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Batch Demonstration and Key Technologies of the Electric Commercial Vehicles in Beijing

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Abstract

Beijing is one of the 25 cities in "1000 Electric Vehicles in 10 Cities" project and also the demonstration city of the 6 cities in "Private Consumer of New Energy Vehicles" in China. It firstly introduces the power train platform of the pure electric commercial vehicles in Beijing, as well as the key technologies and series vehicle types. Then, it presents the current demonstration of pure electric buses and pure electric cleaning vehicles from the respects of vehicles, demonstration route and infrastructure construction, etc. Finally, it analyzes technology problems existing in the demonstration of pure electric commercial vehicles and suggests certain solutions.

Keywords: BEV (battery electric vehicle), commercial, data acquisition, demonstration, fleet

1 Introduction

In China, new energy vehicle is identified as the strategic new emerging industry. Beijing is one of the 25 cities in "1000 Electric Vehicles in 10 Cities" project and also the demonstration city of the 6 cities in "Private Consumer of New Energy Vehicles" [1]. Based on the successful demonstration in Beijing Olympic Games, Beijing local government promotes the demonstration in public transportation and civil service represented by pure electric commercial vehicles, and the demonstration in business cars, taxis and private cars, represented by pure electric cars. Up till now, 1060 pure electric sanitation vehicles and 300 pure electric buses have been operated in Beijing. In 2012, more than 1300 electric buses, electric sanitation vehicles and pure electric cars will be added.

2 Powertrain Platform of the Pure Electric Commercial Vehicles

"High cost, short range and long charge period" are the common problems existing in the development of pure electric vehicles. To implement large-scale EV demonstration the performance of powertrain platform is the essence, including high efficiency, low cost and convenient charge characteristics. Through its successful application in 2008 Beijing Olympic Games, 2010 Shanghai Expo and 2010 Guangzhou Asian Games, the pure electric commercial vehicle platform developed by National Engineering Laboratory for

Electric Vehicles (NELEV), Beijing Institute of Technology (BIT) gets improved continuously.

As shown in Figure 1 [2] , the pure electric commercial powertrain platform employs lithium-ion power batteries as the onboard energy source. The high efficient permanent magnetic synchronous motor drive system assisted by multi-gear automatic mechanic transmitter comprises the integrated power transmission system. High efficient electric auxiliary system and its integrated control electric chassis guarantee the performance, economy and reliability of the vehicles.

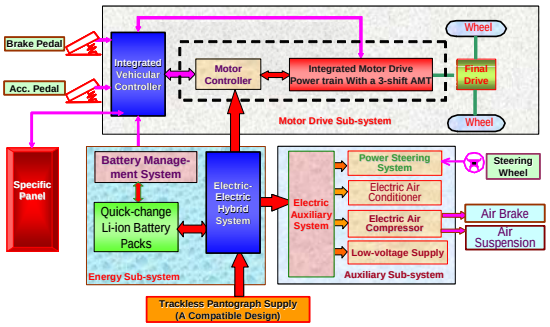
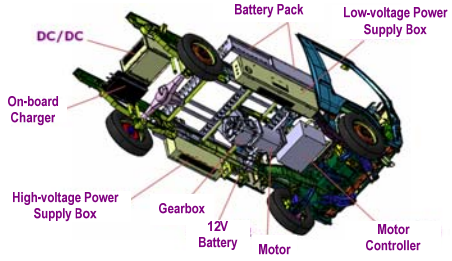
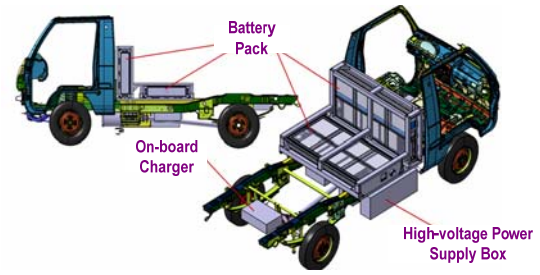


Figure 1: The pure electric commercial powertrain platform

Based on this platform, NELEV developed the power system platform of 2-ton pure electric cleaning vehicles, 8-ton pure electric cleaning vehicles, 16-ton pure electric cleaning vehicles and pure electric buses as shown in Figure 2 taking the 2-ton platform as an example [3,4]. In Figure 2(b) , the battery pack is specially designed after considering the requirement of battery swapping. Additionally, 7 EV types are put into batch production and application as shown in Figure 3.



a) Chassis layout



b) Battery pack layout

Figure 2: Platform of the 2-ton pure electric cleaning vehicle

a) 16-ton electric garbage vehicle

b) 8-ton electric cook garbage collection vehicle

c) 2-ton electric garbage collection vehicle

Figure 3: Series Electric commercial vehicles

3 Key Technologies in Pure Electric Commercial Vehicle Application

Many problems commonly exist in the application of pure electric vehicles, such as infrastructure construction, technology guarantee and data collection/evaluation and also the electric vehicle

itself. Based on the successfully E-Bus application mode in Beijing Olympics and Shanghai Expo as shown in Figure 4 [2], the improved application mode for the batch application of pure electric commercial vehicles is put forward.

The new application mode still adopts the charge station/battery pack quick automatic exchange system, remote security supervision and intelligent dispatching system and maintenance system, etc. To operate small-scale demonstration of pure electric cleaning vehicles, it proposes mobile battery swap and charge cabin as shown in Figure 5 [5,6].

