Battery swapping for electric buses in Qingdao

In ‘conventional’ electric vehicles, the battery is charged inside the vehicle as needed, using direct or alternating current. However, battery swapping takes a different route: The drained batteries are replaced with freshly charged ones. This alternative is particularly interesting for commercial vehicles. It is used for electric buses in the eastern Chinese harbour city of Qingdao - with plug-in connectors from Phoenix Contact.

The batteries of electric buses do not need to be charged inside the vehicle: with battery swapping, they are replaced with charged batteries at the charging station by means of a plug-in connector solution and robot system.

Commercial vehicles often have limited driving range

In the current discussions surrounding the acceptability of e-vehicles, the main consideration besides vehicle price and range is the vehicle’s ease of use. The requirements posed by commercial vehicles - such as ground conveyors, airport vehicles, and electric buses for public transport - are notably different. The range required of these vehicles is defined by their area of use - city and commuter buses are not required to drive long distances. A point in favor of battery swapping are the short stationary times of vehicles, given that charging duration is basically irrelevant. In addition, the charging process need not be performed by
laymen handling connectors. The battery swapping plug-in connectors used for commercial vehicles are also established in other performance ranges - up to 300 kW must be transmitted in this case.

**Batteries must perform under extreme conditions**

The XJ Group Corporation, local public transport operator in Qingdao, an eastern Chinese city with 8 million inhabitants, uses electric buses with great success. At the swapping stations, drained batteries are automatically exchanged for charged ones on a swap aisle equipped with robots on both sides. It takes seven minutes for all the battery units of a bus to be swapped, after which the fully charged bus can resume its duties.

The biggest challenge that came with this project was to implement a charging station concept from scratch in less than six months. A reliable and robust plug system had to be developed in the same short period of time - with a plug on the battery (Figure 1) and a socket in the charging station and in the vehicle. Because draining and charging a battery several times a day places extreme strain on it, charging needs to be smooth but also quick. Phoenix Contact developed a plug-in connector solution especially for these commercial vehicles in round-the-clock operation. Thanks to its dimensions and material properties, the connector system can handle currents up to 400 A and voltages up to 750 V.

**1500 electric buses in Qingdao by the end of 2013**

More than 12,000 plug connector sets have already been delivered to China. The batteries of some 450 buses are swapped 2-3 times a day at the charging stations. Until now, 800,000 battery swaps have been performed, and the e-buses have covered approx. 18 million kilometres. By the end of 2013, the bus fleet will be expanded to a total of 1,500 electric
buses. In China, Phoenix Contact is involved in a number of these projects. Similarly in Europe, there is growing interest in battery swapping solutions for commercial traffic.

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