EVS27
Barcelona, Spain, November 17-20, 2013

Improving Safety and Performance Testing for EV Batteries

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Abstract

Alfons Westgeest and Lois Brett will present on the mutual activities of EUROBAT – the Association of European Automotive and Industrial Battery Manufacturers – and the European Commission Joint Research Centre (JRC) to improve the standardization framework for safety and performance testing for Hybrid Electric Vehicle (HEV) and Electric Vehicle (EV) batteries.

EUROBAT and the JRC began formal cooperation in 2012 to support the JRC Institute for Energy and Transport's (IET) battery energy storage testing for safe electric transport (BESTEST) activity. The BESTEST programme was initiated after the JRC-IET signed a letter of intent for closer cooperation with the US Department of Energy (DoE) on EVs and SmartGrids during a meeting of the EU-US Transatlantic Economic Community (TEC) in 2011. It contributes to the TEC's overarching objective to remove regulatory and standardization barriers between both countries, which could otherwise impede the broad commercialization of (H)EVs.

JRC-IET's BESTEST activity will provide impartial and balanced scientific evidence to ensure that European standardisation supports legislation and policies on clean transport. BESTEST's role in the transatlantic letter of intent is to accelerate the electrification of transport by contributing to the development of harmonised testing methodologies and global standards specifically related to EV batteries. Through these activities BESTEST will ultimately facilitate technology development and innovation thereby enhancing the global competitiveness of European industry.

Keywords: standardisation, interoperability, battery-electric vehicles,

1 Batteries in all levels of e-Mobility

Safe and sustainable battery technologies are key constituents for the successful commercialisation of electric vehicles (EVs) in Europe. Already, the four battery families represented within EUROBAT's membership provide a number of emission-reducing functions in cars, buses, trams and trains [1]:

- Start-Stop systems in Micro-Hybrid EVs;
- Regenerative braking in Mild-Hybrid EVs;

- Part electric functionality in Full Hybrid EVs and Plug-in Hybrid EVs;
- Full electric functionality in full EVs

With the electrification of transport remaining a central component of Europe's transition towards a low-carbon and resource-efficient economy, demand for such technologies will continue to increase over the next decade.

In the path to bringing all types of electric vehicle to the European mass market, government and industry must collaborate to develop testing procedures that ensure the safety, performance and environmental sustainability of internal components. Over the last year, international co-operation has brought about several standards and type approval regulations for the different battery technologies used in EVs, which will guarantee their safety and sustainability for European consumers. These will be outlined in the presentations.

2 Why are standards needed for EV Battery performance and safety testing?

Before new technologies of any type are introduced to the market, testing and standardisation requirements are crucial to identify and rectify any safety, performance or environmental issues that could impact on consumers. Such tests are especially important for batteries in EVs.

Performance, endurance, reliance and abuse tests help to identify potential hazards – for example overheating or short-circuiting – that a battery could be susceptible to under strenuous conditions. These are undertaken in a controlled environment, and allow regulators or manufacturers the opportunity to identify whether further safety improvements are needed before commercialisation.

Given that EVs have been prioritised as a 'green' solution to decarbonise Europe's transport sector, it is also important for precommercialisation tests to measure their environmental impact over their entire lifecycle. Testing of batteries can identify how to prolong calendar and cycling life in addition to establishing the potential for reuse or recycling at end-of-life, thereby informing regulators of appropriate standards that should be set to maintain environmental performance.

Testing procedures are first of all set at an international level, with targeted standards introduced through the International Electrotechnical Commission (IEC) and International Organization for Standardization (ISO), and type approval requirements formulated through the United Nations Economic Commission for Europe's Working Party 29 (UN-ECE WP.29).

Several IEC and ISO standards already exist to give safety and test specifications for batteries used in EVs:

- IEC 62660-1, 2: Secondary batteries for the propulsion of electric road vehicle. Part 1: performance. Part 2: reliability;
- IEC 61982: Secondary batteries (except lithium) for the propulsion of electric road vehicles – performance and endurance tests;
- IEC 62485-3: Safety requirements for secondary batteries and battery installations. Part 3: traction batteries;
- ISO 6469-1, 2, 3: Electrically propelled road vehicles – safety specifications. Part 1: on-board rechargeable energy storage system (RESS). Part 2: vehicle operational safety means and protection against failures. Part 3: protection of persons against electric shock;
- ISO 12405-1, 2, 3: Electrically propelled road vehicles – test specification for lithium-ion traction battery packs and systems. Part 1: high power applications. Part 2: high energy applications. Part 3: Safety performance requirements (DIS).

