Low voltage AC drives

Enhancing efficiency in mining
Safe and reliable control of motor-driven applications

Power and productivity
for a better world™

Improving the efficiency of mining operations

Contents

The machines and equipment used in mining must provide reliable, safe and efficient operation in hot, humid and dusty environments. ABB's low voltage AC drives and high efficiency motors are designed to meet motor-driven application challenges found in the most hostile locations. Together with extensive mining experience and a wide portfolio of life cycle services, ABB is well positioned to tackle the industry's most demanding situations.

Automating the future

Recent years have seen a significant increase in the level of automation and, in particular, the use of low voltage AC drives within the mining industry. Automation leads to less man power and increased safety in production, while optimizing the process and making control easier, faster and more efficient.

Replacing traditional control with variable-speed drives

Low voltage AC drives are primarily used to adjust the speed and/or torque of standard AC motors. AC drives, together with induction motors, replace DC and slip-ring motors along with their control systems. AC drives also replace the need for starters, cascade drives, hydraulic speed control, mechanical gears, fan inlet vane control, fan damper control and many other techniques of regulating the speed of electric motors used throughout the mining industry.

Highly reliable, safe and energy-efficient

Mine operators, machine builders and equipment suppliers need to select a drive system that contributes towards:

- Increased productivity and throughput
- Lower energy consumption, gas emissions and pollution levels
- Minimized mechanical wear of the equipment
- Higher process quality and reliability
- Better process equipment efficiency
- Less investment in electrical network compensation devices, such as filters
- Reduced harmonic distortion to the electricity supply network

Meeting safety requirements

Within the mining industry safety is of paramount importance. When an electric motor is installed in a potentially explosive atmosphere, there is an increased risk of an explosion occurring. To tackle this situation, each country has its own regulations, which may differ. National requirements might be needed for final approval of the installation but generally relate to one of the main standards below:

NEC: National Electrical Code in North America
IEC: International Electrotechnical Commission
EN: European Norm

European Union (EU) directives – known as ATEX – have been implemented covering the Essential Health and Safety Requirements (EHSRs) for products used in potentially explosive atmospheres.

Although ATEX directives are only applicable within the EU, they are based on European standards which have lead to their principles being demanded by users throughout the world. However, ATEX approval is generally not recognized outside Europe and the mining industry should investigate, which approval schemes apply locally.

Energy saving potential

Among the most energy intensive areas in mining that benefit from drives are excavation and ventilation as well as transfer and crushing of materials. Other applications with high energy saving potential include pumps, fans, hoists, cranes and downhill conveyors and installations requiring braking.

How ABB can help

Throughout all stages of mining ABB offers:

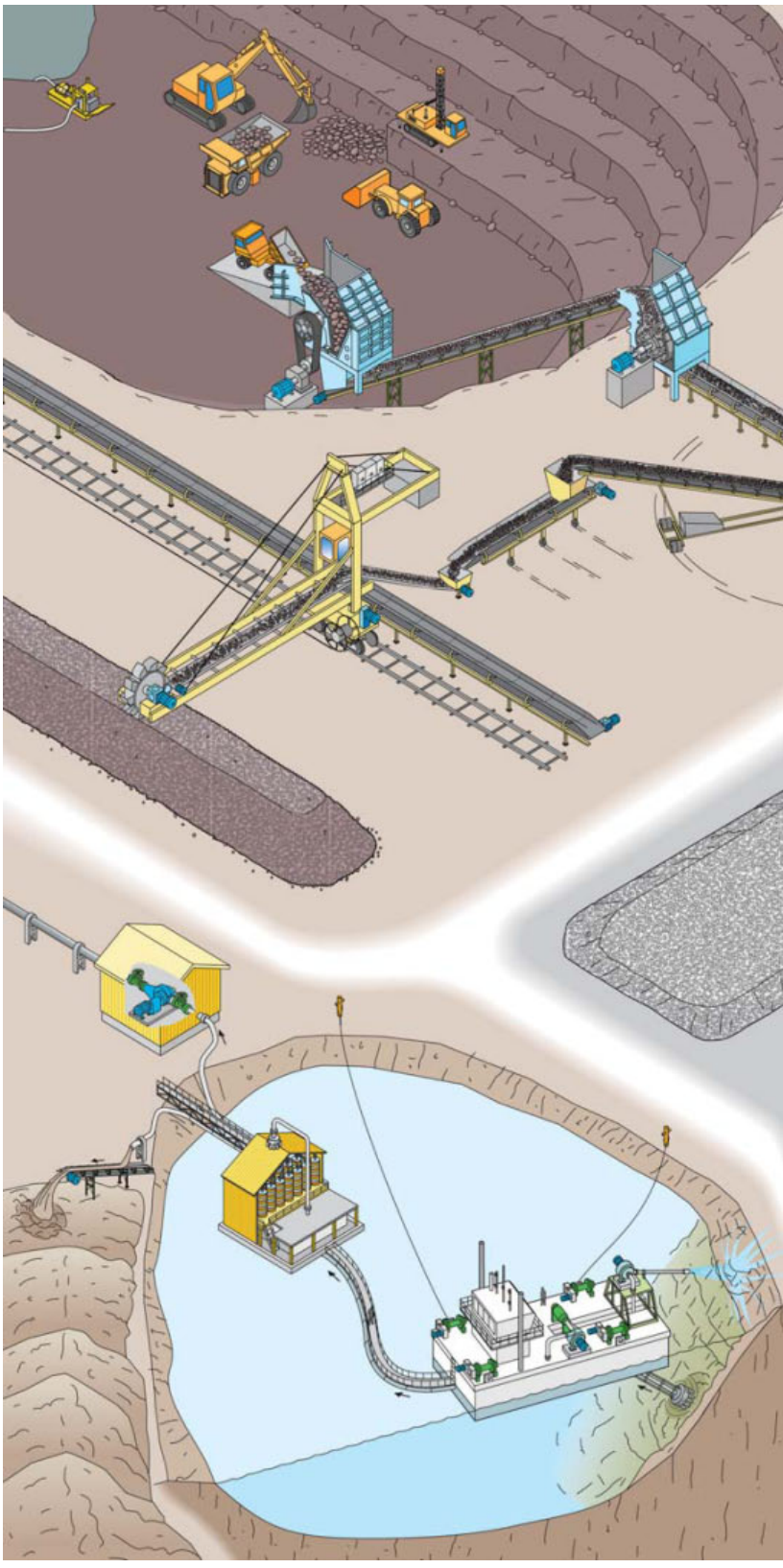
- Wide product range from switches and breakers to complete automation systems
- Versatile services from technical support to plant engineering
- Global presence and local support in over 100 countries

