

The Siemens logo is displayed in a white box in the top left corner. It consists of the word "SIEMENS" in a bold, blue, sans-serif font.

SIEMENS

Ingenuity for life

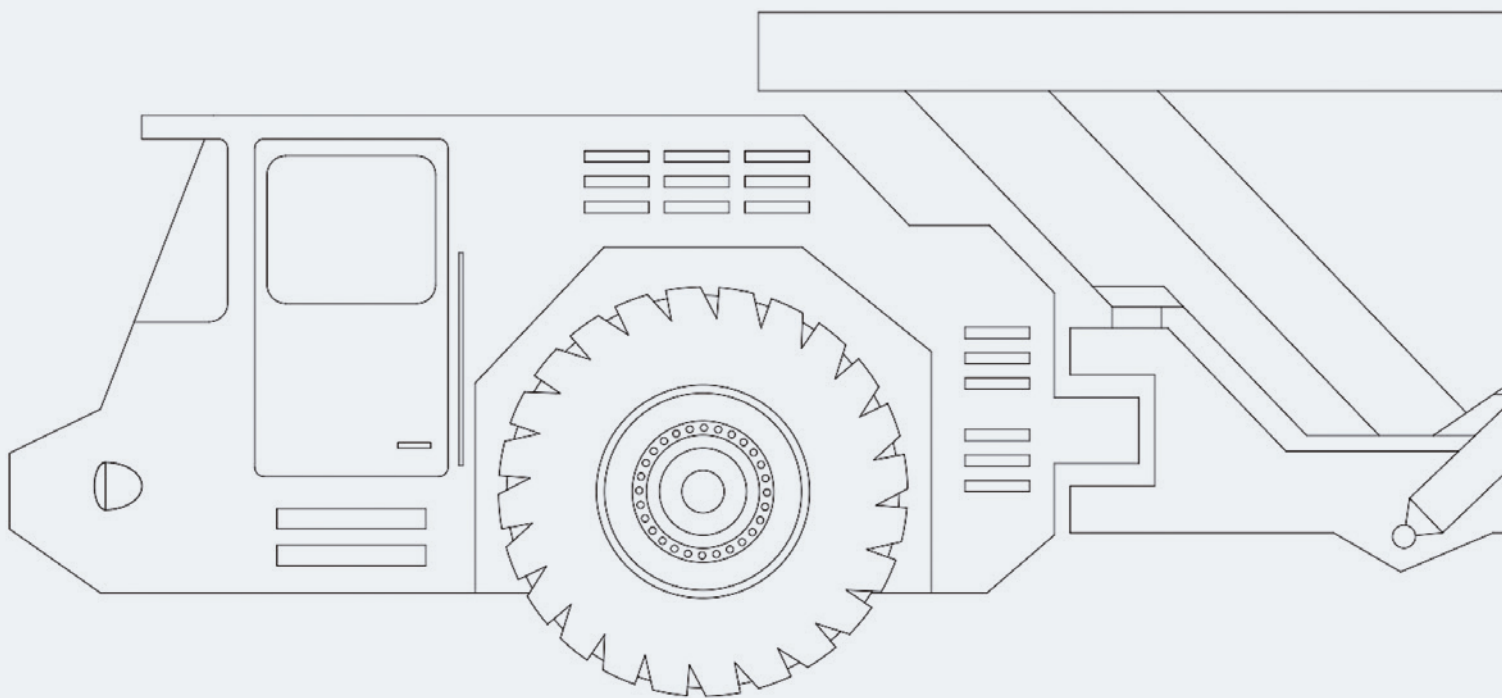
The background of the entire page is a photograph of a large red SIMINE underground truck in a dark mine. The truck is loaded with dark, rocky material. Its large, treaded tires and red body are prominent. The mine's rocky walls and ceiling are visible in the background, illuminated by some lights.

SIMINE Underground Truck

Maximizing transport productivity –
minimizing operating costs

[siemens.com/mobile-mining](https://www.siemens.com/mobile-mining)

