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Haulage and Loading 2013
An Electric Drive System for the Largest Haul Truck in the World

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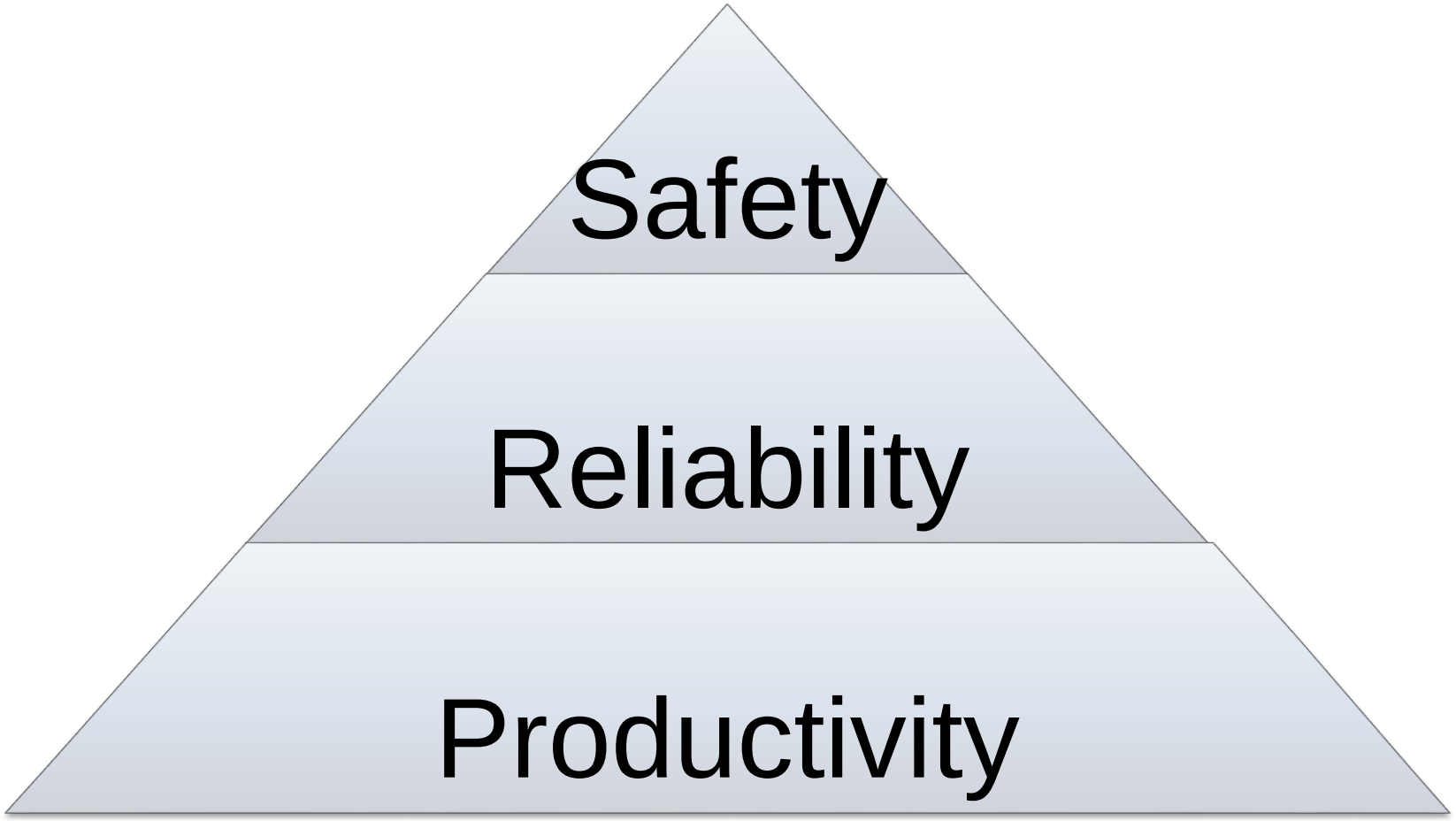
Safety is our top priority



History

1998: Prototype AC trucks for Hitachi and Liebherr - based on GTO traction equipment

2005: AC IGBT water cooled system

2007: Direct trolley for IGBT System

2013: BELAZ 75710 - 500T

1998 2000 2005 2007 2013

2000: Diesel boost trolley system developed

Working with several OEMs to produce truck drive systems size from 240t to 400t

2012: Totally Integrated drive system

Siemens Powered Mining Trucks – More than 700 trucks in 4 continents

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Trends of the Mining Industry

To achieve best results, the mining industry is producing

- bigger machines, capable of higher payloads,
- faster speeds and
- smarter autonomous operation – all increasing
  - productivity while at the same time increasing
  - reliability and reducing
  - operating costs.