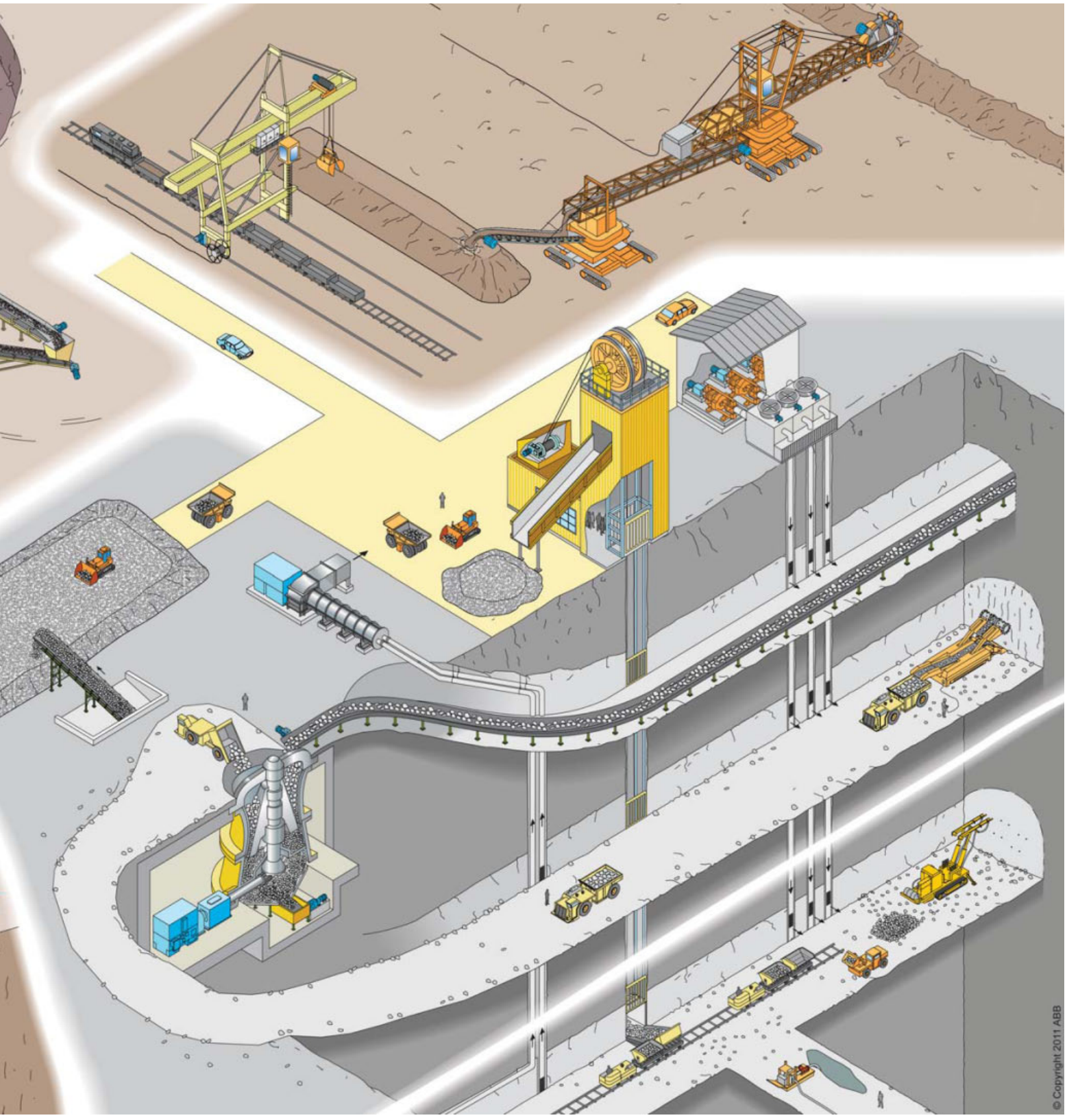
Variable-speed AC drives help control productivity costs and reduce energy use

From surface to underground mining, there are hundreds of motor-driven applications that benefit from the speed and/or torque control offered by variable-speed AC drives. The ever stricter targets to improve productivity and reduce energy costs are often the main reasons for selecting drives. The benefits include:

- High uptime
- Unrivalled energy efficiency
- Extended machinery lifetime
- Lower investment, installation, operational and maintenance costs
- Improved safety and comfortable working environment

Whether pumps, fans, conveyors, compressors, drills, crushers or excavators, the following pages highlight the main benefits that can be easily attained using ABB low voltage AC drives.

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Drills
Extended drill lifetime with lower energy use and environmental impact

ABB drives provide the high-accuracy speed and torque control demanded by drilling operations.

Ever stricter environmental regulations are forcing mining companies to find more energy-efficient and environmentally friendlier drilling techniques. Furthermore, the varying soil quality requires a drill motor that is able to adjust its speed continuously.

Low voltage AC drives help meet these challenges. The drive controls the drill motor speed, ensuring the correct drilling impact is achieved for the particular soil quality. Because the motor speed is raised or lowered depending on the type of soil, the energy use is considerably reduced compared to that of hydraulic or pneumatic drilling systems. Environmental impact is lower by avoiding hydraulic liquids or compressed-air.

Reasons to select an ABB drive

Feature	Advantage	Benefit
Soft starting and reversing of motor	Elimination of high starting currents and reduced mechanical stress during starting and reversing.	Savings through smaller cables and supply switchgear. Considerable maintenance savings and increased productivity. Prolonged drill lifetime.
Variable motor speed control	Drill motor speed can be optimized according to soil quality. Minimized wear and tear of the drill.	Extended drill lifetime, lower operational and maintenance costs.
Dynamic torque regulation	Reduced mechanical stress caused by high torque peaks. High torque during start and operation if required.	Less maintenance and lower costs. High uptime and increased productivity.
Using electrical motor instead of hydraulic or pneumatic motor	No need for hydraulic liquids or compressed-air. Reduced noise levels.	Considerably lower energy bill. Reduced environmental impact due to elimination of liquid use. Maintenance-free solution. Safer and more comfortable working environment.
High power factor	Lower reactive power consumption and reduced need for compensation equipment compared to other control methods.	Lower installation costs and substantial energy savings.
Permanent magnet motor speed control	Ability to use simple and robust gearboxes.	Savings in investment, installation, operational and maintenance costs.

Compressors
Maintaining air pressure at desired level with high energy efficiency and minimal maintenance

Photo: Atlas Copco

ABB drives help maintain stable compressor speed regardless of load.

Pipe bursts caused by variations in air pressure and wasted energy through air leakages are the top two challenges with most compressor applications.

Using low voltage AC drives to control the compressor motor speed offers the most energy-efficient solution available to maintain constant air pressure in the pipe line, with remarkably reduced air leakages. Other benefits of AC drives include reduced mechanical stresses and prolonged lifetime of compressor and the entire air pipe system.

Reasons to select an ABB drive

Feature	Advantage	Benefit
Soft starting and stopping	Avoids excessively high air pressures, minimizing mechanical stresses.	Prolonged lifetime of compressor and compressed-air pipes. Savings in maintenance costs.
	Elimination of high starting currents and reduced mechanical stress during starting and stopping.	Savings through smaller sized cables and supply switchgear.
Accurate speed regulation	Air pressure is maintained at desired level. Elimination of pressure variations. Minimized losses caused by air leakages.	Substantially lower energy use.
Dynamic torque regulation	Full torque that can be precisely controlled throughout entire speed range. Elimination of torque peaks. Enables high starting torque.	Less maintenance and lower cost. Longer lifetime of compressor and compressed-air pipes. High uptime and increased throughput.
Jump-over of critical frequencies	Speeds causing mechanical resonance are automatically skipped.	Prolonged compressor lifetime, considerable cost savings.
PID control included in the drive	No need for external PID controller for pressure control.	Elimination of costs for additional components.
High power factor	Lower reactive power consumption and reduced need for compensation equipment compared to other control methods.	Lower installation costs and substantial energy savings.
Permanent magnet motor speed control	Elimination of gearbox.	Savings in investment, installation, operational and maintenance costs.
Flexible user interface	Easy connection to any automation system through multiple fieldbus adapters.	Reduced installation and programming costs.