Maximizing productivity – minimizing operating costs

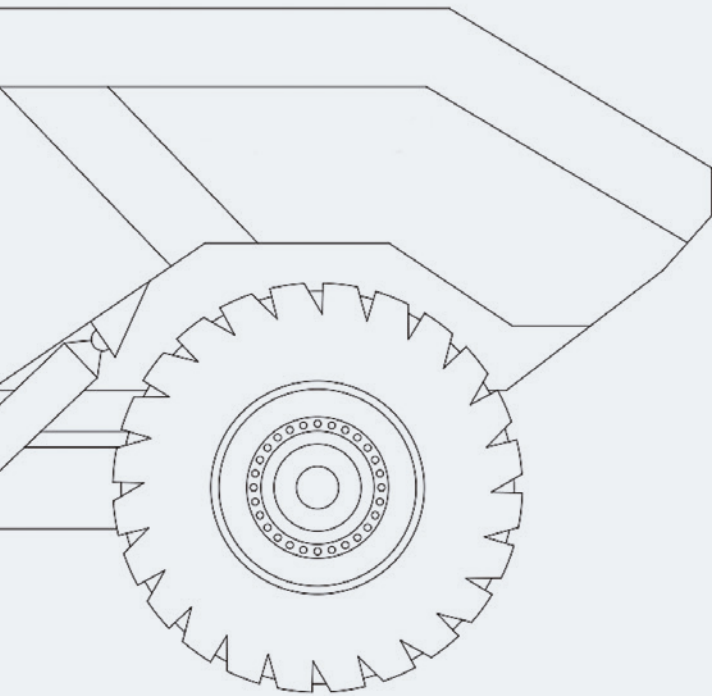


Your challenge:

Many underground mines are facing the challenge of how to maintain productivity as mine depth increases and the mineral grade of deposits decreases. The number of trucks per mine and the maximum power of diesel engines are also limited by mine layout and the required ventilation systems.

Our solution:

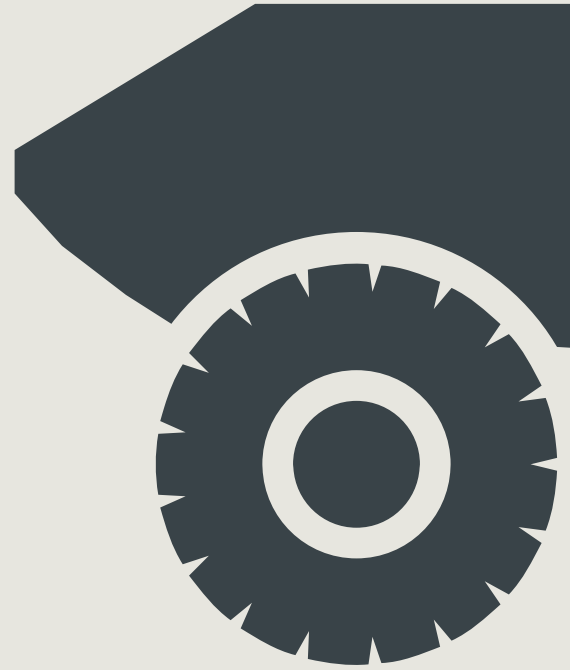
Machinery electrification is part of a strategy Siemens Mobile Mining specialists have come up with to heighten productivity in underground mines – and to improve conditions in underground mines themselves. To this end, Siemens Mobile Mining engineers are currently working on developing a portfolio of highly efficient electric drive systems for underground mining vehicles. At the heart of these systems are electric components that have been successfully used in a number of applications in the mining industry for many years now.



Good reasons for SIMINE UG Truck

- Higher productivity
- Environmentally friendly
- More favorable working conditions deep in the mine
- Reduced mine ventilation costs
- Better mine yield
- Higher speeds on grade
- Enhanced vehicle operation
- Less maintenance

SIMINE UG Truck drive system benefits



Higher productivity

Finding ways to make underground mine trucks work faster and more efficiently by using electric drive systems is an opportunity not only to save fuel costs, but also to increase productivity.

The typical duty cycle for a haul truck in an underground mine consists of loading bulk material in the mine, transporting it uphill to the unloading point, depositing it at the unloading point, usually at the surface, and driving the empty haul truck back to the loading point for another round. With faster speeds come shorter cycle times, which means that more material can be transported in a given time. Productivity is boosted in the process.

Environmentally friendly

Diesel-electric drives are more environmentally friendly because diesel engines run at a constant speed, thus cutting emissions from diesel exhausts.

Roaring engine noises are also a thing of the past. Furthermore, released energy can be harnessed and used for electric propulsion.

Higher speeds on grade

Trucks with diesel-electric drive systems are faster than diesel-mechanical trucks because the diesel-electric drive system has higher total efficiency. More power from the diesel engine is therefore used to propel the vehicle uphill, leading to higher speeds on grade.

Reduced mine ventilation costs

Enhanced use of electrical drive systems for underground haulage cuts mine ventilation costs significantly. This is extremely important as mine ventilation systems normally operate around the clock 365 days per year and account for 25% to 40% of a mine operation's total energy costs.



Enhanced vehicle operation

Electric power means easy and smooth start/stop operations with less operator strain thanks to precise torque control. Electric drive trains feature a single-speed transmission so there are no gear-shifting shocks.

