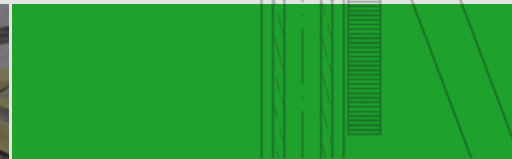
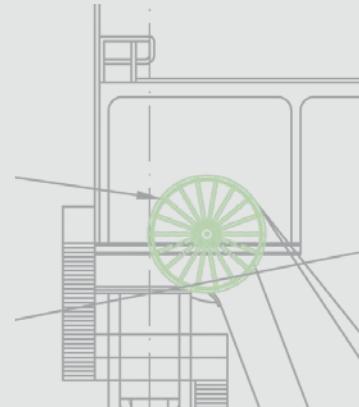


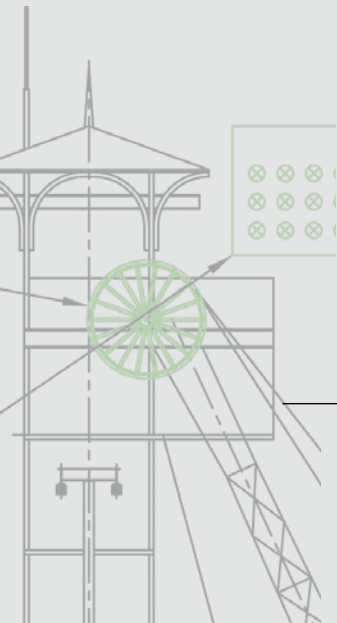


MWM ELEKTRO

COMPLETED PROJECTS



COMPREHENSIVE MODERNISATION OF THE MINE SHAFT HOISTS FOR THE "KINGA" AND "DANIŁOWICZ" SHAFTS OF THE "WIELICZKA" S.A. SALT MINE



The "Wieliczka" Salt Mine is one of the most valuable historic monuments of the material and spiritual culture in Poland, visited by over a million tourists from all over the world every year. It is also a world class heritage site, it was placed on the original UNESCO list of the World Heritage Sites.





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Objective of the project

The main objective of the modernisation was the replacement of the elements of the mine shaft hoists of the "Kinga" and "Daniłowicz" shafts used for many years with modern, more functional and energy-effective solutions and to provide safe transport of tourists visiting the "Wieliczka" salt mine.

One of the most important objectives of the modernisation was the unification of the applied equipment and elements of mine shaft hoists.

Scope of the project

As a result of a tender process, MWM Elektro Sp. z o.o. was awarded the contract for the comprehensive modernisation of mine shaft hoists for the "Kinga" and "Daniłowicz" shafts of the "Wieliczka" S.A. salt mine.

- The modernisation of each of the shafts included:
- replacement of the hoisting machine,
 - replacement of the shaft signalling and communication equipment,
 - replacement of the 1-L2500 guiding pulleys,
 - replacement of the shaft gates and locks,
 - installation of the power generator,
 - adaptation and renovation of the civil structures,
 - technical documentation for the entire project,
 - supply and installation of the equipment,
 - overseeing the procedures related to the approval of equipment for use in mining plants,
 - start-up of the supplied equipment.

The comprehensive modernisation of the machines, structures and systems for the mine shaft hoist was provided in the "turn-key" system.

BB-2500/AC-4m/s hoisting machine

The BB-2500/AC-4m/s hoisting machine is a double-drum machine with the capability of mutual exchange of winding drums. It is applied in a two-container mine shaft hoist without a balancing rope. One winding drum is attached to the main shaft, the other one is installed on the shaft via slide bearings and is connected to the shaft with a toothed coupling. The decoupling of the drum is performed using a separate hydraulic unit supplied with oil from one of the H-C MWM-6 control and supply system's units. The machine is placed on a foundation – part of the hoisting machine building on the level near shaft entry. It is intended for the transport of personnel and materials.

The machine is controlled:

- manually from the machine operator's panel,
- remotely from control panels at stations or with an ECHO-S radio device.