Crushers
Uninterrupted throughput with reduced mechanical stress

ABB drives help relieve the enormous stress placed on stone crushers.

Crushing large rocks causes considerable mechanical stress on the crusher and the motor. Prolonging the lifetime of the equipment and maximizing the uptime is easily achieved by controlling the speed and torque of the crusher motor by means of a low voltage AC drive.

Reasons to select an ABB drive

Feature	Advantage	Benefit
Soft starting and reversing of motor	Lower starting currents and reduced mechanical stress during starting.	Savings through smaller sized cables and supply switchgear.
	Elimination of voltage fluctuations in supply network.	Less disturbances caused to various machines and equipment, minimized downtime.
	Minimized wear and tear of mechanics, means improved reliability and prolonged crusher lifetime.	Considerable maintenance savings and increased productivity.
	Smooth reversing in case of blocked crusher.	High uptime of crusher and consistent production.
Accurate speed regulation	Optimization of crusher speed and smooth change of direction of rotation.	Reduced operational and maintenance costs compared to slip-ring motor solutions.
Dynamic torque regulation	Reduced mechanical stress caused by high torque peaks.	Less maintenance and lower costs.
	High torque during start and operation if required.	High uptime and increased throughput.
Synchronizing of double motors	Equal distribution of load between both motors and elimination of undesirable dynamic effects.	Reduced maintenance costs.
High power factor	Lower reactive power consumption and reduced need for compensation equipment compared to other control methods.	Lower installation costs and substantial energy savings.

Drives in action

Mobile mineral crusher powered entirely by ABB

One of the world's largest mobile mineral crushers, located in Australia, uses electrical control and distribution systems from ABB. Constructed by Mining Machinery Development Ltd (MMD) of Derby, UK, the 19,400 tons track-mounted machine is designed for a throughput of 11,000 tons per hour.

The mobile crusher is completely electrically driven and can be supplied with power either from a 4 MW, 6.6 kV umbilical cable up to one kilometer long or from a generator.

The various components of the crusher are all powered by ABB multidrives and motors – two 575 hp (430 kW) brake motors with propelling inverters; two 575 hp (430 kW) inverters for the crusher; two 575 hp (430 kW) motors and inverters for the apron feeder; one 575 hp (430 kW) brake motor and inverter for the discharge conveyor; one 350 hp (250 kW) inverter for the transfer conveyor; and a 125 hp (90 kW) inverter for the hydraulic pump.

In addition to inverter units, an ABB multidrive incorporates an inverter supply unit to give a regenerative capability, used to brake the machine and allow it to move up and down inclines of up to 10 degrees as well as allow the discharge conveyor to carry material downward without running overspeed.

Excavators
Energy-efficient and optimized excavator operation

ABB drives contribute towards a higher level of productivity, lower operating costs and less maintenance.

The operation of the excavator needs to be adapted according to the varying quality of the overburden. In addition, voltage fluctuations in weak supply networks can jeopardize the excavator's operation, leading to unplanned production downtime.

Using low voltage AC drives to control the excavator's travel, slew, excavation, dragging, conveying and hoisting functions, allows the entire operation to be adjusted to match the overburden requirements.

The use of a drive results in lower energy use and less wear on the excavator's motors and mechanical parts. Soft starting of various motors eliminates high starting currents and reduces mechanical stresses on the motors and machines.

Reasons to select an ABB drive

Feature	Advantage	Benefit
Soft starting, stopping and reversing of motor	Elimination of high starting currents and reduced mechanical stress during starting, stopping and reversing.	Savings through smaller sized cables and supply switchgear. Prolonged excavator lifetime. Reduced maintenance costs.
	Easy manoeuvrability of excavator.	Improved working environment.
	No conveyor belt stretching, slipping or breaking.	Prolonged conveyor lifetime, reduced maintenance costs.
	Elimination of voltage fluctuations in supply network.	Less disturbances caused to various machines and equipment, minimizing downtime.
Variable motor speed control	Motors can be operated at crawling speed for removing large rocks in overburden. Bucket wheel and conveyor speeds can be optimized according to varying operational requirements.	Reduced energy consumption, lower operational and maintenance costs.
	Reduced noise level.	Safer and a more comfortable working environment.
Synchronizing of multiple motors	Equal distribution of load between motors and elimination of undesirable dynamic effects.	Less wear and tear, resulting in less maintenance and lower costs.
Dynamic torque regulation	Full torque that can be precisely controlled throughout entire speed range. Elimination of torque peaks. Enables high starting torque.	Less maintenance and lower cost. Longer lifetime for gearboxes and ropes. High uptime and increased throughput.
Regenerative braking	In draglines, braking energy generated when lowering bucket can be fed back into the electrical network.	Reduced energy bill.
High power factor	Lower reactive power consumption and reduced need for compensation equipment compared to other control methods.	Lower installation costs and substantial energy savings.
Electric motor and drive combination replaces diesel engine	Ability to use simple and robust gearboxes.	Reduced need for maintenance leading to lower maintenance costs.
	Reduced energy consumption.	Substantially lower energy bill.
Flexible user interface	Easy connection to any automation system through multiple fieldbus adapters.	Reduced installation and programming costs.
Hydraulic pump fitted with electric motor and drive	Can maintain hydraulic pressure exactly as desired and eliminate high pressure variations. Eliminate gearbox.	Reduced maintenance costs.

Conveyors and feeders
Prolonged belt lifetime and high uptime

ABB drives help protect conveyor belts from stretching, slipping and breaking.

Throughout the mining sector, numerous conveyors are used in demanding conditions, with the risk of belts stretching, slipping or breaking. Using low voltage AC drives protects the belts and other mechanical equipment by offering smooth and accurate control of the motor speed and torque.

The drives also ensure that the material feed on the conveyor belt is accurate and under continuous control.

Reasons to select an ABB drive

Feature	Advantage	Benefit
Soft starting and stopping	No belt stretching, slipping or breaking.	Prolonged conveyor lifetime, reduced maintenance costs.
Smooth reversing of direction of rotation	Easy maintenance in case of belt failure.	Minimized downtime, cost savings.
Accurate speed regulation	Optimization of conveyor speed. Reduced energy consumption.	Prolonged conveyor lifetime, lower operational and maintenance costs.
Synchronizing of multiple motors	Equal distribution of load between the motors and elimination of undesirable dynamic effects.	Less wear and tear, resulting in less maintenance and lower costs.
Regenerative braking	Braking energy is fed back into the plant electrical network.	Reduced energy bills.
Dynamic torque regulation	Enables high starting torque which can be precisely controlled at any time, yet preventing stretching, slipping and breaking of the belt.	Less maintenance and lower costs.