→ **The result is lower cost per ton.**

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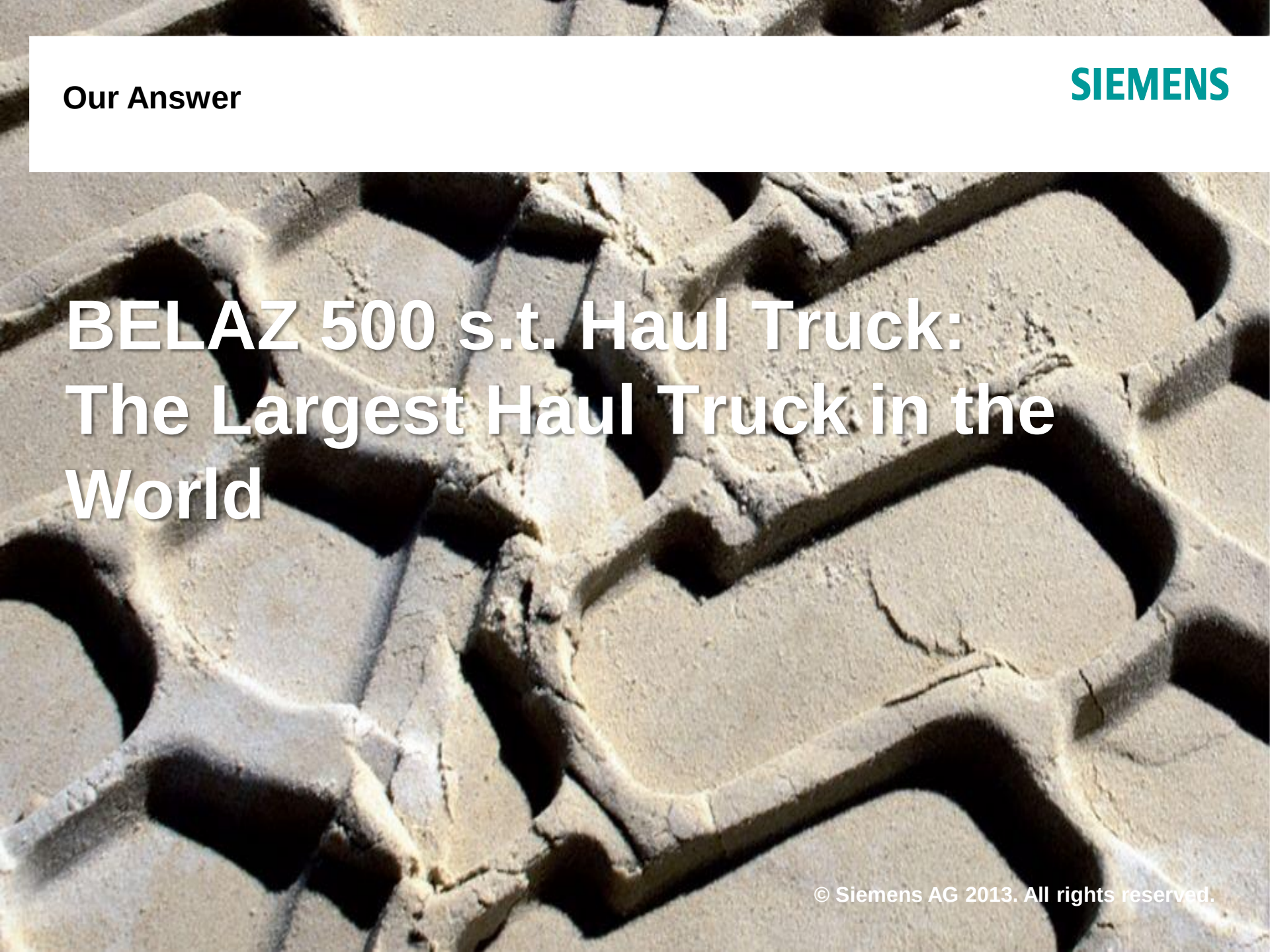