The main components of the machine:

- main shaft unit with roller bearings and winding drums and a hydraulic drum decoupling system,
- cylindrical toothed gear,
- main DC motor,
- redundant drive,
- disc brake unit with the H-C MWM-6 control and supply unit,
- supply transformers,
- power generator,
- control, monitoring and safety systems,
- ergonomic hoisting machine operator's station with a system for displaying the statuses of individual components of the mine shaft hoist and emergency signalling.

photo 1 – BB-2500/AC-4m/s hoisting machine – "Kinga" shaft
photo 2 – BB-2500/AC-4m/s hoisting machine – "Daniłowicz" shaft



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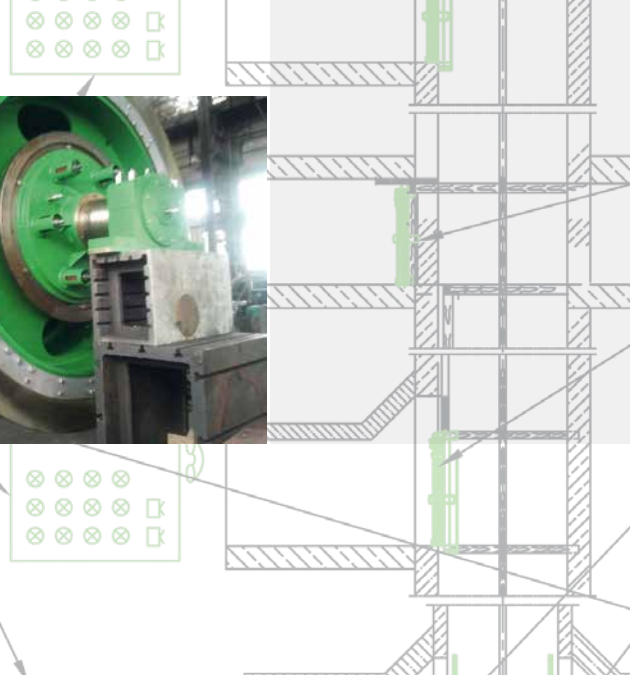
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In order to ensure the highest quality of supplied elements and services, inter-stage inspections, investor acceptance and industry designers' supervision were provided during the production.

photo 3 – Inspection of the main shaft with the installed drum decoupling system

photo 4 – Test installation of the main shaft unit

The hoisting machine is equipped with a hydraulic-controlled disc brake system, which includes the following elements:

- two brake discs,
- two brake columns,
- four pairs of BSFG 405-A00-02-00 brake actuators – two pairs per column,
- H-C MWM-6 electrohydraulic control and supply unit, manufactured by MWM Elektro Sp. z o.o., comprising two hydraulic units: primary and backup, authorised for operation by a hydraulic distributor as well as the supply and control system.

The hydraulic units enable the selection of two values of braking force during emergency braking. The application of this type of braking guarantees the alleviation of the emergency braking effect on the elements of the mine shaft hoist and prevents rope slipping.

photo 5 – H-C MWM-6 electrohydraulic control and power unit

Furthermore, the braking system is equipped with "UWDSO" – additional oil flow forcing device.

The drive system of the hoisting machine is based on an asynchronous motor supplied from the frequency converter. A du/dt filter is installed between the frequency converter and the motor. The filter suppresses short impulses on the converter output and limits sudden voltage surges – dangerous for the motor's insulation. Furthermore, the du/dt filter reduces the emission of high frequency interferences and bearing currents of the motor. The main drive's frequency converters are ACS800-17-0260-5 converters authorised for operation by the distributor. An alternative for the backup converter can be an ACS800-37-0260-5 converter with braking resistors and chopper, enabling effective braking of the drive without returning energy to the grid. This solution is used when the backup power is provided from the generator, with full operational specifications of the mine shaft hoist.

The hoisting machine is equipped with a separate redundant drive used for the evacuation of persons from underground workings and hoist containers trapped in the shaft, in the event the main drive is not operational. The motor of the main drive's motoreducer is also supplied from the 500 VAC distributor of the hoisting machine through the ACS800-11-0025-5 frequency converter for a smooth start and stepless speed adjustment. The redundant drive enables the operation of the mine shaft hoist with the maximum speed of 0.5 m/s. The redundant drive can also be supplied from the ACS800-31-0025-5 frequency converter with a chopper and braking resistors.



