



CHARGING STATION

As the one-acre site behind Waterloo train station in south London has such a central location, it's no wonder that it has been swept up in the evolution of London. Originally cleared to service the Festival of Britain on the nearby South Bank in 1951, the small site, which also features a two-bay workshop and small driver facility, office and public canteen (The Bus Café, open 9 am-4pm), was the first in London in 2003 to convert to articulated Euro 3 Mercedes-Benz Citaro diesel buses. (They were replaced in 2009 by 12m Euro V EV buses).

Then, as now, two routes run out of the depot: the 521 to London Bridge and 507 to Victoria station; both are primarily peak-time commuter services. Bus range, depending on the shift, averages 75 miles, but varies from 40-130 miles/day.

Both routes are central and well suited to TfL's stated desire to improve London's air quality. Operator Go-Ahead anticipated the prospect of a five-year electric bus contract starting in 2016. In

A year after converting the world's first bus depot from diesel to electric outside of China, Go-Ahead Group's Waterloo Bus Garage racked up a million electric miles by February. Will Dalrymple visited

2013, it chose BYD – a Chinese battery manufacturer that has diversified into buses – as trial partner, receiving two buses in August that year. However, they only entered service in December, after requiring bodywork modification by group subsidiary Hants & Dorset Trim to meet TfL specification. Then they ran for more than two years before TfL put out a full tender, for 51 buses for two routes.

Despite the positive experience gained during the trial, developing a bid for an electric bus was an entirely new proposition for an operator used to thinking in terms of fuel consumption and vehicle depreciation. In explaining how Go-Ahead put its bid together, London engineering director

Richard Harrington recalls: "It's about understanding, are they capable of running the route? If they are, how much power are they using? That comes out in terms of kWh/mile. What is the capacity of the vehicles' battery packs? What rate do they charge at? How many do you need to charge at once?"

As a result of its calculations, Go-Ahead applied to local monopoly electricity supplier UK Power Networks for a 2.5 MW grid connection and won the tender. It then had less than a year to convert the whole garage from diesel and roll out a new bus model.

A few changes were made during the design process. The original 12m-long trial buses stored the batteries in partial view of driver sight lines, so were moved to the roof and the 'boot' area, resulting in removal of the rear window. More significant was Go-Ahead's requirement for a European-built body, after questioning the longevity of the Chinese-built variant operating in London. BYD chose ADL, a decision that has come to pay dividends for that Scottish bus manufacturer. (Incidentally,

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the buses are zero-emission at the tailpipe, but still require a small diesel engine for saloon heating. Work is ongoing to replace these with an electric alternative.)

Electricity supply works like this. UKPN laid buried high-voltage cable to two new 11 kV substations on site; infrastructure contractor SSE supplied and fitted two transformers that step down the power to 410V. Each of those feeds a SSE distribution board leading to 22 or 21 bus chargers, supplying an eight-hour charge at 40 kW. Charging points, cables and management software all came from BYD.

Harrington recalls an early project meeting with representatives from SSE, BYD and ADL, at which he stressed the importance of working together to make the project a success, despite its innovative nature. Looking back now, he says that the group had “the right ingredients”, and that each party understood the consequences of failure and the benefits of success.

During the six months of construction, the depot did not have the luxury of an alternative site, so continued on operations. This meant shifting access routes and emergency exits around the site’s temporary obstacles, including 1.5m-deep holes for the transformer bases, and occasionally parking up buses at nearby company premises. But its buses continued to achieve 99.8% of the required route miles.

Key stakeholders to manage were neighbours, who were facing some months of noisy construction laying cables and installing equipment, as well as the depot’s 75 drivers, who were unsure about the new buses. “If you don’t tell people what’s going on, they become nervous and wary,” Harrington observes. Every time he travelled to ADL to check on bus development, the engineering director

took pictures and displayed them in the office; on one influential trip, he even invited the driver mentor and union representative. (Later, drivers also received training.)

During the design stage, a key issue was what Harrington called the run-out and run-in; bus parking. Before the change, diesel buses at shift’s end were reversed in toward the back of the long, rectangular site, and parked head to tail and flank to flank, to be driven out forwards in the morning. The new buses needed more space, so each parking bay could have a charging point.

The new idea was an island running down the middle of the site; buses would drive in on the right side of the entrance, toward the back, then swing around and park either hard against the wall or diagonally across the site. Depot staff practised the run-in and run-out four times, using cones and a banksman, to make sure the parking plan was feasible. Now, the layout accommodates 46 buses, including four spare, though there are only 43 charging points. Two additional charging points are



doubled, providing a four-hour charge. As the entire morning fleet is queued behind parking place number one, directly behind the depot gates, BYD’s smart meter charging management software (pictured below)

prioritises the charging of buses in the early slots over those that depart later. (To make up the required numbers, an additional five electric buses are run out of its nearby Camberwell garage.)

Go-Ahead launched the first six buses from the garage on 28 August 2016, ramping up to full capacity over the next five months. In the year since, bus performance has been good, but not perfect, Harrington observes. Some batteries and hub motors have been replaced, and software glitches have led to problems with doors and ramps. To de-risk the contract, Harrington booked comprehensive maintenance cover from BYD, so these issues are dealt with directly by its maintenance staff flown over from a European base in Rotterdam (BYD also operates a factory in Hungary). But little service has been required so far; brake wear, in particular, is low, given the way the buses’ regenerative braking works. So Harrington notes that, in future, Go-Ahead technicians will carry out maintenance in its own garage bays.

The success of the project, whose planning stages began some seven years ago, has been a stepping stone for the large bus operator. And its journey continues; in February, it received the first 12 of a fleet of BYD/ADL buses for its Northumberland Park depot, now its third electric fleet in London. [TE](http://www.transportengineer.org.uk)

