Versailles-Satory test site integration of a DWPT solution and achievements
VEDECOM: collaborative RESEARCH HUB on new mobility

VEDECOM, hub de recherche coopérative créé en 2014
VEDECOM, a cooperative research hub created in 2014

Industriels
Académiques
Territoires
Industrials
Academics
Local authorities

Certified as Institut for Energy Transition in 2014 by

Founders

21 June 2018
Final Event Conference_Turin, Italy
VEDECOM IN THE CENTER OF 3 MAJOR SOCIETY CHALLENGES

Mission

Develop disruptive technologies and a cross-disciplinary vision of new usages, for sustainable, safe, efficient and affordable mobility

To contribute to air quality improvement in urban areas and CO2 massive reduction
By moving Electric Vehicle from niche to mass market

To offer sustainable, safe and efficient mobility
By accelerating the introduction of automated cars, with or without driver

To optimize mobility systems on territories
By analysing and experimenting new services linked with green, autonomous and connected vehicles

Vehicle electrification
Driving delegation and connectivity
Shared mobility and energy

TRAINING

21 June 2018
Final Event Conference_Turin, Italy
VEDECOM: an ecosystem & a centre for excellence

- Electric motor Workshop
- Power Electronic Workshop
- Satory Test tracks
- Wireless Dynamic Power Transfer Test Track
- Driving Simulator
- Bidirectional Power Transfer - Smart Grid
- 6 « Perception » Vehicle
- Connected Vehicle
- 2 autonomous vehicles
Agenda

1. INTRODUCTION
2. TEST SITE, DYNAMIC WPT SOLUTION AND CAR DESCRIPTION
3. TEST METHODOLOGY
4. MAIN RESULTS AND DISCUSSION
5. MAIN CONCLUSIONS
# Agenda

1. **INTRODUCTION**
2. TEST SITE, DYNAMIC WPT SOLUTION AND CAR DESCRIPTION
3. TEST METHODOLOGY
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5. MAIN CONCLUSIONS
2012 European Electrification Roadmap

Charging While Driving
- Investigate & Develop Dedicated Charge While Driving System
- Broad Establishment of Infrastructure

Investigate Quick Charging
- Contactless Charging
- Develop Contactless Charging (First Applications)
- Broad Establishment of Infrastructure
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The French test site in Versailles - Satory
# Prototype DWPT system specifications

<table>
<thead>
<tr>
<th>Specification</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Maximum power into vehicle</td>
<td>20 kW</td>
</tr>
<tr>
<td>Maximum speed</td>
<td>100 km/h</td>
</tr>
<tr>
<td>Alignment tolerance</td>
<td>+/- 20 cm</td>
</tr>
<tr>
<td>Vehicle pad size</td>
<td>350 mm * 600 mm</td>
</tr>
<tr>
<td>Base pad width</td>
<td>450 mm</td>
</tr>
<tr>
<td>Track length</td>
<td>100m</td>
</tr>
<tr>
<td>Number of Vehicles capacity</td>
<td>2</td>
</tr>
</tbody>
</table>
Prototype DWPT system electric infrastructure
Complete car additional equipment

- DSRC Antenna
- GSM Antenna
- GNSS Antenna
- Camera
- EVCC
- Data logger
- Supervision PC
- GPS RTK system
- HMI interface (LKA)
- LKA PC
- Battery + BMS
- Measurement Box
- Laser sensor
- Magnetic field (85 kHz)
- Primary coils
- Secondary coils
- Converter
- Battery
- BMS
- Supervision PC
- HMI interface (LKA)
Charging lane and car prototype implemented

View of the 100m experimental track equipped with DWPT system & first integrated car prototype (delivered in September 2016).

Fully integrated & instrumented second car prototype (delivered in March 2017)

video describing the charge system and showing the track operated can be seen at https://www.youtube.com/watch?v=2t0E4AcVu6o
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Electromagnetic field exposure & EMC

Inside the vehicle probe location

Outside the vehicle measurements

ICNIRP (*) 2010 common reference document for exposure limits

(*)INTERNATIONAL COMMISSION ON NON-IONIZING RADIATION PROTECTION, ICNIRP GUIDELINES FOR LIMITING EXPOSURE TO TIME-VARYING ELECTRIC AND MAGNETIC FIELDS (1Hz – 100 kHz), HEALTH PHYSICS 99(6):818-836; 2010. (1Hz – 100 kHz), HEALTH PHYSICS 99(6):818-836; 2010.

EMC

Functional verifications.
Electric measurements, charge performance indicators & definitions

The system efficiency is calculated after a whole test run and is defined as the ratio between:

- Energy received by the battery (DC):
  \[ E_{\text{bat}} (U_{\text{bat}}, I_{\text{bat}}) \]

- Energy sent by the grid after DC conv.:
  \[ E_{\text{DCline}} (U_{\text{DCLine}}, I_{\text{DCLine}}) \]

The average power \( P_a \) received by the battery (over the whole active track length) is defined as the ratio of \( E_{\text{bat}} \) over the Time of charge (\( T_c \))

\[ P_a = \frac{E_{\text{bat}}}{T_c} \]
Influence factors on charge performance, metric, functional limits & test plan

<table>
<thead>
<tr>
<th>Influence factors</th>
<th>Metric (indicator)</th>
<th>Data source</th>
<th>Nominal</th>
<th>Functional limits</th>
</tr>
</thead>
<tbody>
<tr>
<td>Misalignment</td>
<td>Average deviation during charge</td>
<td>GPS RTK</td>
<td>0 cm</td>
<td>+/- 20 cm</td>
</tr>
<tr>
<td>Speed</td>
<td>Average speed during charge</td>
<td>Veh. CAN</td>
<td>50 km/h</td>
<td>0/100 km/h</td>
</tr>
<tr>
<td>Air gap</td>
<td>Static</td>
<td>Tape (laser)</td>
<td>175 mm</td>
<td>+/- 25 mm</td>
</tr>
</tbody>
</table>

54 tests plan
- Three levels for each studied parameters (misalignment, speed, air gap).
- Tests repeated twice;
- Total 2*2*3*3= 54 tests.
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EM exposure (EMF) and EMC

EMC

- No issues with basic functions activated during charge (wipers, turn signals and lightening system, mobile communication)
- No issues detected 1 year (> 1000 tests) of CAN monitored tests
- Complementary investigations needed
**Charge performance**

*Indicator of average power received by the battery (expressed as ratio between the measured value vs the maximum recorded value) as a function of average speed and average misalignment.*

Efficiency indicator (expressed as ratio between the measured value vs the maximum recorded value) as a function of average speed and average misalignment.
MAIN CONCLUSIONS-1

**EMF**
- EMF exposure complies with FABRIC ICNIRP 2010
- Further methodology development needed

**EMC**
- No EMC issues detected (1 year)
- Future investigations needed

**Charging current shapes**
- Ripple could be reduced
- Optimal trade-off level between costs, efficiency and battery life TBF

**Energy efficiency**
- FABRIC methodology for future standard?
- 80-90% levels could be reached with different design approach.
MAIN CONCLUSIONS -2

Influence of misalignment, speed, air gap in functional range
- Misalignment: most significant influence

Grid impact
- No issues with 2 vehicles
- Wider scale experimentation needed

ICT technologies
- LKA great open-loop feedback system
- Fully automated trajectory control needed

Experimental track concept
- Easy access to PE components
- Adequate for future road integration studies and validation of prototype DWPT system
Acknowledgment

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Thank you!

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