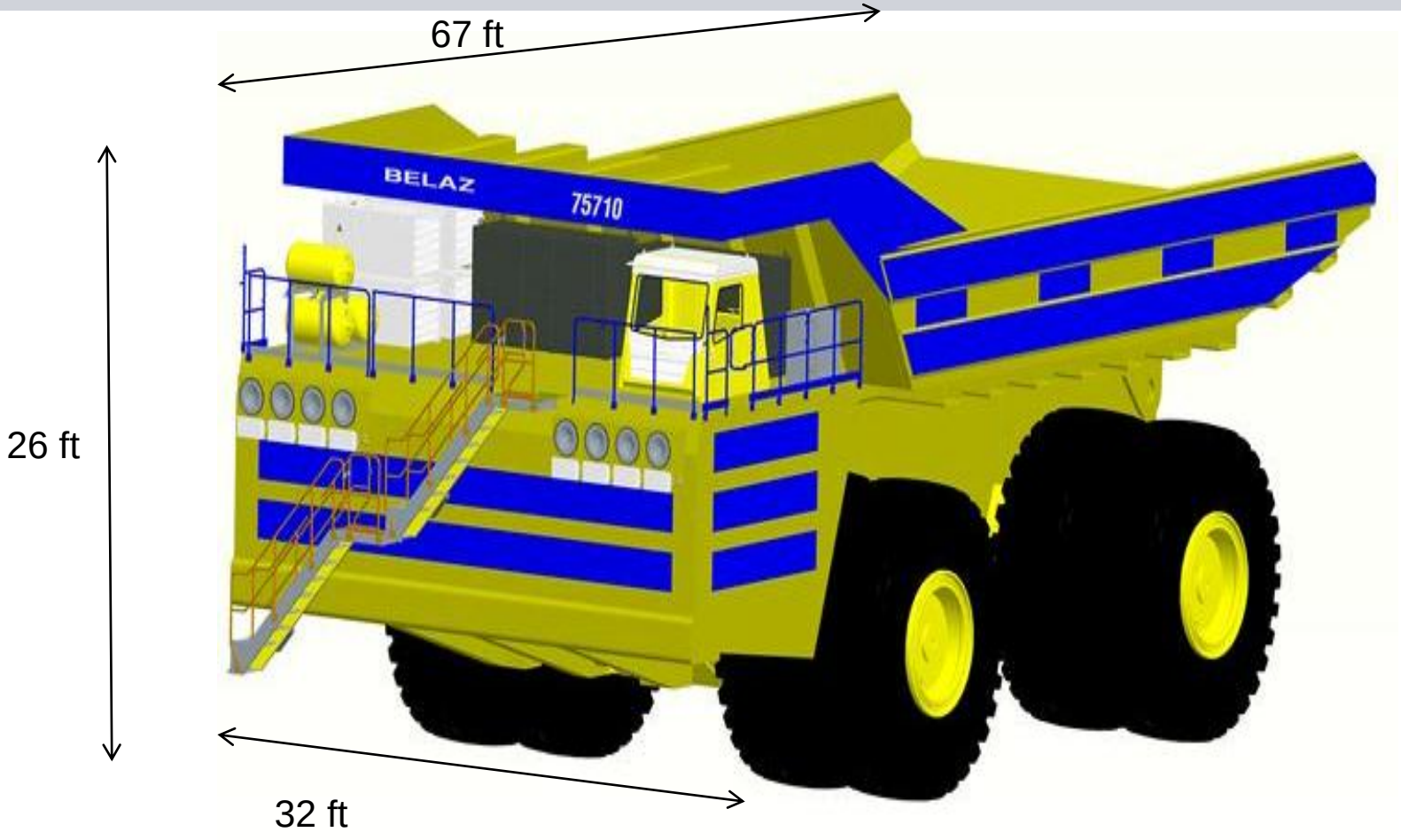
BELAZ 500 s.t. Haul Truck: The Largest Haul Truck in the World