Drives in action

Overburden conveyor benefits from ABB drives

An overburden conveyor in the Czech Republic needed to be refurbished with some 37 ABB low voltage AC drives.

The conveyor system is divided into eight sections, with eight rail-mounted stations to accommodate the operating equipment. Each station has two steel structures, one to house the main low voltage AC drives and transformers and the other to house the switchgear and belt tension control system. The structures are provided with air conditioning to protect the equipment against dust and the wide variation in temperatures between summer and winter. The entire conveyor system is controlled from a single, central point, and the individual stations are unattended in normal operation.

Each station has up to four main motors of 675 hp (500 kW) to operate the conveyors, and two 100 hp (75 kW) motors for belt tensioning. The motor supply voltage is 690 V. Some 21 drives operate the main motors and 16 drives control the belt tensioning system.

Stacker-reclaimers and spreaders
Improved productivity through lower energy use and reduced downtime

ABB drives help secure efficient stacking and reclaiming, ensuring the required quality of the blended material.

Mining companies are faced with continuous pressures to reduce stacking and reclaiming times, lower operational and maintenance costs and maximize plant uptime.

Using AC drives for motor speed control ensures efficient stacking and reclaiming, substantially lower energy consumption compared to any other motor control method, reduced wear and tear and prolonged machine lifetime with improved uptime.

Reasons to select an ABB drive

Feature	Advantage	Benefit
Soft starting, stopping and reversing of motor	Elimination of high starting currents and reduced mechanical stress during starting, stopping and reversing.	Savings through smaller sized cables and supply switchgear.
	Easy manoeuvrability of machine.	Improved working environment.
	No conveyor belt stretching, slipping or breaking.	Prolonged conveyor lifetime, reduced maintenance costs.
	Elimination of voltage fluctuations in the supply network.	Less disturbances caused to various machines and equipment, minimized downtime.
Accurate speed regulation	Motors can be operated at crawling speed. Bucket wheel and conveyor speeds can be optimized according to varying operational requirements.	Reduced energy consumption, lower operational and maintenance costs.
	Speeds of all motors can be synchronized, enabling exact positioning of machine.	Increased productivity through substantial time savings.
	Reduced noise level.	Safer and a more comfortable working environment.
Dynamic torque regulation	Full torque that can be precisely controlled throughout entire speed range. Elimination of torque peaks.	Less maintenance and lower cost. Longer lifetime for gearboxes and ropes.
	Enables high starting torque.	High uptime and increased throughput.
Regenerative braking	Braking energy generated when lowering bucket wheel can be fed back into electrical network.	Reduced energy bill.
High power factor	Lower reactive power consumption and reduced need for compensation equipment compared to other control methods.	Lower installation costs and substantial energy savings.
Flexible user interface	Easy connection to any automation system through multiple fieldbus adapters.	Reduced installation and programming costs.
Electric motor and drive combination replaces diesel engine	Ability to use simple and robust gearboxes.	Reduced need for maintenance leading to lower maintenance costs.
	Reduced energy consumption.	Substantially lower energy bill.
Hydraulic pump fitted with electrical motor and drive	Can maintain hydraulic pressure exactly as desired and eliminate high pressure variations.	Reduced maintenance costs.
	Eliminate gearbox.	

Pumps
Efficient operation of pumps, pipes, joints and valves

Hundreds of pump types used at every stage of mining can benefit from ABB drives.

Pumping applications represent a significant opportunity for applying low voltage AC drives in new, as well as retrofit installations. The majority of pumping applications need to be controlled. It is unlikely that a pump will run continuously at a maximum flow.

Controlling the pump motor speed with an AC drive brings substantial energy savings compared to on/off control, throttling or any other control method. Another major benefit offered by AC drives is the elimination of pressure peaks in pipe lines due to soft starting.

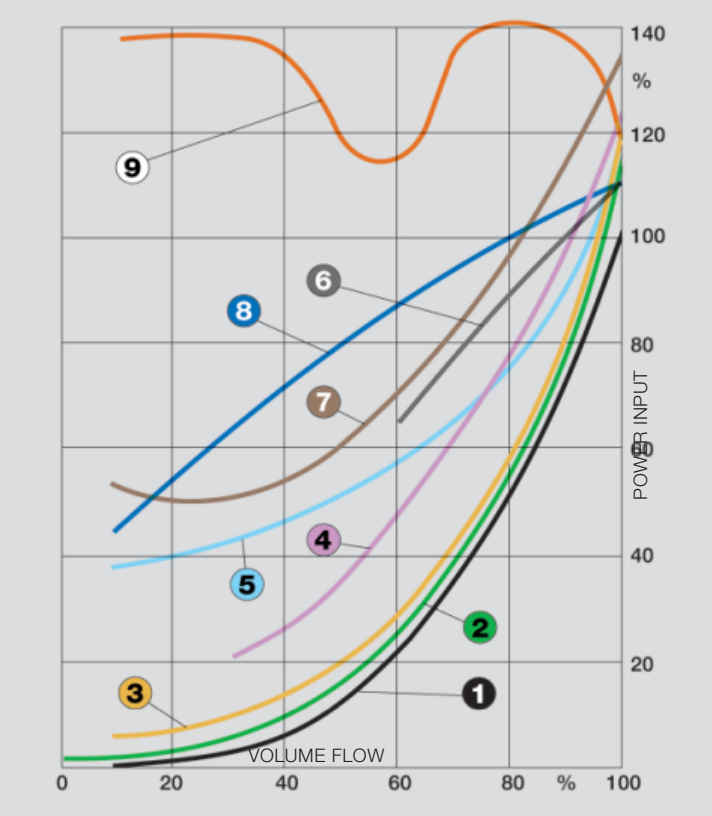
Reasons to select an ABB drive

Feature	Advantage	Benefit
Soft starting	Avoids excessively high water pressures, minimizing mechanical stresses. Soft pipe fill without pressure peaks. Elimination of high starting currents and reduced mechanical stress during starting.	Maximized pump run time and savings in maintenance costs. Prolonged lifetime of pumps, pipes, joints and valves. Savings through smaller sized cables and supply switchgear.
Accurate speed control of pump motor	Flow rate varies according to process requirements.	Low maintenance costs. Substantially lower energy use.
PID control included in the drive	No need for external PID controller for flow or pressure control.	Elimination of costs for additional components.
High power factor	Lower reactive power consumption and reduced need for compensation equipment compared to other control methods.	Lower installation costs and substantial energy savings.
Flexible user interface	Easy connection to any automation system through multiple fieldbus adapters.	Reduced installation and programming costs.
Jump-over of critical frequencies	Speeds causing mechanical resonance are automatically skipped.	Prolonged pump lifetime, considerable cost savings.

Fans
Precise air flow with minimized energy consumption

In underground mines, there is a need for precise control of the air flow. This is valid for both the fresh air and the gases produced during the mining operation. Accurate control of the air flow has a key role in securing worker safety and comfortable working environment. As to energy consumption, fans are the biggest source of energy saving, provided that they are efficiently controlled.

