

Curtain up for CANopen stage drives

Introduction

The works of Beckett and Brecht, Mozart and Wagner, and of course Goethe and Shakespeare are all performed on the stage of Theater Duisburg (Germany). After decades or even centuries, these plays, concerts, and operas continue to fascinate the audience. The drive technology for the stage, however, had seen better days and therefore, the theater had installed new electrical equipment for backstage technology.

Hoists, rods, and other proven mechanical components as well as most existing geared motors continue to perform their duties, but are now controlled by a system from Unican specialized in equipping theaters. The high-availability stage automation system is a solution that fulfills the requirements of SIL 3 according to IEC 61508. It includes HMI consoles, software, and application-tailored enclosures with axis controllers by Nord Drivesystems that are connected to dozens of drive units via frequency inverters.

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Hand-operated spotlights, curtains, and stage elements are no longer common in opera houses and theaters. Today, complex automation technology and many drive units ensure that heavy scenery objects are moved to change sets at the right time during a show, spotlights are repositioned again and again, and sound and video systems are operated synchronously. Unican is one of few manufacturers of extensive automation-based operating and control solutions for all types of theater stages. The OpenCue software solution provides opera houses, theaters, congress centers, and similar facilities with a modern system featuring fixed or mobile operating consoles. The HMI units and their graphical interfaces allow for easy access, continuous monitoring, and ver-

satile show programming of up to 240 drives in the upper and lower machinery area of stages. In opera houses and theaters, operating many hoists and other ma-



Figure 1: Each enclosure contains one ICU computer by Unican (bottom left) and an SK 535 frequency inverter by Nord (top right)

chinery in the vicinity of artists, technical staff or even the audience is practically unavoidable. This often involves the lifting or moving of heavy loads, which further increases the risk potential. Safety measures to prevent serious accidents are therefore mandatory. In most cases, the safety-relevant electrical components must ensure safety integrity level SIL 3 according to IEC 61508.

More than one hundred drives

This safety requirement also applied to the new systems for the Theater Duisburg. All in all, 74 drives in the so-called upper machinery (that is, drives used to move rope and chain hoists above the stage area) and 39 drives on six podiums and slopes in the lower machinery were modernized. ▷

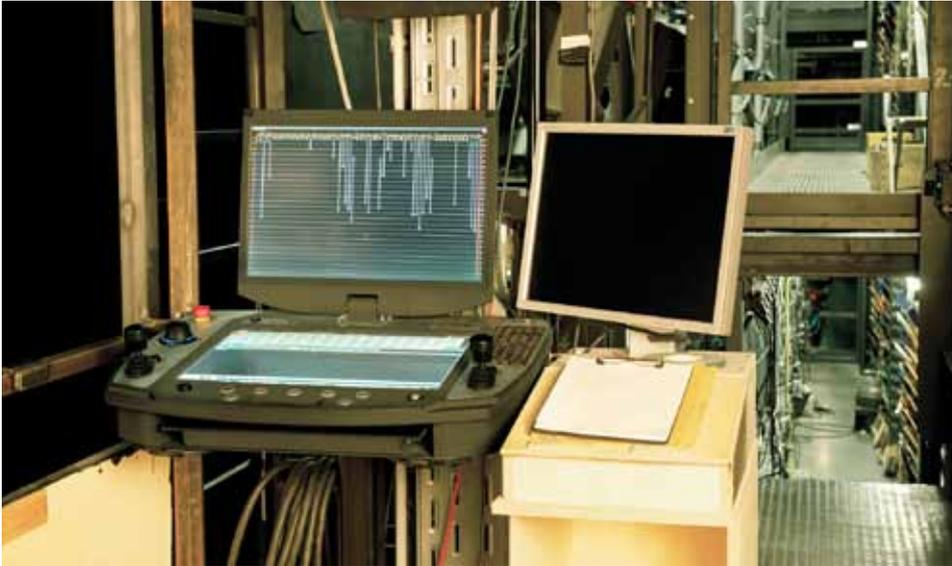


Figure 2: After a modernization, stage technology at Theater Duisburg is now mainly operated by means of fixed OpenCue consoles with two 22-inch touchscreens

For the control solution, Unican installed three operating consoles: two with double 22-inch screens and one with a single 19-inch screen. The screens can be operated in an upright position or lying on the console. Input options are the touchscreen display and the keyboard integrated into the aluminum console, which features various backlit special keys, two joysticks, and a trackball. In addition to these fixed stations, the system house also delivered a handheld HMI with a 12-inch touchscreen. The largest part of the system installation, however, was taken up by customized enclosures for the more than one hundred drives, each of which is equipped with a host-computer from the ICU series by Unican. These electronic units operate regardless of the type of connected drives and can therefore be used to control hydraulic and pneumatic solutions as well as electric ones. The controllers feature a double CAN interface supporting CANopen, and are equipped with two inputs for SSI encoders and an integrated emergency stop relay. The host controllers are available as dual channel versions for SIL-3 applications.

Reliable frequency inverters

At Theater Duisburg, the host computers control the electric motors. For that purpose, each of the more than one hundred customized enclosures is equipped with an CANopen-connected SK 535 frequency inverter from Nord Drivesystems. The stage drives required reliable power electronics that could seamlessly fit into the safety concept.

All inverters feature integrated brake management, a brake chopper and a line filter as well as sensorless current vector control. Even the basic model,



Figure 3: The safe control solution includes customized enclosures for each of the more than one hundred drives in the upper and lower machinery

which is equipped with five configurable control inputs, two analog inputs, one analog output, and two relay outputs, provides a wide range of connection options. For Theater Duisburg, SK 535E models in sizes 5 and 6 with an 11-kW and 22-kW performance were chosen from the SK 500E series, which is currently available with rated motor outputs up to 90 kW. In addition to the basic features described above, these models also feature two digital input and two output channels and a TTL input for speed and torque control. Moreover, they feature a "Safe Stop" function in compliance with EN 954-1 and EN 13849-1 (up to safety category 4, stop category 0 and 1) and come with an on-board CANopen interface. A Posicon module that provides positioning control functions is also included in delivery. Furthermore, the controller card of the drive can be powered from a separate 24-V supply, allowing access to parameter data and the bus interface even if the mains power is switched off. This enables specific applications such as elevator evacuation and increases online availability.

Holger Zeltwanger

Nord Drivesystems

The drive manufacturer employs some 2900 people. The portfolio ranges from standard drives to customized solutions, e.g. based on energy-efficient or explosion-protected drives. Gross sales amounted to 450 million € in 2012. Founded in 1965, the company has grown to include over 35 subsidiaries. The company offers also gear and motors as well as frequency inverters. The inverter line-up features conventional models for installation in control cabinets as well as design types for integrated drive units with network interfaces, e.g. CANopen.

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Summary

With the described automation technology controlling more than one hundred drives in the upper and lower machinery, Theater Duisburg has been equipped with a system solution that fulfills the safety requirements of SIL 3. The system enables easy operation as well as the programming of complete performances on touchscreen operating consoles. Numerous customized enclosures for the stage drives – which provide a functionally safe connection between the partially modernized electric motors and the state-of-the-art control system via new frequency inverters – are the core component of the electric equipment.