CIGRE Study Committee C6

PROPOSAL FOR THE CREATION OF A NEW WORKING GROUP

WG C6.40	**Name of Convenor:** Joao Peças Lopes (Portugal) **E-mail address**: jpl@fe.up.pt
Technical Issues #[2]: 1, 4, 5	**Strategic Directions #[3]: 1, 2**
The WG applies to distribution networks[4]: Yes	
Potential Benefit of WG work #[6]: 1, 2, 3, 4, 5	
Title of the Group: Electric Vehicles as Distributed Energy Resource (DER) systems	

Scope, deliverables and proposed time schedule of the Group:

Background:

The charging system of Electric Vehicles (EV), given the battery energy storage system on board the vehicle, can be considered one of the important DER systems, providing flexibility to the distribution and transmission system operator, in the form of a stationary Battery Energy Storage System (BESS) when the EV is connected to the charger. The state of charge of the EV battery and the available energy depend upon the past use of the EV and the energy stored in the battery during the charging process at the time of use of the system as a DER. In the charging process, the EV battery becomes a load on the electrical grid, a fully controllable load if the customer agrees, allowing the system operator to control the charging rate as required. When fully charged, the EV battery becomes a fully controllable BESS, if the customer agrees. When multiple EV chargers are considered, EV charging can also be controlled and coordinated to meet distribution grid requirements and constraints. In addition, when fast charging stations incorporate large stationary batteries on their premises to support simultaneous fast battery charging for several or even many EVs, demand charges can be reduced and the stationary battery acts as a BESS even in the absence of a connection to an EV.

The EV battery and its charging system, with or without the addition of a stationary battery, can therefore be used in almost the same manner and with almost the same potential benefits as any BESS type DER. Some of the benefits include demand response management (load shifting and load smoothing), distribution grid resilience enhancement (building back-up power supply, local grid support, enhanced hosting capacity and stability, contribution for islanding operation and black start in microgrids), renewable energy system balancing (solar PV), and ancillary services to the transmission system, particularly when aggregated, for purposes such as ramping and frequency support.

This WG deals with the EV charging systems as a key distribution grid enabling technology. The EV battery and charging system technologies are presented from the distribution grid perspective, and the control systems required to enable the multiple benefits these systems can provide are described.

Scope:

The scope of this working group is to study different evolving EV charging station configurations, their benefits and impacts on the distribution grid, and their potential to enable enhanced solutions for intelligent electricity distribution systems. The working group will produce a brochure covering the following topics.

1. Overview of different forecasts worldwide on EV deployment, current and future prospects – impact of EV charging (discharging) on the distribution grid and EV hosting

capacity issues. Charging requirements, charger locations and charging patterns for slow and fast charging for EV individual transportation (cars and scooter / bikes) and electric buses and trucks, considering spatial and temporal distributions for the different types of EV charging solutions and mobility types.

2. Review of EV charging technologies – Technology readiness and expected developments, charger types (slow and fast charging, Grid-to-Vehicle, G2V), charger technology, enabling bi-directional capabilities (Vehicle-to-Grid, V2G and Vehicle-to-Building, V2B); different semi-fast and fast chargers with integrated storage (battery storage, other technologies), installation in residential, commercial and utility settings; coupling chargers with renewable energy resources, standardization (existing and planned); typical connection voltage to the grid.
3. Review of approaches worldwide to managing EV charging – Single EV charging, multiple charger control and coordination, demand management and response to meet grid constraints; managing fast charging and the impact on the planning and operation of distribution systems; role of advanced metering.
4. Review of progress worldwide enabling EV charger ancillary services to distribution system operator (DSO) and transmission system operator (TSO) – Demand response management (load shifting and load smoothing); distribution grid resilience enhancement (building back-up power supply, local grid support, grid hosting capacity and stability); ancillary services to the transmission system (aggregation) for ramping and frequency support services; EV support to islanding operation of distribution grids with large-scale deployment of RES (microgrids) and support to black start strategies in microgrids.
5. Review of regulatory issues and multiple EV charger management – Business and ownership models, intermediaries, aggregators, and coordinators; technological, socio-economic, financial, and regulatory challenges in the deployment of G2V, V2G, V2B and fast charging.
6. Overview of worldwide business cases for EV charger deployment – Experiences and case studies, regional differences, ownership in slow, semi-fast and fast charging systems – for different mobility types.
7. Building on all the above reviews and overviews, discussion and derivation of guidelines and recommendations for technology deployment, business case and economic considerations, regulatory issues to be considered.

Results from previous working group C6.21 (electric vehicles) and of parallel JWG C6/C2.34 (flexibility) will be taken into account. Liaison experts from SC C2, C5 and D2 will be invited.

Deliverables:

☒ Technical Brochure and Executive summary in Electra

☒ Electra report

☒ Tutorial[5]

☒ Webinar[5]

Time Schedule: start: August 2019 **Final Report**: December 2021

Approval by Technical Council Chairman:

Date: June 5th, 2019

Notes: [1] Working Group (WG) or Joint WG (JWG), [2] See attached Table 1, [3] See attached Table 2,
[4] Delete as appropriate, [5] See attached Table 3,
[6] Presentation of the work done by the WG

Table 1: Technical Issues for creation of a new WG

1	Active Distribution Networks resulting in bidirectional power and data flows within distribution levels up to higher voltage networks
2	Digitalization of the Electric Power Units (EPU): Real-time data acquisition includes advanced metering, processing large data sets (Big Data), emerging technologies such as Internet of Things (IoT), 3D, virtual and augmented reality, secure and efficient telecommunication network
3	The growth of direct current (DC) and power electronics (PE) at all voltage levels and its impact on power quality, system control, system operation, system security, and standardisation
4	The need for the development and significant installation of energy storage systems, and electric transportation, considering the impact they can have on the power system development, operation and performance
5	New concepts for system operation, control and planning to take account of active customer interactions, and different generation types, and new technology solutions for active and reactive power flow control
6	New concepts for protection to respond to the developing grid and different generation characteristics
7	New concepts in all aspects of power systems to take into account increasing environmental constraints and to address relevant sustainable development goals.
8	New tools for system technical performance assessment, because of new Customer, Generator and Network characteristics
9	Increase of right of way capacity through the use of overhead, underground and submarine infrastructure, and its consequence on the technical performance and reliability of the network
10	An increasing need for keeping Stakeholders and Regulators aware of the technical and commercial consequences and keeping them engaged during the development of their future network

Table 2: Strategic directions of the Technical Council

1	The electrical power system of the future: respond to speed of changes in the industry
2	Making the best use of the existing systems
3	Focus on the environment and sustainability
4	Preparation of material readable for non-technical audience

Table 3: Potential benefit of work

1	Commercial, business, social and economic benefits for industry or the community can be identified as a direct result of this work
2	Existing or future high interest in the work from a wide range of stakeholders
3	Work is likely to contribute to new or revised industry standards or with other long term interest for the Electric Power Industry
4	State-of-the-art or innovative solutions or new technical directions
5	Guide or survey related to existing techniques; or an update on past work or previous Technical Brochures
6	Work likely to contribute to improved safety.
7	Work addressing environmental requirements and sustainable development goals.