3 Working towards interoperability

EUROBAT and the JRC-IET share the conviction that commercialisation of EVs will only be achieved if batteries are manufactured and implemented under the same optimised standards worldwide. There are several benefits of internationally harmonising safety and environmental testing processes:

- Interoperability of EVs;
- Increased administrative efficiency;
- Increased research collaboration and reduced testing overlap;
- Optimised tests through pooling of resources.

EUROBAT works alongside EU institutions to raise awareness of these advantages at a bilateral and international level. For example, the association took part in formal meetings between European and Chinese regulators and industry representatives, which have brought increased commitment from both parties towards the UN-ECE's international leadership and an agreement to reduce R&D overlap.

4 Trans-Atlantic Business Council (TABC)

A prime example of how bilateral co-operation can induce mutual advances in electric vehicle and battery testing is the Transatlantic Economic Council (TEC)'s Transatlantic Business Dialogue (TABD) between European and American regulators and industry – including both the European Commission (including the JRC) and EUROBAT. TEC was established in 2007 as a political forum to guide and accelerate government-to-government co-operation and advance economic integration between the European Union and the United States of America. As a key topic of the TEC, a work plan on e-mobility was submitted in May 2011 by TABD, with the motivation to prevent regulatory and standardisation barriers between countries that could impede the broad commercialisation of EVs. As a direct result of this work plan, in November 2011 the JRC signed a letter of intent for closer co-operation with the US Department of Energy (DoE) on EVs and smart grids during the TEC meeting. The letter of intent facilitates the establishment of two Electric Vehicle-SmartGrid Interoperability Centres (EV-SG ICs), one at Argonne National Laboratory (ANL) and the other at the JRC-Institute for Energy and Transport (IET). This promotes a common approach between the EU and US on testing of relevant electric vehicle and smart grid equipment, and prioritises standardisation at a global level. The letter also addresses interoperability issues between e-vehicles, smart grids and recharging systems, including connectivity and communication capabilities.
Within this framework, the JRC-IET is establishing three new activities related to the electrification of transport:

- Electric vehicle performance testing – in Ispra, Italy;
- Interoperability & integration of smart grids – in Petten, Netherlands, and Ispra;
- EV battery energy storage performance and abuse testing (BESTEST) – in Petten.

5 EUROBAT- JRC-IET mutual cooperation

The BESTEST activity has aimed to firm relations between the JRC-IET and relevant European industries and their representative associations.

In November 2012 the JRC-IET and EUROBAT signed a Memorandum of Understanding to formalise their cooperations in areas including:

1. Streamlining pre-normative research activities on battery performance and safety testing and evaluation to best meet the priorities of European battery manufacturers and component suppliers;
2. Contributing to European and international standardisation and regulation by ensuring a sound scientific and technical basis for robust legislation and policies on clean, efficient and safe electricity storage particularly for transport.

Such mutual co-operation helps to highlight pertinent issues facing the European battery industry concerning battery testing (e.g. performance evaluation methods, need for independent evaluation, abuse tests, safety issues, etc.), and will ensure that, when appropriate, these issues are addressed in BESTEST's battery testing activities.
EUROBAT and the JRC-IET believe that mutual co-operation between Europe's battery industry and government will guide BESTEST's programme results towards supporting and harmonising robust international standards and regulations related to EV battery testing procedures and safety requirements. The establishment of an internationally harmonized standardisation framework for EV/HEV batteries will facilitate the global commercialisation of EVs, and thereby accelerate Europe's transition to a low-carbon economy. In this process, a strengthened relationship between Europe and the US would be very beneficial for the sharing of ideas and experiences about safety. This will in turn impact positively on the market deployment of new and more sustainable transportation modes.

The presentation will give an update on specific activities being undertaken as part of this mutual cooperation.

Acknowledgments

The JRC - Institute for Energy and Transport is financed through the 7th Framework Programme (FP7) .

References

[1] EUROBAT, *White Paper Battery Energy Storage Solutions for Electro-Mobility* Brussels, 2012

Authors

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Alfons Westgeest is responsible for the representation of EUROBAT and the management of its staff in Brussels. His 25-plus years of experience include executive positions in associations in a variety of sectors. He has a high level contact network in the European Union institutions, Standards Organizations and Chambers of Commerce. Alfons is LLM in Commercial and European law of Leyden University, Netherlands.

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Lois Brett leads the JRC-IET's BESTEST project. Previously she was responsible for activities in the field of hydrogen safety and detection. Before joining JRC-IET Lois worked for TNO and the International Flame Research Foundation. Lois has a PhD degree in Physical Chemistry from University College Galway, Ireland and a MSc in Hydrogen Safety Engineering from Ulster University.