boat lift. The term "pylon" comes from the ancient Egyptian and Greek towers that flanked entrances. The red pylons at Lüneburg house the drive technology for the gates of the boat lift. Between the troughs, looking out to the south and the bridge that connects the waterway to the lift, is the control station. This is where all data such as camera images and measured values is collated. The operators monitor shipping traffic from both sides and carry a weighty responsibility to ensure the lift runs smoothly and safely.

When a vessel moves into a trough, it displaces a certain volume of water depending on how much it weighs, which helps ensure that the overall weight of the filled trough stays the same. Each vessel also creates a wave that is deflected back at the end of the trough, and it is only after this wave has dissipated that the gate can be closed. If the water in the canal level above the lift is low, four electrically operated tubular casing pumps (4 x 1200 kW, 4 x 2.3 m^3/s) pump water from the Elbe into the canal.

The retrofit – rejuvenating the lift

After more than 35 years in operation, the boat lift had to be thoroughly overhauled to ensure its safety and availability. The structure was inspected and building technology, drive engineering parts, and drive components were renewed. To keep shipping moving during the retrofit, the east side of the lift was renovated first. During the rebuilding work, which took almost two years, the pulley wheels on the east-side trough were replaced and a cable lubricating plant was installed. This retrofit was also designed to increase the torque and

power of the drives for the trough gates. Instead of the previously installed power rating of 55 kW, the new motors were to boast 75 kW. The nominal torque of the gear unit was also increased from 80 kNm to 130 kNm.

A site visit revealed that the SEW-EURODRIVE industrial gear units fit very well into the maximum height specified. The Bruchsal-based company also has intermediate sizes in its product portfolio, which is not the case with every supplier. This unique selling point gives SEW-EURODRIVE a crucial competitive edge – which is of benefit to its customers. The drive concept that was recently implemented was drawn up by the Drive Technology Center (DTC) in Hanover, as was the arrangement of the components. Internal and external customer focus is a natural feature of operations at the Bruchsal-based company. It has been the secret to success at SEW-EURODRIVE for more than 80 years.

The drive technology – the power of two gear units

The electromechanical drive technology in the gates originates from the beginning of the 1970s. It consists of an AC asynchronous motor with a braking unit and an industrial gear unit that is linked to a second motor/ industrial gear unit opposite the gate via a mechanical connection. Both motors are powered by a shared inverter (500 V, 0–50 Hz). Thanks to variable frequency, the gate drive can be accelerated and braked gently. An electrical auxiliary drive was installed as a reserve for emergency situations and there is also a manual wheel for emergency operation.

In a new development, an SEW-EURODRIVE DVE280 S4 75-kW AC motor is now being used as the main drive. This is coupled to an SEW X4KS230 industrial gear unit. It has three helical gear stages and one bevel gear input stage. One of the customer's requirements was that the original basic structure of the system be retained. The mechanical interlinking of the two gate drives was already part of the original design and was therefore to be kept. To meet this requirement, a mechanical connection had to be created from the main gear unit to the second main gear unit on the other side of the lock gate. SEW-EURODRIVE manufactured a modification for this based on a standard industrial gear unit from the X4 series. A second output shaft is led out of the gear unit after the first gear unit stage. To achieve this, it was only necessary to modify the shaft of this gear unit stage and exchange the bearing cover. This shaft leads to a transfer case. This is a helical-bevel gear unit that distributes the rotary motion of the input shaft at equal speed to two output shafts through a bevel gear set. One output shaft establishes the permanent mechanical connection to the second drive system via a synchronization shaft. The auxiliary drive is connected to the second output shaft of the transfer case via a clutch. In normal operation this is disengaged, but it can also lift the gate in an emergency. In doing so, it operates with significantly less power than the main drive, and at

