

FOCUS ON | HOW TO SPECIFY A FULL-E

Every bus route is different, in terms of distance travelled, topography traversed, popularity of use, traffic conditions and road location (urban/suburban/rural). Countries and operators have their own preferences of vehicle type and specification.

To suit these differing needs, BAE Systems offers a range of partly- and fully-electric drivetrains for buses that all draw from a common platform. They range from Series-E hybrid electric models and Series-ER extended range electric models as well as Series-H and Series-EV fully-electric powertrains, such as those now fully-operational in Mulhouse, France by local operator Soléa.

All of the variations use a common electric architecture and a range of standard components, including traction motors, power control systems and auxiliary power systems supplying hotel loads.

Where emissions are strictly regulated, such as in city centres, the zero



tailpipe emissions provided in operation by the full-electric Series-EV comes to the fore. Its direct drive DC traction motor takes power at high voltages (500-750V) from a battery pack, via a propulsion control system, turning the driven wheels via driveshaft and differential. Even though it contains no engine or generator (unlike the Series-ER), the system still handles bi-directional energy

flows, for example during regenerative braking, in which the system effectively runs the motor backwards, generating - rather than consuming - electricity.

Existing applications demonstrate the vast operational range possible with this system. Mulhouse's new GX 337 ELEC runs from the 120kW continuous DDTM-100 model traction motor (output: 980Nm peak



ELECTRIC BUS FOR ZERO-EMISSIONS OPERATIONS



continuous at 1,100rpm), fitted to 360kWh batteries mounted in a 12m chassis from Heuliez Bus. In Mulhouse, the five steel chassis/composite body buses were equipped with NMC batteries from Forsee Power. Fitted with air conditioning, heating and an integrated access ramp, they accommodate up to 90 passengers with two wheelchair spaces.

A measure of the flexibility of the system is that a variant of the powertrain is also powering 18m-long bendy buses in Europe. The 160kW ACTM-200 model traction motor, which generates 3,340Nm of torque to the driveshaft, is being used in the Heuliez Bus GX 437 ELEC articulated bus in Trondheim, Norway. Having ordered 11 units, which have been operating since January, local operator Tide Buss now claims the largest full-electric

fleet in the country, running through the downtown area. The vehicles, which offer air conditioning and heating, are fitted with LTO batteries and can transport up to 130 people.

TWO PHILOSOPHIES

As for the charging method, two different philosophies for electric buses are currently being employed: overnight, after the bus has finished for the day, and opportunity charging, at the end of, or even along routes. Technically, the two systems are completely different. The former involves a relatively low and slow charge (circa 150A for several hours); the latter, a relatively high and rapid one (600A for 15 minutes).

Again, BAE Systems can accommodate either. To cater for either option, the central power control system, PCS, comes in two versions: standard, and one with larger contactors and heavier bus bars internally to stand up to the rigour of fast charging.

In fact, the BAE Systems equipment can support either method. For example, Heuliez Bus offers options to recharge both ways: there's a CCS Combo 2 ISO 15118 external plug-in connector that is required by the European Clean Vehicle Directive for overnight charging (as in Mulhouse), but is also fitted with a Heliox 650A pantograph fast charging system at the end of the route (as in Trondheim). And BAE Systems is working towards being able to support even higher-capacity planned fast

charging systems using DC that operates at up to 1kV.

That's not all; BAE Systems can also support both technologies on the same bus. First, the Trondheim vehicles are charged slowly overnight. All the next day, they will run from that power, plus a small top-up at either end of the route. The same thing was chosen by Dutch operator Q-Link, which operates intercity routes in the north of the country. It has received the first vehicle in an order of 49 that features both overnight and opportunity charging, although it will primarily use the former. The Heuliez Bus ELEC GX 437 18m articulated, full-electric bus is powered by a 250kWh Li-ion NMCG battery driving through a 160/200kW BAE Systems electric traction motor. The vehicle travels up to 120km on a single charge, although fast-charging during the day via 450kW on-board pantograph connection can further extend its range. **TE**

MORE INFORMATION

To learn more about the Series-EV and its role in the entire BAE Systems powertrain range, and to download a 12-page brochure, go to www.gettozero.com



RECORD-BREAKER

A full-electric 12m Heuliez Bus GX 337 ELEC production city bus fitted with a BAE Systems powertrain has exceeded 500km on a single run. Following its debut at IAA 2018, the bus had been tested on real-world routes by more than 25 public passenger transport companies in Germany. For example, in August 2019, the bus, equipped with a 350 kWh battery pack for overnight charging, reached 416 km on a customer line in Hafenlohr, Lower Franconia, after which it still had 6% available battery capacity.

Curious to know how much farther it could go on a single charge, bus manufacturer IVECO Bus operated the vehicle on its Ulm, Germany test track on 10 October 2019. After nearly 12 hours of operation, and having used 96% of its battery capacity, a team of seven drivers clocked up a distance of 527km (351 mi). The average speed during the record run was 46.6 kph, with outside temperatures ranging from 10-15°C during the day, with sporadic light rain and wind.