The most accurate control of the air flow is achieved by controlling the speed of the fan motors by low voltage AC drives. ABB drives, incorporating direct torque control (DTC), provide excellent speed control plus have a wide variety of features suited to fan applications. Controlling the fan speed with AC drives is the most energy-efficient control method, ensuring significant energy savings compared to any other control technique.



Energy consumption of fan installations with different control methods. 1. Required fan power 2. Speed control by AC drive (both for centrifugal and axial-flow fans) 3. Variable pitch angle (for axial fans only) 4. Fluid coupling (slip control) 5. Inlet vane control (for centrifugal fans with backward-curved impeller) 6. By-pass control (for axial fans) 7. Damper control (for centrifugal fans with forward-curved impeller) 8. Damper control (for centrifugal fans with backward-curved impeller) 9. Damper control (for axial fans)

Reasons to select an ABB drive

Feature	Advantage	Benefit
Accurate speed control of fan motor	Air flow rate varies according to ventilation need. Lower fan noise level. Prolonged fan lifetime. Reduced energy consumption.	Safer and a more comfortable working environment. Savings in investment, operating and maintenance costs. Lower energy bill.
Soft starting	Elimination of high starting currents and reduced mechanical stress during starting. Avoids too high or low air pressures, minimizing mechanical stresses. Prolonged fan lifetime.	Savings through smaller sized cables and supply switchgear. Maximized fan run time and savings in maintenance costs.
High efficiency	Efficient use of electrical energy, ie, low power losses.	Reduced energy costs, improved environmental friendliness.
Flying start	Fans can be started when spinning.	Time savings through immediate starting and no need for braking.
Power loss ride-through	Uninterrupted operation of drive and motor in power failure situations, with no need to restart the drive when the supply voltage is restored.	Time savings.
Jump-over of critical frequencies	Speeds causing mechanical resonance are automatically skipped.	Prolonged fan lifetime, considerable cost savings.
High power factor	Lower reactive power consumption and reduced need for compensation equipment compared to other control methods.	Lower installation costs and substantial energy savings.

Cranes
Uninterrupted materials handling through safe and reliable crane movement control

ABB drives provide accuracy and stepless control throughout the entire speed and torque range, thereby increasing crane productivity.

Handling various materials using cranes needs to be efficient, continuous and safe to ensure maximum uptime of the mine.

Using low voltage AC drives with built-in crane control program for controlling all crane movements ensures uninterrupted, safe and reliable materials handling. Further benefits offered by AC drives include easy and accurate maneuverability of the crane, lower maintenance cost and extended crane lifetime.

Reasons to select an ABB drive

Feature	Advantage	Benefit
Soft starting, stopping and reversing of motor	Elimination of high starting currents and reduced mechanical stress during starting, stopping and reversing.	Savings through smaller sized cables and supply switchgear.
	Easy maneuverability of crane.	Improved working environment and productivity.
	Minimized wear of gearbox, wheels and ropes.	Prolonged crane lifetime, reduced maintenance costs.
	Elimination of voltage fluctuations in supply network.	Less disturbances caused to various machines and equipment, minimized downtime.
Using drive for controlling operation of mechanical brake	Simple, accurate and reliable mechanical brake control. Elimination of external brake control logic.	Enhanced safety. Lower investment cost.
Torque memory	Avoidance of load jerk when starting the motor and releasing brake, minimized wear of gearbox and other mechanics.	Enhanced safety. Lower maintenance costs.
Accurate speed and dynamic torque regulation	Motors can be accurately controlled in entire speed and torque range, including low and zero speeds.	Increased productivity through time savings. Enhanced safety.
Using drive for comparing actual motor speed with reference motor speed, including zero speed	Simple, accurate and reliable supervision of motor speed without external control devices.	Enhanced safety. Lower investment cost.
Using drive for overspeed protection	Simple, accurate and reliable protection against motor overspeeds without external control devices.	Enhanced safety. Lower investment cost.
Regenerative braking	Braking energy is fed back into electrical network. No need for braking resistors, no heat dissipation.	Lower energy bill. Cost savings.
Flexible user interface	Easy connection to any automation, control and supervision system.	Reduced installation and programming cost.
Predefined acceleration and deceleration ramps according to direction	Easy and accurate crane control ability.	Improved working environment, increased productivity.
Synchronizing of multiple motors	Equal distribution of load between motors connected to same gearbox, elimination of undesirable dynamic effects.	Less wear and tear, resulting in less maintenance and lower costs.

Winches
Constant belt and rope tension for prolonged equipment lifetime

ABB drives keep belt tension constant.

Belt stretching, slipping and breaking causes considerable downtime.

Using low voltage AC drives in winches to control the belt tension avoids breakages and prolongs the belt lifetime. AC drives replace traditional and costly hydraulic winch controllers, eliminating high maintenance costs and energy inefficiency while improving the overall system reliability. In addition, using an AC drive for winch control eliminates the pollution risk as no hydraulic liquids are needed.

Dredgers need to be accurately positioned to enable efficient and accurate dredging of minerals. Constant rope tension is essential for keeping the dredger firmly in desired position.

AC drives enable easy and accurate maneuverability of the dredger as well as precise positioning according to varying needs. Further benefits include reduced noise levels, lower energy and maintenance costs plus elimination of hydraulic liquid leakages.

Reasons to select an ABB drive

Feature	Advantage	Benefit
Soft starting, stopping and reversing of motor	Elimination of high starting currents and reduced mechanical stress during starting, stopping and reversing.	Savings through smaller sized cables and supply switchgear.
	Easy maneuverability of dredger.	Improved working environment.
	Minimized wear of gearbox, wheels, ropes and belts.	Prolonged lifetime of belts and ropes, reduced maintenance costs.
	Elimination of voltage fluctuations in supply network.	Less disturbances caused to various machines and equipment, minimized downtime.
Using drive for torque control to keep rope and belt tension desired	No need for external tension measuring devices, reduced maintenance.	Lower investment and maintenance costs.
Using drive for overload protection	Prevention of rope breakage.	Enhanced safety, reduced maintenance costs.
Accurate speed and dynamic torque regulation	Smooth moving of the dredger to a new position.	Increased productivity.
Automatic belt and rope tension control to keep tension desired	Prolonged belt and rope lifetime, reduced need for maintenance.	Time saving, reduced maintenance costs.
Accurate open-loop motor control thanks to DTC (direct torque control)	Elimination of external motor encoder.	Lower investment and maintenance costs.
Using drive for controlling operation of mechanical brake	Simple, accurate and reliable mechanical brake control. Elimination of external control logic.	Enhanced safety. Lower investment cost.
Electric motor and drive combination replaces hydraulic control system	Ability to use simple and robust gearboxes, no hydraulic liquids needed. Reduced energy use.	Elimination of pollution risk. Investment cost savings. Lower energy bill.

Mine hoists
Enhanced safety and high reliability for improving mine productivity

ABB drives provide smooth and accurate hoist operation.

Gearbox failures, wear and tear of ropes and hoist mechanics as well as energy inefficiency have a negative impact on the mine's profitability and safety.

Using low voltage AC drives for varying the speed of hoist motors provides smooth and accurate hoist operation throughout the entire speed range. Further benefits include excellent energy efficiency, enhanced safety, prolonged equipment lifetime and reduced maintenance cost.

