Supporting the electrification of industrial vehicles

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According to National Grid ESO's Future Energy Scenarios 2021 report, there will be approximately 37.4 million electric vehicles (EVs) on Great Britain's roads by 2050. This rapid growth in the UK's commercial EV market is made more likely by legislation passed by the UK Government that bans the sale of new petrol and diesel cars by 2030. However, while most conversations around EVs focus on commercial vehicles, businesses are also looking to increase EV usage for industrial applications. This guide explores some of the technology that will be crucial in facilitating the growth in industrial EV usage, such as in the truck industry or for use in hazardous environments.

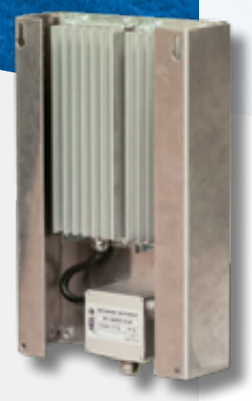
Supporting the EV truck industry with braking resistors

Supporting the electrification of industrial vehicles has its challenges. For electric trucks, the driving range is the biggest challenge. Due to being typically used for logistics and haulage, trucks often drive for longer distances and have more impending deadlines to meet than regular vehicles. Improving and extending battery energy is crucial to supporting the EV truck industry. One of the ways this can be done is through regenerative braking.

One study found that regenerative braking efficiency can reach up to 70 per cent, depending on the driver's style of driving. Regenerative braking also reduces brake wear and tear, extending the life of vehicle components.

During braking, thermal energy is one of the main excess energies produced and sources of losses. Making effective use of this in regenerative braking requires a braking resistor with good heat dissipation. The braking resistors offered by REO UK, for example, use water-cooling for increased heat dissipation, thus meaning that more energy can be reclaimed into processes such as heating.

> **REGENERATIVE BRAKING INVOLVES RECOVERING EXCESS ENERGY AND FEEDING IT BACK INTO OTHER VEHICLE PROCESSES OR SYSTEMS, MINIMISING LOSSES AND REDUCING THE AMOUNT OF POWER DIRECTLY REQUIRED FROM THE BATTERY.**



Braking resistors also have an important part to play in allowing electric trucks to brake safely. For the electric truck to be able to have a safe stopping distance, braking resistors are needed, as excess braking could overload and potentially damage the system. The braking resistors required for an electric truck also have to manage a higher wattage because of the increase torque. The REO UK REOHM series 155 is ideal for this as it offers a small footprint and large power capacity, ideal for larger vehicles.

What about using EVs in harsh environments?

There has also been a rise in the number of electrified and battery-powered explosion-proof vehicles. Unlike internal combustion engine (ICE) counterparts, these EVs avoid ignition risks in the surrounding atmosphere, reducing explosion risks. As a result, there is a growing gap in the market for explosion-proof trucks and vehicles in ATEX environments like oil and gas processing plants, mining facilities and chemical plants.

For EVs to be used in harsh environments, they will mainly use AC motors with high torque and gradual power distribution, preventing the risk of sliding or poor grip on sandy, snowy and icy terrains. These vehicles will also have specific safety features covering electrical components like the batteries and connectors as well as non-electric parts that could generate high temperatures or sparks, such as the brakes.

The importance of cooling

Every electric car battery needs a cooling system, they operate optimally at certain temperatures and are designed to only withstand certain temperature fluctuations. Generally, lithium-ion batteries operate best between 20-40 degrees Celsius, so operating outside this range requires an appropriate cooling system to facilitate heat dissipation. Generally, most electric vehicles use a cooling loop containing an ethylene glycol coolant, which is circulated through the batteries via an electric pump.

The BWD 158 standard range utilises water-cooled resistors into the braking system. The indirect cooling system ensures that the coolant and power remain totally isolated, but as a separate safety feature, the resistors can provide continuous operation for a period of time without coolant flow. Meanwhile, an internal thermal switch can also be used to execute a safe and controlled shutdown of the system if the coolant runs out or the cooling system fails.

> **INSTEAD OF RELYING ON AIR COOLING AND FANS, WHERE VEHICLES ARE AT RISK OF DUST AND OTHER DEBRIS ENTERING THROUGH THE VENTS AND CAUSING DAMAGE, ONE POPULAR ALTERNATIVE IS TO INCORPORATE LIQUID COOLING SYSTEMS FROM THE BEGINNING.**

Would an increase in industrial EVs overload the electric grid?

Some EV sceptics argue that the National Grid is not powerful enough to handle the charging needs of millions of electric cars in the UK. Electricity demand for road transport is estimated to have increased by 50 per cent between 2019 and 2020 in the UK, according to a government report on energy consumption and this will only increase. As a result, there is concern about the need for more charging points and the impact this will have on the National Grid.