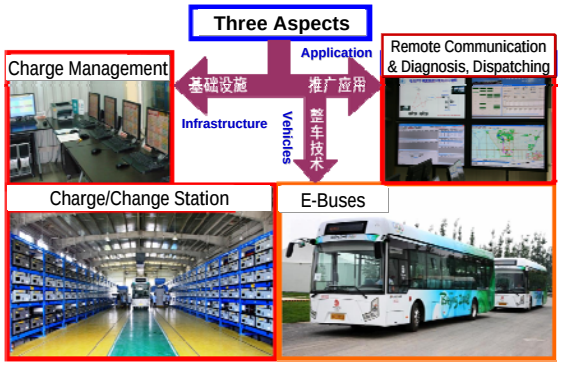


Figure 4: The pure electric commercial vehicle application mode

Figure 5: Mobile Battery Swap and Charge Station

Considering the lack of experiences in EV operation, NELEV constructed the Monitor Centre of Electric Vehicles Operated in Beijing in order to get the first-hand materials as shown in Figure 6. This Centre can monitor the battery condition (current, voltage, temperature and battery alarm), vehicle condition (speed, gear, acceleration value, motor fault code, system fault situation and range), as well as GPS position (longitude, latitude, direction and speed) through the distant communication terminal. All the processed data will be displayed in the monitor software, including battery voltage and its extreme value, temperature and its extreme value, SOC and current, as well as vehicle condition, etc. It can also alarm when finding any fault information. This system can combine the fault information and position information to manage EV operation effectively and conveniently.

Figure 6: Monitor Centre of Electric Vehicles Operated in Beijing

Since pure electric vehicles are a kind of new type vehicles, there are few professionals to operate them. In order to guarantee their fluent operation, we started trainings for the management staff, operators, maintenance staff and charge staff. The training is comprised of theoretical training and practical training. Up till now, more than 400 persons have participated in our training and 6000 persons will be trained totally.

4 Pure electric commercial vehicle demonstration in Beijing

4.1 Construction of EV Charge Station

Concentrating in the public transportation and cleaning vehicles, Beijing launches demonstration of pure electric commercial vehicles. It plan to construct 3 large-scale charge/exchange stations to offer services for more than 2000 vehicles, among which 300 are pure electric buses, 2000 are pure

electric cleaning vehicles. On Feb. 7, 2012, GAOANTUN EV Swap Charge Station, the biggest EV charge station in China was put into operation. It integrates all the quick charge and swapping modes and can provide 146,000 times of service for EV charge. It can swap 8 vehicles at the same time within the period of 4-6 minutes. It is estimated to charge 400 pure electric sanitation vehicles per day. It will become the transfer centre of electric sanitation vehicles and charge/exchange centre for power batteries covering CHAOYANG, TONGZHOU and SHUNYI districts. In 2012, more charge stations will be built near the Capital Airport, Chang'an Street, DAXING district and YANQING district in Beijing.

4.2 Demonstration of EVs in Beijing

The 50 pure electric buses are continually put into service in public transportation, 35 of them are running in the bus route 84 and the left are running in the bus route 81. Up to May, 2011, there have covered 4458000 km and consumed 5580000kWh of grid electricity totally.

In 2009, the development of pure electric road-sprinkler, pure electric garbage vehicle and pure electric cleaning vehicle has been finished and 30 vehicles are manufactured. On Sept. 25, 2009, the demonstration of the 30 electric sanitation vehicles was initiated in Xicheng district of Beijing, there has covered 90886km totally and worked 11354h during the 11 months. By the end of 2010, the industrialization of the series production of 8-ton, 16-ton and 2-ton electric sanitation vehicles was finished and 1060 vehicles are manufactured, On Jun. 30, 2011, the demonstration of the 1000 electric sanitation vehicles was initiated in Beijing and the first 78 electric vehicles are put into operation.

For the pure electric passenger cars, the first demonstration is mainly focused on the taxi market in suburban districts in Beijing. The demonstration models include the electric Midi passenger car by FOTON Company and the electric BEIJING passenger car by Beijing New-energy Vehicle Company. In the end of 2010, the first 50 electric Midi passenger cars began to demonstrate in YANQING district as taxis, and the other 400 electric passenger cars will began to demonstrate in YANQING and FANGSHAN districts soon in this year.

Additionally, the Beijing Public Transportation Group bought 870 hybrid electric buses and put into operation in 34 bus routes. There has covered 74061000km totally and the average fuel consumption is 31.1L per 100km.

5 Key Technologies in EV Demonstration

(1) The pure EV design theory and system integration, as well as the matching techniques need further improvement and perfection, especially in the aspects of proper matching of vehicle and it operation condition, proper arrangement of power battery packs and cost reduction.

(2) The application of electric vehicles is now still in the situation of "spot", "line" demonstration and scale operation. The infrastructure construction therefore shows the spot-like characteristics. Efforts are still needed to do network infrastructure construction in the large-scale demonstration.

(3) Various demonstration modes have been explored in Beijing. As a represent, E-Bus application mode in Beijing Olympics has been successfully further used in Beijing. Electric vehicles have significant meaning in environment protection and social benefit. However, the high cost and lagging infrastructure construction will make it hard for consumers to choose pure electric vehicles. These problems handicapped the development of EV market and the initiative of EV producers.

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