Reasons to select an ABB drive

Feature	Advantage	Benefit
Soft starting, stopping and reversing of motor	Elimination of high starting currents and reduced mechanical stress during starting, stopping and reversing. Minimized wear of gearbox, wheels and ropes. Elimination of voltage fluctuations in supply network.	Savings through smaller sized cables and supply switchgear. Prolonged hoist lifetime, reduced maintenance costs. Less disturbances caused to various machines and equipment, minimized downtime.
Using drive for controlling operation of mechanical brake	Simple, accurate and reliable mechanical brake control.	Enhanced safety.
Accurate speed regulation	Optimization of hoist speed. Reduced energy consumption.	Prolonged hoist lifetime. Lower operational costs.
Dynamic torque regulation	Full torque that can be precisely controlled throughout entire speed range. Enables high starting torque.	Less maintenance and lower cost. Longer lifetime for gearboxes, ropes and wheels. High uptime and increased throughput.
Synchronizing of multiple motors	Equal distribution of load between the motors and elimination of undesirable dynamic effects.	Less wear and tear, resulting in less maintenance and lower costs.
High power factor	Lower reactive power consumption and reduced need for compensation equipment compared to other control methods.	Lower installation costs and substantial energy savings.
Regenerative braking	Braking energy is fed back into plant electrical network.	Lower energy bill.
Flexible user interface	Easy connection to any automation system through multiple fieldbus adapters.	Reduced installation and programming costs.
Permanent magnet motor speed control	Ability to use simple and robust gearboxes.	Savings in investment, installation, operational and maintenance costs.

Trucks and loaders
Reduced fuel consumption and higher production efficiency

Increasing fuel prices and growing pressures to limit exhaust gas emissions are forcing mining companies to find alternatives for conventional trucks and loaders with mechanical transmission systems.

Using AC induction motors and low voltage AC drives to haul trucks and loaders and to control the movement of truck decks and loader buckets enables faster driving speed, lower fuel consumption, minimized need for maintenance as well as reduced noise levels and gas emissions. AC drives help improve the maneuverability of the vehicles. Electricity needed to rotate AC motors is produced with a diesel generator.

ABB drives improve the maneuverability of trucks and loaders, lower fuel consumption and minimize maintenance costs.

Reasons to select an ABB drive

Feature	Advantage	Benefit
Smooth speed-up, slow-down and reversing of motor	Easy maneuverability of vehicle. Minimized wear and tear of the mechanics, means improved reliability and prolonged equipment lifetime.	Improved working environment. Considerable maintenance savings and increased productivity.
Accurate speed regulation	High speed on climbing and high top speed when driving on flat.	Increased production efficiency.
Dynamic torque regulation	Full torque throughout entire speed range if required. Minimized mechanical stress due to smooth speed-up, slow-down and reversing of motor.	Less maintenance and lower costs. High uptime and increased productivity.
Electric motor and drive combination replaces diesel engine	Ability to use simple and robust gearboxes. Variable motor speed control with full torque throughout entire speed range. Diesel generator can be rotated at constant speed.	Reduced need for maintenance leading to lower maintenance costs. Lower fuel consumption. Reduced noise of diesel engine. Lower gas emissions.
Hydraulic pump fitted with electric motor and drive combination to control movement of truck deck and loader bucket	Can maintain hydraulic pressure exactly as desired and eliminate high pressure variations. Eliminate gear box. Variable motor speed control with full torque to maintain hydraulic pressure as desired.	Reduced maintenance costs. Lower fuel consumption.
Electrical braking	Smooth braking, minimized wear of mechanical brake.	Reduced maintenance costs.
Flexible user interface	The drive is easy to connect into the vehicle control system.	Reduced installation and programming costs.

Locomotives and trains
Safe and environmentally friendly materials transportation

ABB drives offer easy maneuverability and high energy efficiency in mine locomotives and trains.

The ever stringent safety requirements, type of transported material, amount of load, driving conditions and track profile set different challenges on operating mine trains. The importance of energy efficiency and healthy working environment is becoming more significant.

Using low voltage AC drives for controlling the speed of locomotive and train motors brings flexible train operation irrespective of load and environmental factors. Further benefits include safe and comfortable working conditions, lower energy bill and reduced maintenance costs.

Reasons to select an ABB drive

Feature	Advantage	Benefit
Smooth speed-up, slow-down and reversing of motor	Easy maneuverability of vehicle. Minimized wear and tear of mechanics, means improved reliability and prolonged equipment lifetime. Lower starting currents and reduced mechanical stress during starting. Elimination of voltage fluctuations in supply network.	Improved working environment. Considerable maintenance savings and increased productivity. Savings through smaller sized cables and supply switchgear. Less disturbances caused to various machines and equipment, minimized downtime.
Accurate speed regulation	Optimization of vehicle speed according to type and amount of load, driving conditions and track profile.	Enhanced safety, increased productivity.
Dynamic torque regulation	Full torque throughout entire speed range if required. Minimized mechanical stress due to smooth speed-up, slow-down and reversing of motor.	Less maintenance and lower costs. High uptime and increased productivity.
Regenerative braking	Braking energy is fed back into plant electrical network.	Lower energy bill.
Electric motor and drive combination replaces diesel engine	Ability to use simple and robust gearboxes. Variable motor speed control with full torque throughout entire speed range.	Reduced need for maintenance leading to lower maintenance costs. Lower energy bill. Reduced noise level. Elimination of gas emissions.
Synchronizing of multiple motors	Equal distribution of load between the motors and elimination of undesirable dynamic effects.	Less wear and tear, resulting in less maintenance and lower costs.
Permanent magnet motor speed control	Ability to use simple and robust gearboxes.	Savings in investment, installation, operational and maintenance costs.
High power factor	Lower reactive power consumption and reduced need for compensation equipment compared to other control methods.	Lower installation costs and substantial energy savings.
Flexible user interface	Easy connection to any automation system through multiple fieldbus adapters.	Reduced installation and programming costs.

ABB drives - reliable, safe and energy-efficient

ABB drives bring together a world leading and recognized brand which has carved a niche as a global number one supplier for AC and DC drives together with a product range from 0.25 hp to 130,000 hp that is simply the widest available from any manufacturer.

