Part 1

Company Profile
Section 1 Enterprise Profile

- CRRC Qingdao Sifang Co., Ltd. is the core subsidiary of CRRC;
- Established in Oct. 1900, enjoyed a long history of 116 years;
- Created a number of records in China;
- 13 subsidiaries (5 of them are wholly-owned), 8 equity affiliates, 10 participating stock companies.

<table>
<thead>
<tr>
<th>Year</th>
<th>Event</th>
</tr>
</thead>
<tbody>
<tr>
<td>1952</td>
<td>The First Steam Locomotive</td>
</tr>
<tr>
<td>1958</td>
<td>The First Diesel-hydraulic Locomotive</td>
</tr>
<tr>
<td>2005</td>
<td>The First Qinghai-Tibet Coach</td>
</tr>
<tr>
<td>2007</td>
<td>The First High Speed EMU</td>
</tr>
<tr>
<td>2012</td>
<td>The First Intercity EMU</td>
</tr>
</tbody>
</table>
Section 2 R&D Capability

World-leading R&D Base

- National Engineering Technology Research Center for High-Speed EMU Final Assembly
- National Engineering Laboratory for System Integration of High-Speed EMU
- National R&D Center
- Post-doctoral workstations.
Section 2 R&D Capability

Specialized R&D Team

- R&D and design engineers 1,700+
- Professional technical leaders 300+
- Doctors 30+
- Masters 600+

Educational Background
Section 2 R&D Capability

Joint R&D Centers worldwide with Global Well-known Universities and Research Institutes:

- China – Germany
- China – UK
- China – Thailand
- China – USA
Section 3 Production Capacity

Carbody Factory

Bogie Factory
Section 3 Production Capacity

Final Assembly Factory

Electrical Debugging Workshop
Section 4 Main Business

The speed of products covers a variety range from 60km/h to 380km/h.
Part 2

HyperTram
(Hydrogen Powered Tram)
Section 1 Development Process

- Hydrogen powered tram – Perfect solution for the cancellation of traction power supply system

Transmitter Grid → Transformer substation → Traction network → Hydrogen powered tram

Natural Gas → Hydrogen station → Tram
Section 1 Development Process

Phase 1: Prototype Tram Development

Phase 2: Application of Test Project

Phase 3: Application of Demonstration Project

11th IHC, Birmingham Centre for Railway Research and Education, 4 - 5 July 2016
Section 2 Vehicle Structure

Power supply system
Traction system
Bogie
Braking system
Passenger information system
Door system
Train control system
Carbody
Lighting system
Signal system
Section 3 Technical Parameters

Layout and capacity

<table>
<thead>
<tr>
<th></th>
<th>Person/Coach</th>
<th>T Coach</th>
<th>Three coaches</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Mc1&amp;Mc2 Coach</strong></td>
<td>18</td>
<td>22</td>
<td>58</td>
</tr>
<tr>
<td><strong>6 person/m²</strong></td>
<td>102</td>
<td>106</td>
<td>310</td>
</tr>
<tr>
<td><strong>8 person/m²</strong></td>
<td>130</td>
<td>134</td>
<td>394</td>
</tr>
</tbody>
</table>
### Section 3 Technical Parameters

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lifetime</td>
<td>30 years</td>
</tr>
<tr>
<td>Design speed:</td>
<td>80km/h</td>
</tr>
<tr>
<td>Running speed:</td>
<td>70 km/h</td>
</tr>
<tr>
<td>Starting acceleration:</td>
<td>$\geq 1.2 \text{m/s}^2$</td>
</tr>
<tr>
<td>Average acceleration:</td>
<td></td>
</tr>
<tr>
<td>0~40 km/h</td>
<td>$\geq 1.0 \text{m/s}^2$</td>
</tr>
<tr>
<td>0~70 km/h</td>
<td>$\geq 0.6 \text{m/s}^2$</td>
</tr>
<tr>
<td>Average deceleration:</td>
<td></td>
</tr>
<tr>
<td>Service braking</td>
<td>$\geq 1.1 \text{m/s}^2$</td>
</tr>
<tr>
<td>Safety braking</td>
<td>$\geq 1.0 \text{m/s}^2$</td>
</tr>
<tr>
<td>Emergency braking</td>
<td>$\geq 2.3 \text{m/s}^2$</td>
</tr>
</tbody>
</table>
Section 4 Carbody

- Lightweight design of carbody structure;
- Stainless steel materials;
- Using integral bearing structure;
- Carbody strength meeting EN12663 standards;
- Crashworthiness requirements meeting EN15227 standards;
- Large areas of doors and windows.
Main Technical Characteristics

- Casting and steel-plate welded structure frame;
- Independent car axle bridge;
- Independent elastic rotating wheels;
- Rubber ring inside wheels for shock adsorption;
- Direct-drive permanent magnet motor, without gear box;
- Hydraulic disc brake.
Section 6 Power System

Electrical theory topology

- Fuel cell + Li$_2$TiO$_3$ Battery;
- Simplified structure;
- Fuel cell protected by battery;
- Full fueled with a distance $\geq 100$ km and 150 km targeted.
Section 6 Power System

Fuel cell module → Fuel Cell Module SF-HD

Unidirectional isolation

Power Battery

Li$_2$TiO$_3$ Battery

DC/DC
Section 6 Power System

- Cooling Control Unit
- Fuel Cell
- DC/DC
- Power Battery
- ECU
- Motor
- Train Control & Management System

Connections:
- CAN
- MVB

Wires:
- Traction hard wire
- Braking hard wire
- FC start-up hard wire
- FC shut-down hard wire
- FC failure hard wire
- Power system failure hard wire
Section 7 Auxiliary System

Cooling system
- 4 modules, 3 fans/module
- Symmetrical distribution
- 300 kW @ 40 °C
- AC motor
- Axial flow

Hydrogen storage system
- 6 x 140L
- 3.2 kg/cylinder
- Pressure @ 35 MPa
- Alert ≥ 38 MPa
- Cut-off ≥ 42 MPa
Section 8 Overall Layout
Demonstration Project
Gaoming Line
Part 3 Demonstration Project

Overall:
- Gaoming bus terminal – S&T park
- Total distance: 17.4 km
- Stations: 20
- Average distance: 900 m
- Passing through bus stations, CBDs, parks, and factories.

First-phase:
- Cangjiang road – Zhihu
- Total distance: 6.6 km
- Stations: 10
- Average distance: 640 m
- With hydrogen refueling station in the base
## Part 3 Demonstration Project

<table>
<thead>
<tr>
<th>Year Range</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>2015/04 - 2016/07</td>
<td>Development and design of Hypertram</td>
</tr>
<tr>
<td>2016/08 - 2016/12</td>
<td>Manufacturing of whole vehicle</td>
</tr>
<tr>
<td>2017/01 - 2017/06</td>
<td>Commissioning and test of whole vehicle</td>
</tr>
<tr>
<td>2017/07 - 2017/12</td>
<td>Trial running</td>
</tr>
<tr>
<td>Whole process</td>
<td>Infrastructure construction of the demonstration line</td>
</tr>
</tbody>
</table>
Thank you!