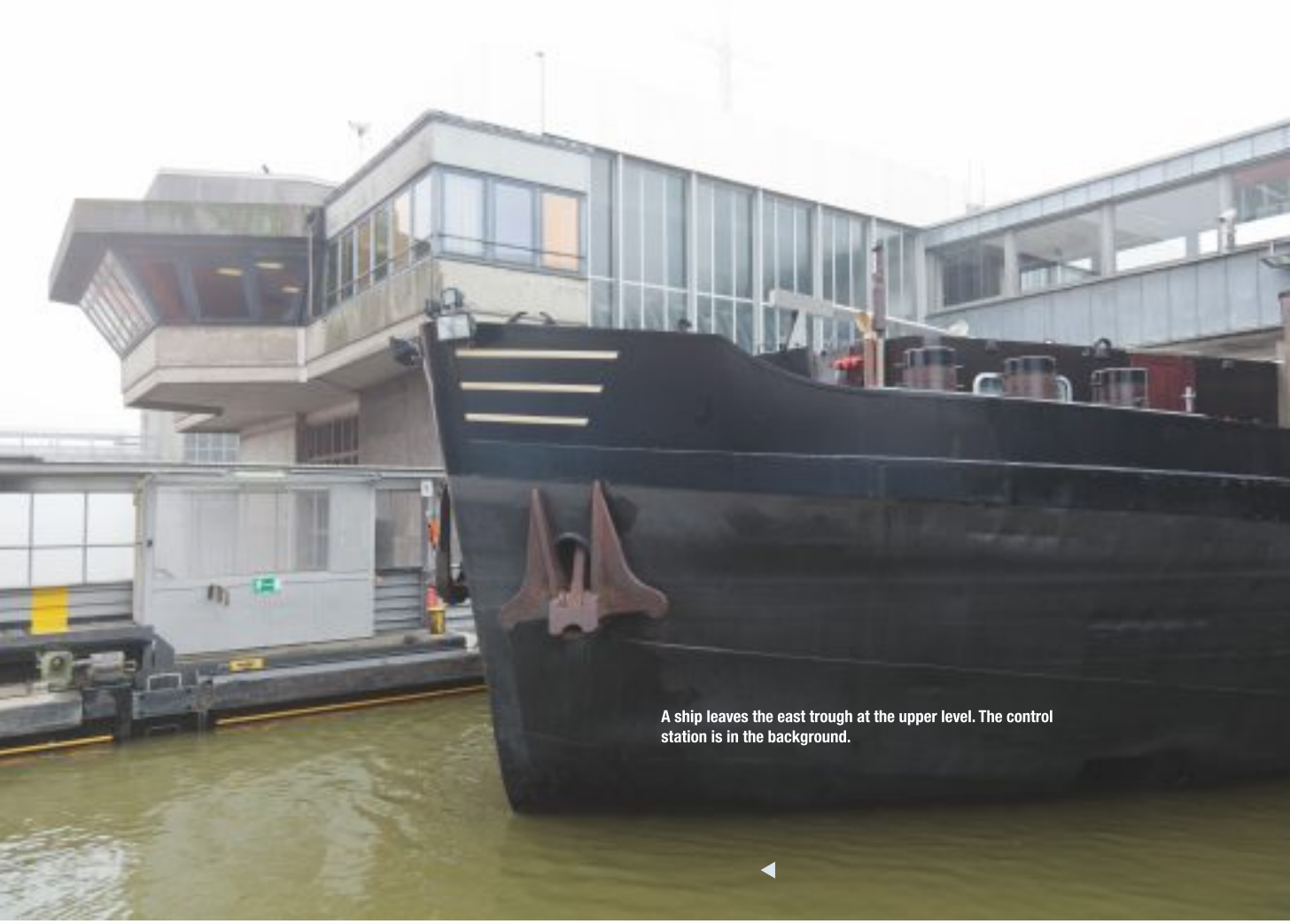
At the top is the industrial gear unit and auxiliary motor, with the transfer case and synchronization shaft below (from left)

only around a tenth of its speed. The auxiliary drive is a standard SEW K127 DRE180 M4 AC asynchronous motor with second motor shaft end. The handwheel for emergency operation can be attached to this.

The torque is transferred from the output shaft of the industrial gear unit via a pinion to a triple-strand roller chain that opens the gate. The same drive construction can also be found on the other side of the gate. As already described, both industrial gear units are mechanically synchronized using a synchronization shaft that runs over the gate. This ensures that the gate moves up and down in a straight line. In addition, sensors were included for function monitoring that check e.g. whether the brake is functioning correctly. There is an absolute encoder on one side of the gate for electrical height monitoring.

The service – reliability as standard

To install the new drive package, the pylon housings had to be removed before the new machine houses could be put in place. They were also fitted out with new insulation so that they can better withstand extreme temperatures in summer and winter. The fundamental overhaul of the east trough took place from June 2010 to May 2012. With the drive unit installed, the customer obtained a broadly standardized drive package that will work reliably for years and, should spare parts be needed for servicing, they can be provided rapidly and easily. The retrofit project for the west trough is due to start in 2016. ◀



A ship leaves the east trough at the upper level. The control station is in the background.

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