More favorable working conditions deep in the mine

Using diesel-electric trucks creates more favorable working conditions for machine operators and mine personnel in deep mines, as a direct result of less heat and exhaust from diesel engines.

Better mine yield

An upshot of using diesel-electric drive systems is that operators can gain access to ore bodies that can't be mined economically with conventional diesel-powered engines. This makes it possible to exploit underground deposits much more extensively.

This is particularly important as the mineral content of underground deposits is decreasing and more material has to be extracted to keep mineral production constant.

Less maintenance

Compared to diesel-mechanical drives, diesel-electric drive systems require less maintenance, which leads to more operating hours between scheduled downtime. Higher availability is the result.

Softer and smoother driving means less maintenance on the vehicle and road so a longer lifetime is possible with lower overall operating costs.

Generally we expect approximately 15% less maintenance with diesel-electric haul trucks compared to conventional mechanical trucks.

More productive, more reliable: AC drive system – how it works on an articulated truck with a 60t payload

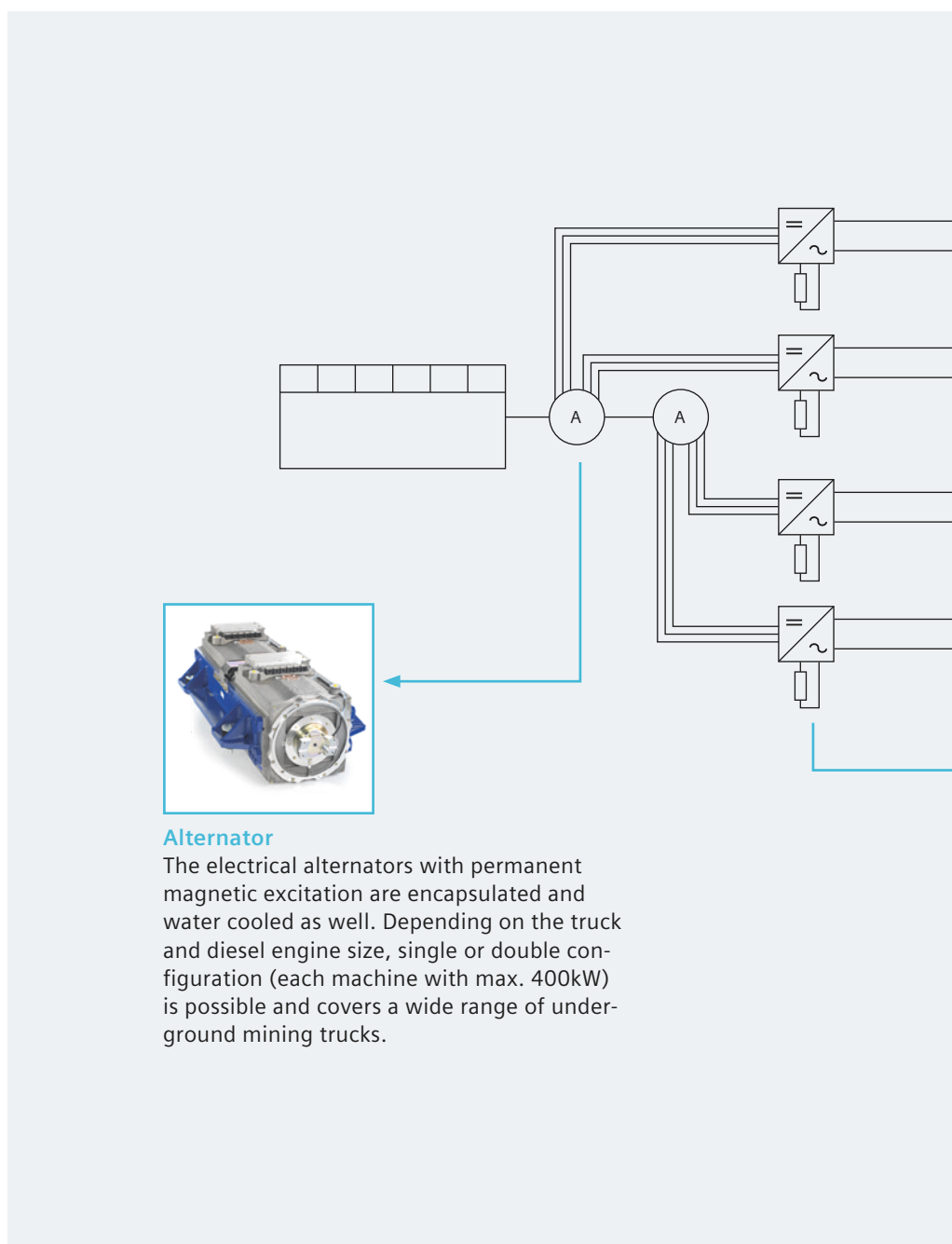
System block diagram

Mechanical power from the diesel engine is converted into electrical AC power at its most efficient working point using a highly efficient permanent magnet double generator with four independent winding systems in total. Each generator winding is connected to an active IGBT rectifier, which feeds a constant 700V DC link throughout the entire speed range from idle to full throttle.