The World's Largest AC Electric Truck – 500 s.t.



The World's Largest AC Electric Truck
Belaz 500t - Concept

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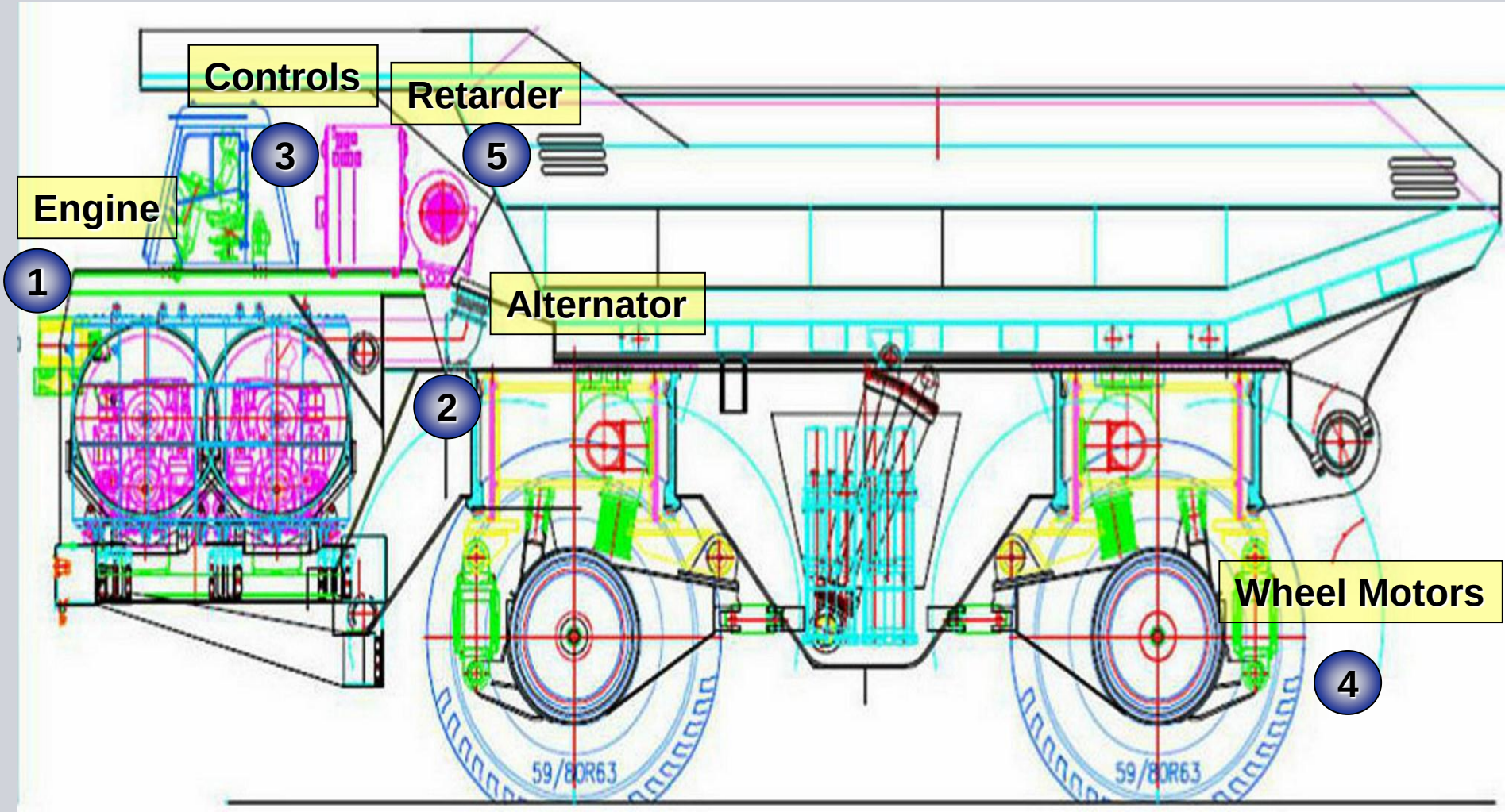

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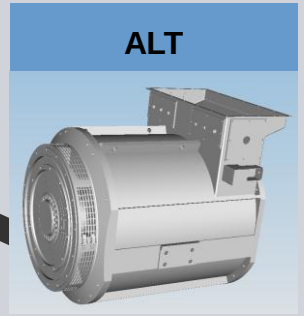
GRIDBOX