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Shaft signalling and communication equipment

The application of the independent redundant power supply from the power generator, with enough power to enable the operation of the hoist at its full capacity, provides full independence of the mine hoist transport from the outside power supply (power grid) and is the first solution of its kind in the Polish mining industry.

photo 6 – Drive system supplied from the frequency converter and redundant drive

photo 7 – Power generator

The control and safety system as well as the digital hoisting machine travel regulator are based on a redundant system of logical controllers.

The BB-2500/AC-2m/s machines use the GRZ-08 digital travel regulator. It enables the control of hoisting machine's travel diagram according to the requirements of the user and works as the continuous and end speeds control system simultaneously.

photo 8 – Supply, safety and control system

The functional and ergonomic machine operator's station, equipped with the hoisting machine's status display system as well as shaft signalling and communication equipment, is installed in an air-conditioned and soundproof booth.

photo 9 – Hoisting machine operator's station

The applied shaft signalling and communication equipment is constructed using a system of redundant logical controllers exchanging data with local stations using optical fibre cables.

The shaft signalling and communication equipment has the following features:

- all communication nodes of the system are connected with two independent Profibus DP networks,
- each of the Profibus DP networks works in a closed loop configuration, allowing for undisturbed system operation in the event of breaking,
- two-channel supply to the equipment installed in the shaft allowing for undisturbed operation in the event of breaks in one of the supply voltages,
- modular design for easy expansion and replacement of damaged components,
- clear visualisation of all device elements on the screen of the industrial computer.

The modernised shaft signalling and communication equipment provides duplex sound communication between the control and signalling stations of the mine shaft hoist.

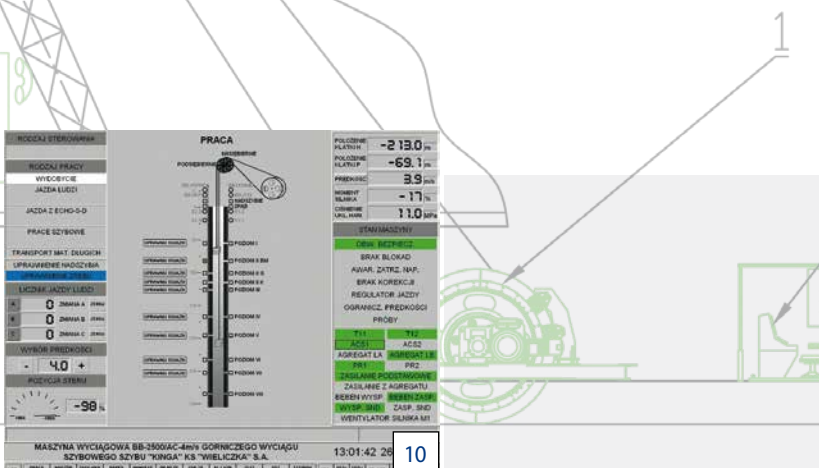
Due to the aggressive environment conditions, the housings of all signalling stations are made of stainless steel.

photo 10 – View of one of the display system screens

photo 11, 12, 13 – Components of the shaft signalling and communication equipment

Additionally, the shaft gates with locks were replaced in both shafts at all levels.

