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ELECTRIFIED POWER SYSTEM REVEALED BY CUMMINS AT BUSWORLD EUROPE

Cummins Broadens Power Portfolio with Battery Electric and Range Extended Electric Vehicle Systems to Offer the Most Energy-Diverse Solutions in the Industry

KORTRIJK, Belgium, (18 Oct. 2017) — Cummins today revealed an electrified powertrain at the BUSWORLD show taking place in Kortrijk, Belgium, configurable for either a full battery electric vehicle (BEV) or a range extended electric vehicle (REEV) combining battery power with a compact engine-generator. The Cummins electrified system is ideally suited for integration into city, intercity and airport buses with a high-efficiency traction motor providing direct drive with continuous acceleration and quiet operation.

Cummins proprietary control technology extends the zero-emissions bus range by optimally managing subsystems to maintain a sufficient battery state-of-charge for longer. Enhanced energy storage for the BEV and REEV system is achieved with a high-density battery enclosure, designed by Cummins in a compact, modular format for both on-roof and chassis integration into existing bus designs.

Operational flexibility is improved with fast recharge capability using an integral plug-in connection, as well as options for on-route opportunity charging where a pantograph or charge plate infrastructure is available.

“The introduction of our new BEV and REEV systems will complement Cummins clean diesel, natural gas and diesel-hybrid products to offer the broadest, most energy diverse power portfolio — one able to meet the needs of every transit route, every duty cycle and every environmental consideration in Europe on the most cost-effective basis,” said Brian Wilson, Cummins General Manager — Global Bus Business.

The standard-size Cummins battery enclosure provides a 70-kWh storage capability with up to 8 enclosure units (560-kWh) integrated within the BEV bus. This enables a zero-emissions range of up to 360 km (224 miles) on a single charge, with an energy consumption of just 9 Litres/100 km diesel equivalent (30 mpg) — bringing a major reduction in operating costs.

A Cummins REEV system specified with a battery pack of 3 enclosures (210-kWh) provides a zero-emissions range of up to 135 km (84 miles) — a significant advantage over conventional diesel-hybrid bus capability. When the battery pack depletes to a low state-of-charge, the REEV system brings online a 120-kW (160 hp) engine-generator to recharge the batteries and continue operations with ultra-low emissions capability.

The Cummins 2.8-litre engine incorporated with the REEV system represents a 60 percent downsize in displacement compared to engines used in an equivalent diesel bus. When operating in engine-generator mode, the REEV system achieves a fuel consumption of 18 Litres /100 km (15 mpg) to significantly lower the carbon footprint. A power assist function is available from the battery pack whenever the system needs additional energy.

The ability of the REEV system to switch between shorter-range battery-only mode and extended-range engine-generator mode allows specific areas to be geofenced by utilising Cummins over-the-air connected technology. The REEV system also enables buses to travel significant distances beyond the city charging infrastructure.

“A key focus in the design of both our BEV and REEV systems was to ensure our electrified architecture would be modular and adaptable to enable an easier technology transition for bus manufacturers,” said Julie Furber, Cummins Executive Director - Electrification Business. “This then allows transport authorities to specify the same bus models that work so well for them today and retain fleet commonality.

“The new systems will be expertly serviced by the Cummins distribution network in the same way we currently support our diesel-, hybrid- and natural-gas-powered fleets. This is an important factor for bus operators, as it means seamless support for when they specify our BEV and REEV systems for their fleets.”

Energy Efficiency

The BEV and REEV systems incorporate the same traction motor and power electronics to deliver a continuous torque output of 1850 Nm, eliminating the need for gear shifting and dramatically reducing powertrain noise. When the vehicle requires additional tractive power during rapid acceleration or while climbing gradients, the system delivers an instant peak torque boost up to 3400 Nm.

The system provide a continuous electrical output of 225-kW (302 hp), increasing to a peak output of 350-kW (469 hp) whenever a power boost is required. The high-voltage system operates at a nominal 660V when battery state-of-charge is around 50 percent. Battery energy storage levels are boosted on-route by accepting “free” energy recovered

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through a regenerative braking system. On a frequent stop/start bus duty cycle, this could contribute the equivalent of 20 percent to the battery pack state-of-charge.

Electrical energy is also exportable from the Cummins system to the electric-powered accessories featured on the bus, such as e-power steering, e-HVAC, e-air compressors and e-cooling fans, adding up to a typical 25-kW (33 hp) load at any one time. The electrical supply from the Cummins system can be both low-voltage DC and high-voltage AC, helping to simplify the installation and lower the cost of the e-accessories package.

The same electronic control module used on the popular B4.5, B6.7, L9 and L9N bus engines is adapted for use as the BEV and REEV system controller, offering familiar diagnostics and the connectivity that bus operators experience today.

About Cummins Inc.

Cummins Inc., a global power leader, is a corporation of complementary business units that design, manufacture, distribute and service diesel and natural gas engines and related technologies, including fuel systems, controls, air handling, filtration, emission solutions and electrical power generation systems. Headquartered in Columbus, Indiana (USA), Cummins currently employs approximately 55,400 people worldwide, and serves customers in approximately 190 countries and territories through a network of approximately 600 company-owned and independent distributor locations and approximately 7,400 dealer locations. Cummins earned \$1.39 billion on sales of \$17.5 billion in 2016. Press releases can be found on the web at cummins.com or cumminsengines.com. Follow Cummins on Twitter at twitter.com/cumminsengines and on YouTube at youtube.com/cumminsengines.

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Note to editor: Images of Cummins electrified systems for bus applications can be downloaded from: <http://cumminspr.com/2017Busworld.aspx>