High reliability

- ABB has over 30 years‘ experience in engineering and supplying AC and DC drives to the mining sector
- During manufacture, every ABB drive undergoes thorough tests and checks before delivery

Enhanced safety

- Drive safety functions, such as safe torque-off, are certified according to SIL2 and PLd (Cat. 3)
- Optimized drive cooling system and components that are proven and tested in full-load operating conditions
- ATEX and IECEx-certified drive and motor packages available
- Adjustable current and torque limits in the drive firmware to give extra protection to the driven machine

Unrivalled energy efficiency

- Operating electric motors with variable-speed drives, instead of using constant-speed motors, saves 20 to 60 percent in energy consumption depending on the application, load and speed
- Lower reactive power consumption
- High efficiency of 98 percent
- Minimized need for air conditioning in electrical rooms

Flexible customer interface

- Easy connection to automation systems:
  - several fieldbus protocols available
  - same application program for a wide power range
- Drive’s input and output signals can be used as they are, or modified depending on the application
- Parameter setting is extremely easy to use and understand
- Easy-to-use PC tools for drive programming and monitoring

Superior control accuracy and high dynamics

- The world leading motor control method, direct torque control (DTC), ensures extremely high control accuracy
- DTC behavior in abnormal situations is excellent, ie,
  - short supply voltage breakdown
  - heavy variations of torque
  - motor already rotating
  - cable short-circuits

Maximized uptime

- Preventive maintenance to avoid unplanned downtime
- Short repair time to minimize production losses
- Alarms before malfunction
- Drive diagnostics to help personnel locate any faults

ABB industrial drives, ACS800 and ACS880

ABB industrial drives provide scalable motor control from the standard to the demanding applications found within the mining industry. A wide voltage and power range with various drive configurations and options enables one drive platform to be used for all needs.

ACS800 single drives - 0.75 to 7,500 hp, 0.55 to 5,600 kW
Single drives are available as wall-mounted, free-standing and cabinet-built constructions, providing standalone solutions for scalable motor control. Protection is to at least IP21, with higher protection classes available.

A wall-mounted regenerative drive comes with LCL line filters and EMC filters built inside the drive. The wall-mounted low harmonic drive fulfills the strictest harmonic requirements without the need for external filtering devices or multi-phase transformers.

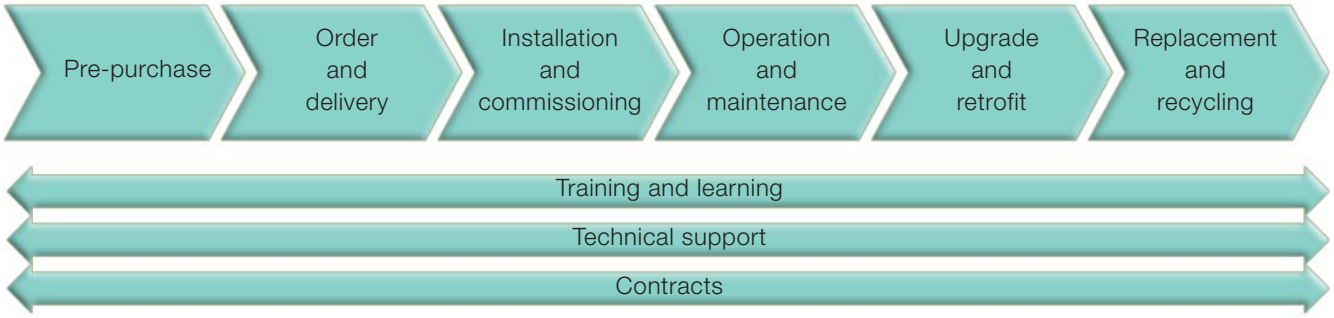
A cabinet-built liquid-cooled regenerative version is also available as is a cabinet-built low harmonic drive. ABB also manufacture a cabinet-built liquid-cooled low harmonic drive.

ACS800 modules - 0.75 to 2,500 hp, 0.55 to 1900 kW
Drive modules enable machine builders, system integrators and panel builders to build their own drive solutions while benefitting from ABB's support, drives technology and a wide range of options. ABB industrial drive modules include everything that is required for a complete drive. For example, a built-in harmonic filtering choke comes as standard. There is also a wide selection of built-in options such as EMC filtering and different I/O and communication options. In addition to these a selection of external accessories is also available. All the modules can be mounted side-by-side.

ACS800 multidrives - 2 to 7,500 hp, 1.5 to 5,600 kW
Multidrives control multiple motors from a single cabinet. The common DC bus is used to supply the drive modules with DC power. The DC power is derived from a single supply unit built into the same installation. This construction simplifies the total installation and results in cabling savings, reduced installation and maintenance costs and lower line currents.

ACS880 single drives - 0.75 to 350 hp, 0.55 to 250 kW
This new generation of ABB industrial drives provides standalone solutions for scalable motor control. The drives come with new intuitive user interfaces and many new features that simplify operation and help optimize processes.

Expertise at every stage of the value chain



The services offered for ABB low voltage drives span the entire value chain, from the moment a customer makes the first enquiry through to disposal and recycling of the drive. Throughout the value chain, ABB provides training and learning, technical support and contracts. All of this is supported by one of the most extensive global drive sales and service networks.

Pre-purchase

ABB provides a range of services that help guide the customers to the right products for their applications. Examples of services include correct drive selection and dimensioning, energy appraisal, harmonic survey and EMC assessment.

Order and delivery

Orders can be placed through any ABB office or through third party channel companies. Orders can be placed and tracked online.

ABB's sales and services network offers timely deliveries including express delivery.

Installation and commissioning

While many customers have the resources to undertake installation and commissioning on their own, ABB and its third party channel companies are available to advise or undertake the entire drive installation and commissioning.

Operation and maintenance

Through remote monitoring, ABB can guide the customer through a fast and efficient fault-finding procedure as well as analyze the operation of the drive and the customer's process. From maintenance assessment to preventive maintenance and reconditioning of drives, ABB has all the options covered to keep its customers' processes operational.

Should corrective maintenance of drives be needed, ABB offers on-site and workshop repair, fully backed up by the most extensive spare holding.

Upgrade and retrofit

An existing ABB drive can often be upgraded to the latest software or hardware to improve the performance of the application.

Existing processes can be economically modernized by retrofitting the latest drive technology to mechanical control equipment, such as inlet guide vanes or dampers or older generations of drives.

Instead of replacing an entire drive or drive system, it is often more economical to modernize the old installation by reusing all relevant parts of the original equipment and purchasing new where necessary.

Replacement and recycling

ABB can advise on the best replacement drive while ensuring that the existing drive is disposed in a way that meets all local environmental regulations.

Entire value chain services

The main services available throughout the value chain include:

- Training and learning – ABB offers product and application training in classrooms and on the Internet.
- Technical support – At each stage of the value chain, an ABB expert is available to offer advice to keep the customer's process or plant operational.
- Contracts – Drive care contracts and other types of agreements, from individual services through to complete drive care covering all repairs and even drive replacements, are available.

Secure uptime throughout the drive life cycle

ABB follows a four-phase model for the life cycle management of its drives. The life cycle phases are active, classic, limited and obsolete. Within each phase, every drive series has a defined set of services.

Examples of individual services are drive selection and dimensioning, installation and commissioning, preventive and corrective maintenance, remote monitoring and intelligent diagnostics, technical support, upgrade and retrofit, replacement and recycling plus training and learning.

In the active phase the drive is in serial production. The drive, with complete life cycle services, is available for purchase.

In the classic phase, the serial production of the drive has ended. The drive, with complete life cycle services, is available for plant extensions.

In the limited phase, the drive is no longer available. The life cycle services are limited. Spare parts as well as maintenance and repair services are available as long as materials can be obtained.

In the obsolete phase, the drive is not available. ABB cannot guarantee availability of services for technical reasons or within reasonable cost.

To ensure the availability of complete life cycle services, ABB recommends that a drive is kept in the active or classic phase by upgrading, retrofitting or replacing.