TRACTION MOTORS

INVERTER

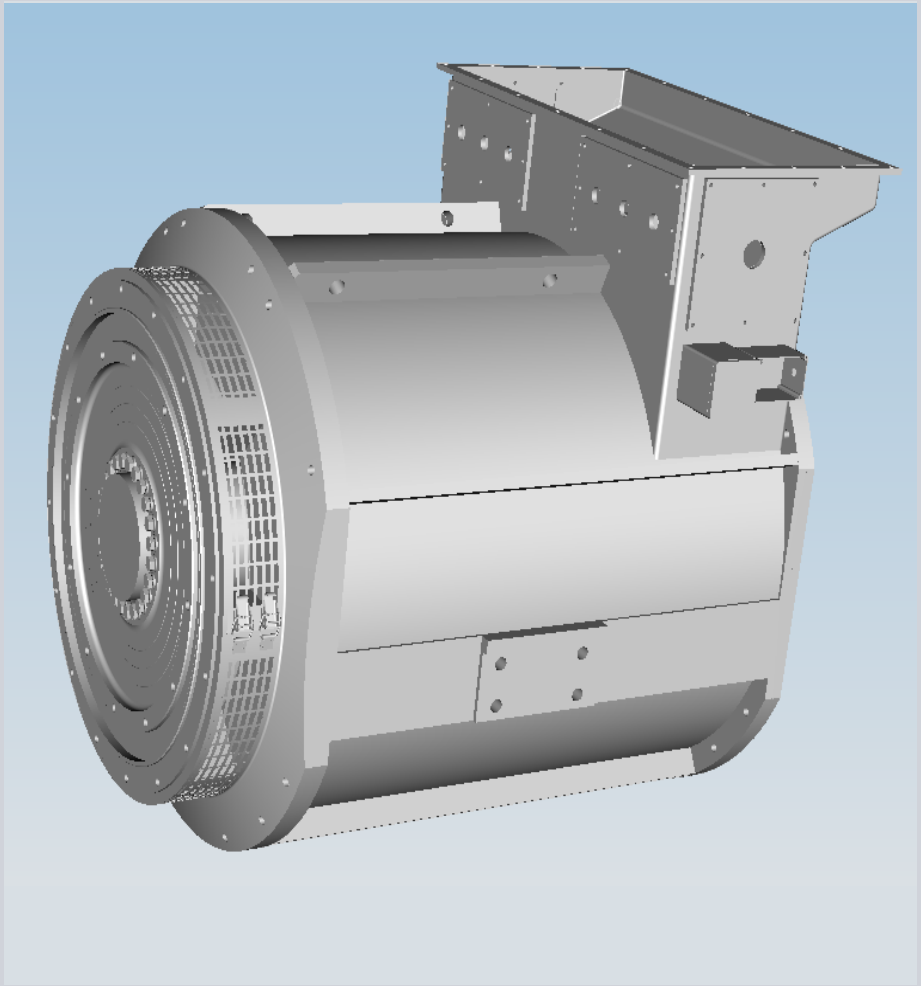
BLOWER

ALT



Frame and Spindle

Alternator – 2, one for each engine



Rated Data

- 3 Φ, two main windings and an auxiliary winding (isolated), brushless AC alt
- 8 Pole, 2500HP, 40-127Hz, 1500V, 667A on main windings
- Auxiliary winding: 180KVA, 120/127Hz, 500V, 207A
- Bearing and windings temperature is monitored
- Efficiency 95%

Weight

- 3550 kg / 7826 lbs

Wheel Motors – 4 wheel drive

Rated Data

- 6 pole / 1375V / 550A / 838 kW /753 rpm / 38Hz
- Single sided forced cooled
- Speed and Temperature signals combined in 1 plug

Peak Torque

- 26000 NM propel
- 13262 MN retard

Weight

- 3385 kg / 7464 lbs

IGBT Inverter – 4 independent inverters / controls

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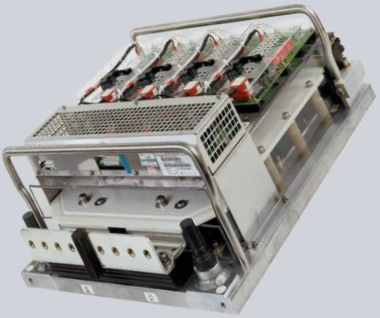