photo 14 – Newly installed shaft gates



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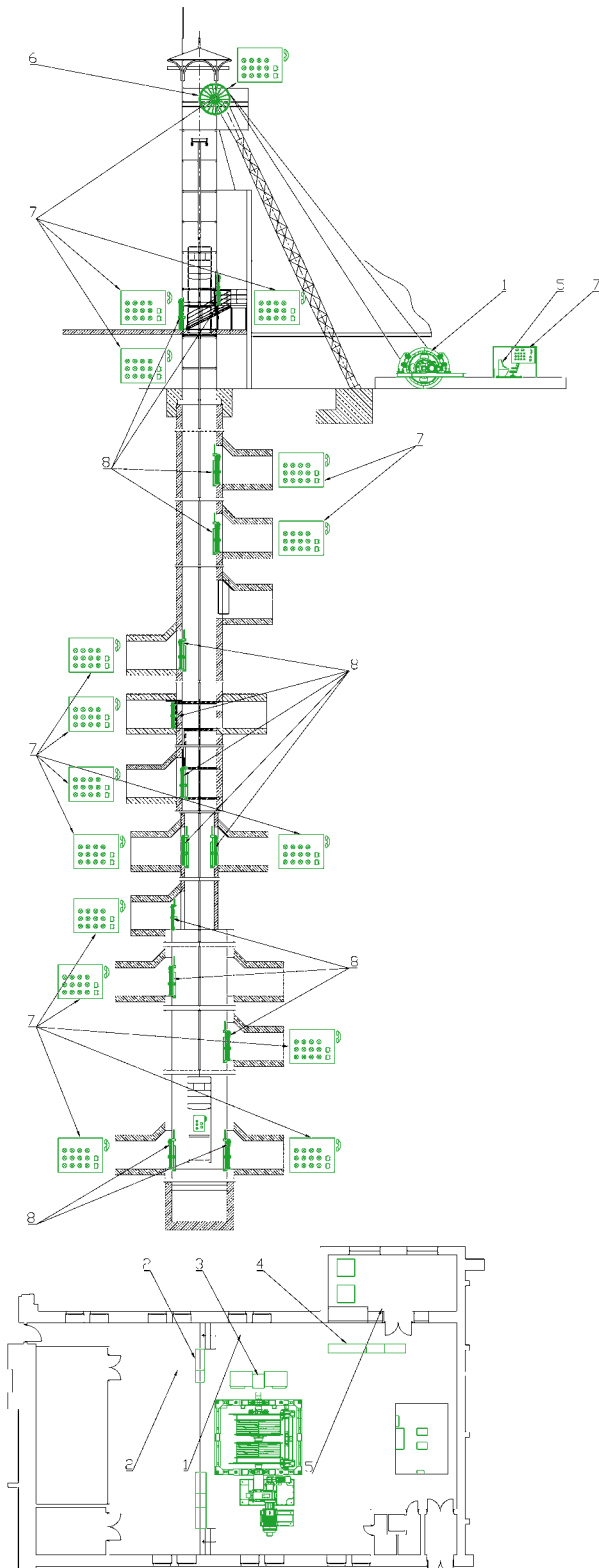
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Mining shaft hoist

Cross-sectional drawing of the shaft and hoist building, modernised elements highlighted:

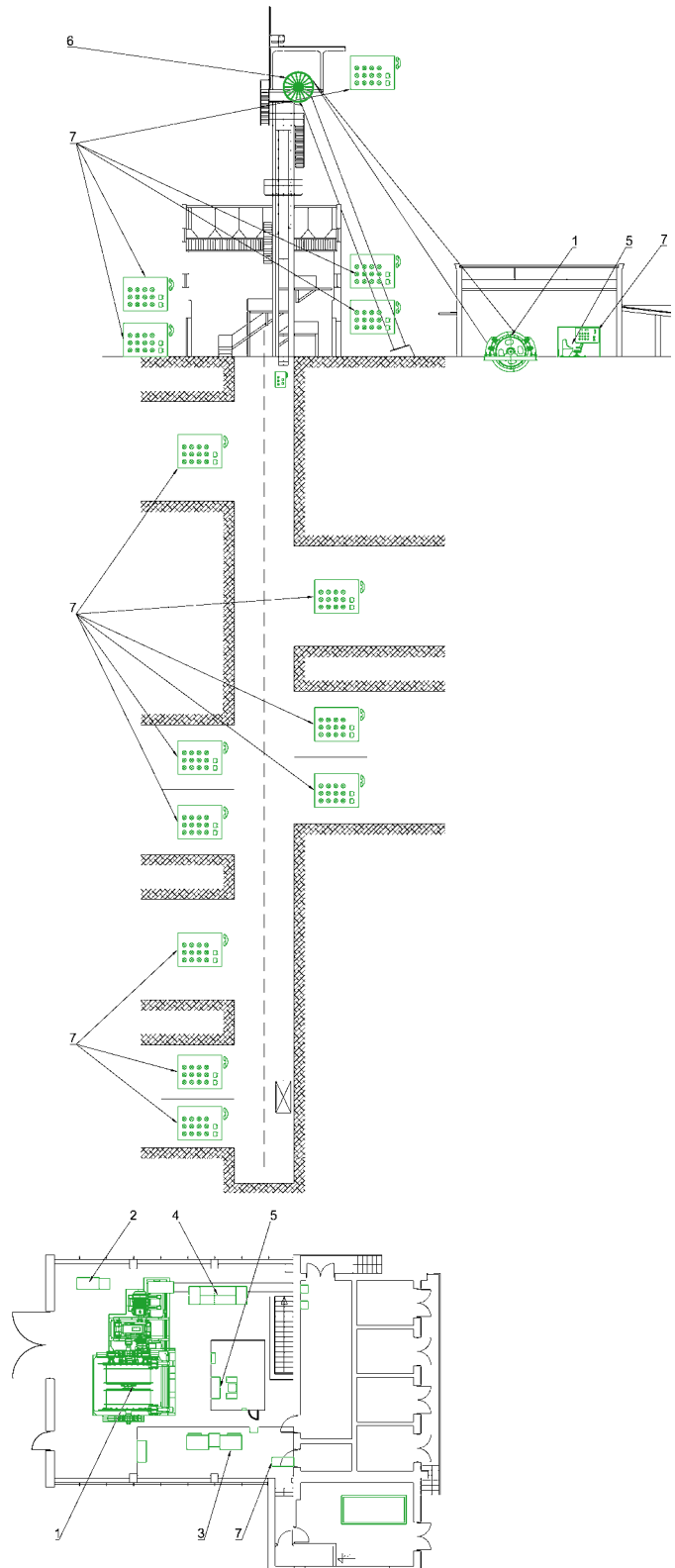
Kinga

- 1 – BB-2500/AC-4m/s hoisting machine
- 2 – Inverter drive
- 3 – H-C MWM-6 control and power unit
- 4 – Control, monitoring and safety systems
- 5 – Hoisting machine operator's station
- 6 – Guiding rope pulleys
- 7 – Shaft signalling and communication equipment
- 8 – Shaft gates



Daniłowicz

- 1 – BB-2500/AC-4m/s hoisting machine
- 2 – Inverter drive
- 3 – H-C MWM-6 control and power unit
- 4 – Control, monitoring and safety systems
- 5 – Hoisting machine operator's station
- 6 – Guiding rope pulleys
- 7 – Shaft signalling and communication equipment



Guiding rope pulleys

The guiding rope pulleys on the “Daniłowicz” shaft headframe were also replaced in the mine shaft hoist modernisation process. The new 1-L 2500 pulleys were used instead of the previous pulleys with the diameter of 3,200 mm. The new pulleys use the SKF rolling bearings. Furthermore, the headframe was adapted for the installation of new guiding rope pulleys.

photo 15 – Replacement of guiding pulleys

Civil structures

The modernisation required constructional modifications, such as the adaptation of cellar spaces and the replacement of transport gates. After the completion of the assembly and commissioning works, a new ceramic tiles floor was provided on the hoisting machine’s level.



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Technical specifications of the mine shaft hoist after modernisation

	“Daniłowicz” Shaft	“Kinga” Shaft
intended use		personnel and materials transport
container guiding		rigid
hoist containers	cage with counterweight	2 x cage
number and diameter of lifting ropes		2 x 28 mm
travel route length	211 m	292 m
transported material weight	3.24 Mg	1.80 Mg
number of transported persons	36	20
hoisting machine type		BB-2500/AC-4m/s
maximum travel speed		4 m/s
maximum static overload	25 kN	30 kN
drive type		160 kW AC motor with frequency converter
brake type		disc, hydraulic control

Summary

The modernisation of two mine shaft hoists in the presented scope significantly contributed to the reliability and safety of tourists transported by the hoist as well as the personnel.

The application of the power generator provides full independence of the mine hoist transport from the power grid.

The unification of the applied equipment and solutions significantly reduces operation costs and enables problem-free work for the service personnel of the “Kinga” and “Daniłowicz” shafts.

The application of an AC drive in the selected configuration increased the energy efficiency of the system and reduced the amount of interferences generated into the power supply network.



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