In the classic phase ABB carries out an annual review for each drive life cycle plan. Should any changes to the availability or duration of the services be necessary, ABB gives a life cycle announcement indicating eventual change of life cycle phase and/or any change in the duration of services.

In the limited phase, ABB issues a life cycle phase change announcement, half a year prior to shifting the product into the obsolete phase.

Maximizing return on investment

The four-phase drive life cycle management model provides customers with a transparent method for managing their investment in drives. In each phase, customers clearly see what life cycle services are available, and more importantly, what services are not available. Decisions on upgrading, retrofitting or replacing drives can be made with confidence.

ABB drive life cycle management model

Active	Classic	Limited	Obsolete
The drive, with complete life cycle services, is available for purchase.	The drive, with complete life cycle services, is available for plant extensions.	Spare parts, maintenance and repair services are available as long as materials can be obtained.	ABB cannot guarantee availability of services for technical reasons or within reasonable cost.

Complete life cycle services — **Limited life cycle services**

To ensure the availability of complete services, a drive must be in the active or classic phase. A drive can be kept in the active or classic phase by upgrading, retrofitting or replacing.

Caution! A drive entering the limited or obsolete phase has limited repair options. This may result in unpredictable process downtime. To avoid this possibility, the drive should be kept in the active or classic phase.

Expertise that matches the challenges

ABB has amassed a wealth of knowledge and expertise on all aspects of drive systems throughout the mining sector. ABB has dedicated experts who understand motor-driven mining applications; talk your language; and can offer the quickest route to a profitable solution, without forgetting personnel safety and environmental responsibility.

Leading technology in design and production

For over 100 years, ABB has consistently invested a large proportion of its turnover in research and development, working closely with some of the world's leading universities and institutions. The result is the most advanced range of low voltage AC drives in the market, designed to meet the specific needs of various mining applications. This has also lead to several patents for leading edge technology within ABB drives.

ABB's reputation is further enhanced through its work with world leading authorities and legislative bodies. This cooperation contributes to the safety of ABB's products and thus the personal safety of the users.

Cooperating with its sub-suppliers, ABB can exploit the latest component technology when designing its drive products. This results in improved quality of ABB's drive products and in enhanced component quality.

ABB's drive manufacturing facilities are equipped with the most modern assembly lines using the latest production techniques and advanced software. Precision robots combined with fully automated material flow and testing routines guarantee high quality of products and short throughput times.

Product reliability is further enhanced through stringent quality control procedures with all manufacturing facilities operating to ISO 9001. Identical manufacturing facilities are located in Finland, the USA, China and India.

Access to authoritative technical advice

ABB constantly monitors all legislation, regulations, directives and standards, not only ensuring that its products comply but by offering sound advice to customers. Examples of directives guiding the design and use of AC drives are the European EMC (electromagnetic compatibility) directive and the low voltage directive. The IEC regularly publish regulations as does the European Union. ATEX, for example, is the European regulation which is mandatory from July 2003 and covers equipment intended for use in potentially explosive atmospheres. ABB is one of the first companies to gain blanket ATEX certification for its ABB industrial drives and flameproof and non-sparking motors, for use in hazardous areas. By gaining the blanket certification, ABB can provide combined ATEX-approved drives and motors packages that do not need further testing on site.

ABB's expertise extends throughout a mining operations entire electrical installation. ABB's engineers can advise on the correct selection, dimensioning, installation, operation and maintenance of drives, motors, transformers, relays, switches, contactors through to transducers and meters.Advice is available on long cabling, weak networks, protection functions, harmonics, EMC, power factor correction, mounting options and air flow requirements.

Using harmonic filters developed by ABB eliminates the severe plant disruptions caused by harmonic disturbances in electrical equipment. ABB offers proven ways to assess your vulnerability to harmonic problems and your need for filters.

Throughout mining, the consumption of inductive reactive power is significant. Reactive power compensation equipment offered by ABB helps minimize the amount of reactive power.

In many applications there is a need to interface the drives with external systems. ABB has the expertise in all high performance communication protocols including PROFIBUS DP, Devicenet, CANopen and Modbus fieldbus.

Sustainable development for people and the environment

The mining industry is a big energy user and as such is a major contributor to the emission of greenhouse gases.

Replacing fixed speed motors with AC drives can significantly reduce the energy consumed and the greenhouse gas emissions generated. ABB has the expertise and tools, such as its energy appraisal, to quickly identify which motor-driven applications can benefit.

A replacement drive scheme is available for upgrading older, inefficient drives for new, space saving and highly efficient versions. Following an assessment of a plant, ABB helps select a replacement drive with improved efficiency and features relevant to the application.

In some countries, ABB is able to remove and dispose of the redundant drives, in accordance with the latest world standards and regardless of the original manufacturer. ABB's commitment to the environment means that old drives are recycled whenever possible. All new products, even the packaging, are designed for recycling.

The ISO 14001, international environmental management standard, is implemented, with the Finland factory certified since 1996. Life Cycle Assessment (LCA) is applied continually to all product development. All certificates and declarations relating to environmental issues can be found at www.abb.com/drives.

The mining industry, by its nature, is challenging and accordingly ABB operates to the highest standard of occupational health and safety excellence and remains constantly vigilant in carrying out its duty of care. ABB's combined efforts and commitment allows it to achieve a continuing improvement in its safety record.

ABB - your partner throughout the mining sector

ABB is a world leading provider of electrical, automation and instrumentation products and systems to the mining industry. Here is a sample of what ABB offers.

Motors and generators

ABB supplies a wide range of motors and generators for every application. The robust and high efficiency designs meet many of the motor-driven application challenges and standards presented by the mining industry.

Measurement products

To operate any process efficiently, it is essential to accurately measure, record and control. ABB provides a huge range of measurement products that meet the needs of the mining sector ranging from level, temperature, flow and pressure to analyzers, controllers, recorders and valve automation.

Automation and control systems

To meet the increased demand for higher productivity, enhanced safety and a better mining environment, ABB offers automation solutions based on its System 800xA. Such a system takes full control of the mining processes; creates a better working environment; cuts infrastructure and maintenance costs; and increases operating hours and safety.

Based on its in-depth knowledge and experience of mining processes, ABB can act as a main contractor for complete mine automation systems.

Scalable automation solutions provide easy entry to benefit from next-generation automation products. A small, basic system can be rapidly extended into a fully integrated and optimized automation solution.

Existing ABB customers have access to a range of migration plans so they can easily move to modern, integrated process automation. Communication protocols such as OPC, PROFIBUS, Foundation Fieldbus, HART and Modbus bring easy, economical interfacing with a wide range of third-party products.

Electrification

ABB offers the broadest range of high, medium and low voltage equipment for switching and distributing electrical power to the plant, including emergency power generation and UPS, industrial sub-stations, harmonic correction equipment, switchgears and transformers.

Power transmission and distribution systems

ABB offers a complete portfolio of solutions, systems and equipment for the efficient transmission and distribution of electricity. Also available is a wide variety of services for network management.

Engineering

ABB uses an integrated team approach to produce professional engineering documentation, designing the electrical interfaces with its client's appointed consultants, engineers and mechanical and civil partners.

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