The danger of harmonic pollution

Techniques currently used by the National Grid, such as the balancing mechanism, cannot solve more technical issues like complex waveforms and harmonics. EVs require various power electronics equipment that convert AC power to DC for vehicle systems like heating and ventilation. These unwanted higher frequencies create a distorted wave pattern that can lead to the overheating of conductors and cause faults in the operations of protection relays. Failures can have a knock-on effect and lead to problems for the wider grid, including blackouts in small and densely populated areas.

One way to reduce the total harmonic distortion (THD) in the EV charging system is to use harmonic filters. These filters are often either active, passive or hybrid. Active harmonic filters monitor harmonic currents and generate corresponding waveforms to counter the original harmonic current. Passive harmonic filters, on the other hand, use inductors and capacitors to shunt or block harmonics.

Some harmonic filters, like the ones produced by REO, can reduce the THD to less than five per cent. These filters can also offer other benefits such as reducing the power bill and maintenance costs for EV charger owners. Overall, they can improve energy efficiency and power quality.

Using wind-turbines to generate electricity for EV charging

Why stop at electrifying vehicles when we could also ensure that EV charging units are powered by renewable energy sources? In the UK, wind farms account for one fifth of the UK's total electricity generation. The UK Government's plan to increase offshore wind capacity to 40 GW by 2030, signals a big increase in the number of wind turbines being built in the UK.

The REO BW151 resistor, a braking resistor for renewable applications, has gone through rigorous testing so it can be used in the pitch control systems (PCSs) for wind turbines across the UK.

Each PCS usually comprises a variable speed drive as well as a resilient braking resistor and associated control and power quality circuitry. The BW151 range has been designed with renewable applications in mind. It will work in operating ambient temperatures of up to 50 degrees and at altitudes of 3000 m above sea level, both of which are common requirements for wind turbines. The aluminium enclosure of the BW151 braking resistor also provides corrosion protection and the unit has an IP54 ingress protection rating.

A typical wind turbine generates a large amount of heat from sources like the generator, gearbox and even the sun. Traditionally, wind turbines used heat exchangers in a closed-loop system with forced air cooling. For REO, improving the heat transfer directly from the core components themselves is better than expanding the ambient cooling system. At their core, most inductive components used in converters, generators and transformers are either wound using round copper wire or using copper or aluminium foil. However, this layered approach takes up more room while making but the inner layers run a lot hotter than the outer layers. This means you must use a larger cooling system rated for the worst-case scenario.

This is where edge winding offers a distinct advantage. Each winding is separated from one another and is uniformly heated. It also takes up 30 per cent less space, power loss is reduced by 25 per cent and weight by 10 per cent. Edge winding of rectangular or square conductors allows higher current ratings for a given core size, with higher inductances. The window utilisation factor, which is the area inside the core, is up to 30 per cent higher and because

THE RESISTORS HAVE BEEN TESTED TO MEET EUROPEAN STANDARDS, EN 60068-2-6 AND EN 600068-2-27, TO ENSURE RELIABILITY AND DEGRADATION-FREE PERFORMANCE FOR BOTH ONSHORE AND OFFSHORE WIND TURBINES. ALL ELECTRICAL COMPONENTS PRODUCED BY REO FOR PCSS MUST GO THROUGH EXTENSIVE TESTING DUE TO THE HARSH NATURE OF WIND APPLICATIONS AND TO ENSURE THEY WILL FUNCTION FOR THE LIFETIME OF THE SYSTEM. WIND TURBINE COMPONENTS ARE EXPOSED TO HIGH LEVELS OF SHOCK AND VIBRATION AND CAN EXPERIENCE ROTATIONAL SPEEDS OF UP TO 30 RPM AND ACCELERATIONS OF UP TO 2G.

the windings are side-by-side, cooling is greatly increased. Edge wound inductors generally have a lower parasitic capacitance than other methods of winding, which reduces unwanted high-frequency return paths, helping the products meet electromagnetic compatibility (EMC) standards.

Products such as REO's N CNW 806 Dv/Dt choke are designed to filter over voltages that result from switching transients and our N CNW 903 three-phase mains choke is designed to filter harmonic frequencies and reactive power. All three of these problems generate heat in the wind turbine and it's the edge winding used in these products that drastically improves the cooling function.

Taking the next step in industrial electrification

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To find out more about REO's range of braking resistors, harmonic filters and chokes that will support you in the electrification of industrial vehicles, contact REO UK at main@reo.co.uk or give us a call at 01588 673411.

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