Four motor converters generate voltage and frequency variable AC power to drive the electric wheel motors, each with a maximum power rating of 160kW. A three-stage planetary gearbox (45:1) converts the torque from the electric motors to the wheels, which leads to a maximum rim pull of 464kN.

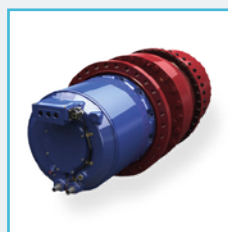
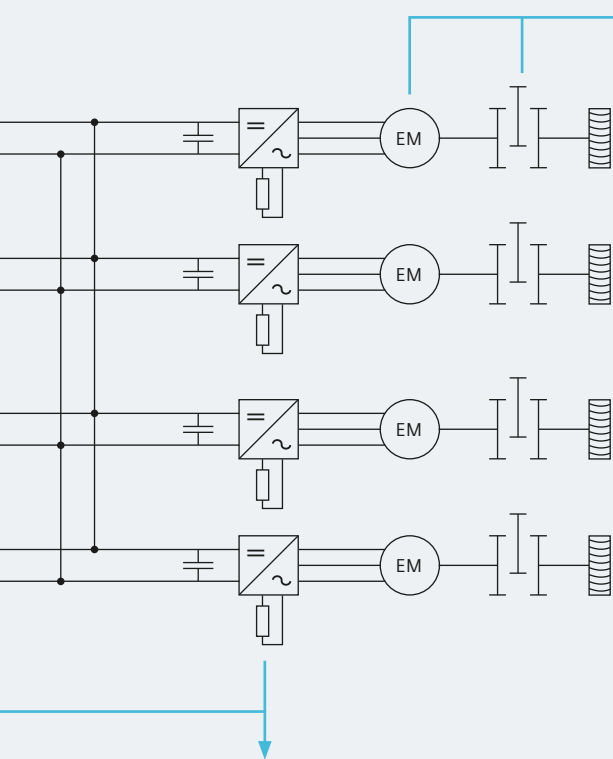
That corresponds to an incredible 43% gradeability in propulsion mode for an underground truck with a maximum gross vehicle weight of 120t.

In retardation mode, the electric drive system can provide maximum braking power of 670kW by heating up water-cooled brake resistors. Hydro-mechanical wet brakes are integrated in the gearbox housing as a redundancy measure and for use in emergency braking situations. Batteries or fuel cells have the potential to replace or massively downsize the diesel engine in future drive concepts.



Alternator

The electrical alternators with permanent magnetic excitation are encapsulated and water cooled as well. Depending on the truck and diesel engine size, single or double configuration (each machine with max. 400kW) is possible and covers a wide range of underground mining trucks.



E-motor and gearbox

The permanent magnet synchronous motors are highly efficient in a wide torque and speed range of typical load cycles in underground mines. That increases productivity and reduces fuel cost per ton payload. Water jacket cooling and an encapsulated IP69k design offer maximum robustness for use in extreme environmental conditions, such as high humidity and dust. This is a significant advantage over induction motors with open-circuit air cooling.



AFEs and IGBT inverters

Active IGBT rectifiers, also known as active front ends (AFEs), are used instead of self-commutated diode rectifiers. The AFE is practically a 'reversed' inverter. While the inverter converts DC voltage into 3-phase AC voltage with a variable frequency and amplitude, the AFE does the opposite. Total harmonic current distortion (THD) is very low due to forced commutation and the high pulsing rate. In addition, AFEs improve the dynamic response to load changes and are extremely robust when faced with power disturbances, caused for example by wheel motors slipping.

More information:
[siemens.com/mobile-mining](https://www.siemens.com/mobile-mining)

Click on the "Mobile Mining Solutions"
navigation point for further details.



Published by
Siemens AG

Siemens Mobile Mining
Vogelweiherstraße 1-15
90441 Nuremberg - Germany

E-mail: mobile.mining.industry@siemens.com

Article-No.: VRMI-B10027-00-7600
Dispo 21662
gB180279 BR 01190.0
© Siemens 2019

Subject to changes and errors. The information given in this document only contains general descriptions and/or performance features which may not always specifically reflect those described, or which may undergo modification in the course of further development of the products. The requested performance features are binding only when they are expressly agreed upon in the concluded contract.

