CIGRE Study Committee C6, «Distribution Systems and Dispersed Generation»

WG N° C6.20	**Name of Convenor : Joao Pecas Lopes** (Portugal)
Title of the Group : ***Integration of electric vehicles in electric power systems***	

Scope, deliverables and proposed time schedule of the Group

Background:

Electric power systems are facing a major new challenge (and hence opportunity): the future integration into the electric grid of a substantial number of plug-in hybrid electric and pure electric vehicles (PHEV & EV). The stimuli of this change are that electricity is likely the lowest cost and most energy efficient energy source for vehicle propulsion, electric motors are nearly ideal vehicle propulsion devices, and the limiting technology – batteries – are rapidly approaching practical cost, performance, and charging properties, thus ensuring that electricity is likely to become the preferred energy source for a new generation of road vehicles. In terms of the electric power system, EVs can be considered as:

- Simple loads, e.g. when their owners simply define that the batteries must be charged at a certain rate;
- Dynamic loads/storage devices, if their owners allow some EV management structure to control the charging process. From the grid point of view, this approach yields more benefits once it provides elasticity to these new loads, allowing the management structure reducing/increasing its values (or even request the battery to inject active power into the grid) when such action is needed. These actions may include real power control, power factor correction or frequency and voltage support.

Looking to EV as a simple load, it is easy to foresee major congestion problems in already heavily loaded grids and voltage profile problems in predominantly radial networks, if no load management strategies are defined, and these drawbacks might even be larger than the economic/environmental benefits arising from electric vehicles usage. Furthermore, if a bolder strategy is embraced, the potential benefits from large adoption of EV are even greater. The EV are then regarded as dispersed energy storage that can be used in ancillary services provision, decreasing traditional primary and secondary reserve needs, helping to manage congestion in some grids by shaving peak loads and by improving system dynamic behaviour in normal and emergency conditions. In this case one says that the Vehicle-to-Grid (V2G) concept is adopted including provision of additional revenue steams for vehicle owners. As large scale deployment of EV is now contemplated by a number of companies, it makes sense to start as early as possible planning the implementation of the smart EV management in the power systems of the future. Distributed intelligence in this new kind of grid needs to be adapted to control EV in a smart way, reducing the need for conventional energy storage devices while maintaining the ability to manage the networks effectively as well as balance the output of Renewable Energy Sources (RES).

Significant efforts have been undertaken around the world related to EV research. This new TF will seek to establish liaisons with key organizations such as EURELECTRIC, EPRI, NRCAN and CEATI to ensure that CIGRE makes a strong contribution to this important area and efforts are not duplicated.

Scope: The following topics will be elaborated within the WG

1. To identify the impacts of a massive integration of EVs in the future transmission and distribution electricity grids. These impacts refer to load consumption profiles, generation schedules, power flow patterns (network losses, congestion levels and voltage profiles), power quality and CO_2 emissions. The potential use of EVs to increase intermittent RES penetration will be examined.
2. To identify potential smart control approaches to be adopted by system operators, based on smartgrid concepts, to allow the deployment of EV without major changes in the existing network and power system infrastructures. Recommendations on potential standardization of technologies (network interface, metering, communication etc.) will be developed;
3. To address the impacts on generation and grid infrastructures planning, evaluating at the same time the required/deferred investments due to the simultaneous presence of intermittent RES and EV in the grid;
4. To identify the most appropriate ways to include EV into electricity markets, including an evaluation of how smart metering should take the presence of EV into account;
5. To collect practical experience from utilities, pilot projects and studies on the impact of integrating EV into the grid.
6. To collect information on standardization efforts for EV charging systems and interfaces.
7. To identify the required study models and analytical tools needed to evaluate the impact of large scale EV

penetration on the electrical system.

8. To identify the charging and discharging capability of battery technology being proposed in the vehicles of the future and the potential requirements of customers to identify gaps and opportunities. (e.g. rapid charging (5 minutes or less), intermediate charging (i.e. at shopping malls), slow overnight charging)
9. To collect information from utilities and manufacturers related to technology, regulatory and support mechanisms for EV and to develop a forecast for adoption of this technology.

Deliverables: Report to be published in Electra or technical brochure with summary in Electra

Time Schedule: start : 2010 **Final report** : 2012

Comments from Chairmen of SCs concerned :

Approval by Technical Committee Chairman : Klaus Fröhlich **Date** :09/01/2010