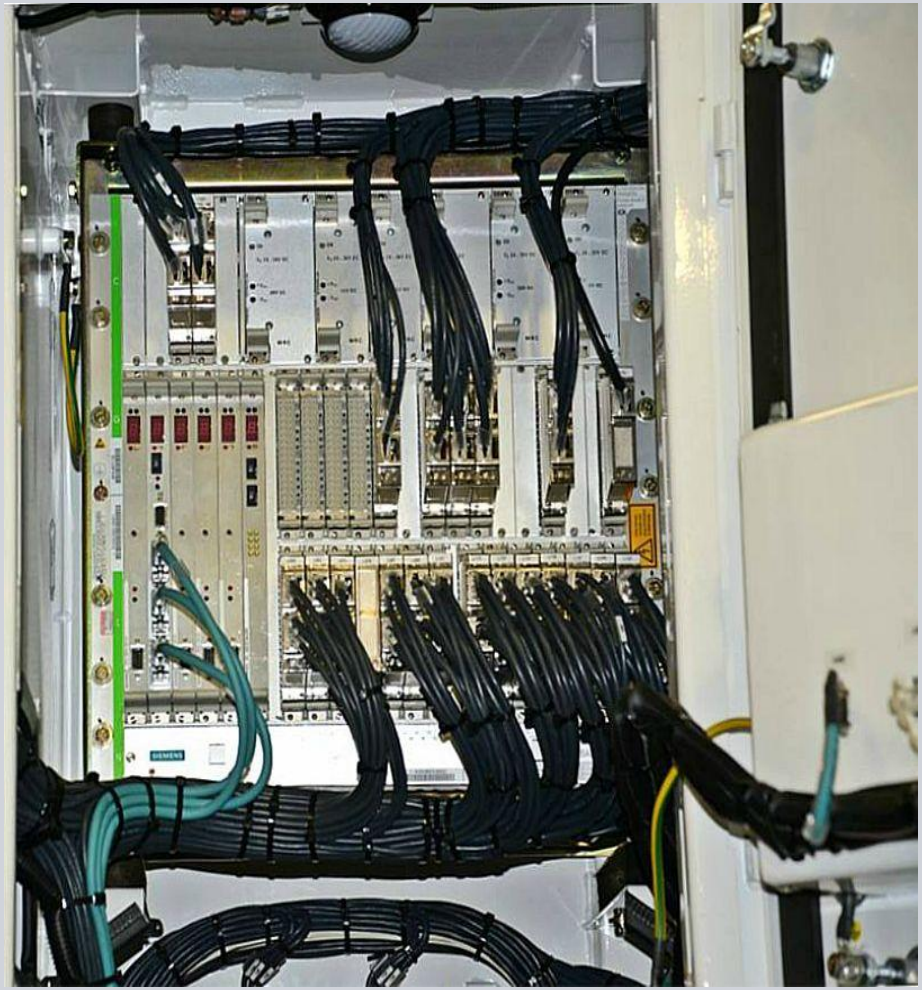
Rated Data

- 4 x 1.2 MW, 1800 V DC / 1400 VAC
- IGBT rating 1500 Amp; 3,300 V
- Liquid Cooled with Water / Glycol Mixture
- Dynamic Retarding 4 x 1,450 kW peak
- Breaking with Choppers to Zero Speed

Weight

- 3849 kg / 8486 lbs

Traction Control Unit (SiBAS)



- SiBAS = Siemens Train Automation System
- Independent Controls for all four wheels
- One unit controls all I/O interface, IGBT inverters, dual engines & alternators and four traction motors
- Traction grade quality
- Design and software by VSS MIN Alpharetta

Grid Box

- Dual fans driven by dual shaft motor
- Rated DC power: 4800KW
- Lower maintenance, low noise
- Four separated banks operated with IGBT choppers
- Soft start: controlled by AC drive

Blower

- Blower for inverter and alternator, cooling
- Variable Speed AC Drive to adjust according to ambient temperature and altitude
- Low maintenance, low noise
- Two motor blowers – one for front and one for back axle
- Speed controlled by the same AC

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Operational Features

Retard to zero speed (Service brake blending)

Automatic hill start (Anti roll)

Slip slide control

Cruise control with active speed limits

Limp mode: system can run in limp mode when there is one or two motors/inverter failure.

Automatic power derate: System can operate in derate mode with the second engine/alternator when there is failure from the first engine/alternator.

Summary

Siemens is proud to power the biggest haul truck in the world – the BELAZ 500

As we showed, this can be done with a 4-wheel drive using practically 2 x 260 ton drive systems and engineering to integrate the systems into one.

As we have seen the shovel payload go up to 135 tons, will there be more 500 ton trucks ?

Is BIGGER BETTER ?

We are looking forward to use our experience and, together with BELAZ, move to the next AC Haul Truck dimension.

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Thank you for your attention!

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