

# Electro-Drive Loads and the Electric Utility

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## Abstract

Anticipating the influx of a large number of electro-drive vehicles either on- or non-road that will plug-in to the national electric grid requires communication between all stakeholders, especially the electric utility to ensure the grid is capable of providing power to this new projected load. This communication and subsequent dialogs will allow the utility and end-users to adequately plan for new energy demands. As electricity use grows, the need to maintain a reliable grid increases. This paper will outline the need for communication and how the electric utilities can provide the knowledge and expertise to ensure all energy demands are met in a safe, efficient and reliable manner.

This paper will show that new electricity demands, in many instances, will require upgrades to the customer facility whether commercial, industrial or residential. It is not an option that all discussions and proposals include the electric utility, but a necessity. The need for a standardized infrastructure is a priority for the utilities to be able to provide efficient, cost-effective and reliable service.

**Key Words:** “Distribution, infrastructure, electric utility, PHEV,”

## 1. Introduction

Over the past 100 years, transportation methods have experienced an extraordinary evolution, moving from steam power to internal combustion engines (ICE) to battery-powered EV's to plug-in hybrid electric vehicles (PHEVs). Current industry emphasis is placed on the PHEV, and is not being limited to passenger cars, but is being expanded to include commercial and industrial vehicles as well. In the future, PHEVs could be seen as a source of energy.

One drawback of the first modern-era EVs was the range limitations of the energy storage device, usually a battery pack. Technology has taken giant steps forward to increase this range by developing hybrid technology. Additional steps have included adding a plug to charge the vehicles larger battery pack. This addition will allow for dual mode operability – battery only and ice/battery mode when needed for greater distances. PHEV technology allows for even longer cleaner operation and further reduces petroleum use – enhancing energy security.

Coupled to this technology is the electric utility. As more and more electro-drive transportation technologies are developed and made commercially available, additional demands will be placed on the electric utility grid. Although some success has been achieved over recent years to restore the health of the electric grid, continued emphasis must be placed on the types of loads that will be receiving power. This paper will examine plug-in hybrid technology and how it relates to the

electric grid - may be used to return energy to the grid during high-use or critical electricity demand periods.

## **2.0 Types of Load**

New technological energy consumers will soon utilize the electric utility grid – the PHEV. The PHEVs' dual operating system will run on batteries, in an all electric mode or use a ICE/generator to power the vehicle, making these vehicles a desirable means to reduce petroleum use and resulting tailpipe emissions and improve our air quality.

Potential Vehicle List may include:

- Utility trouble and bucket trucks
- Delivery vans
- Refuse trucks
- Military vehicles
- Emergency vehicles
- Sweepers, and more

As PHEVs increase in number, it is important to partner with the electric utility to prepare to serve this load.

### **2.1 Power Quality**

Battery chargers have a history of being very inefficient. Electric loads associated with charging batteries are known to have anomalies that may adversely interact with some sensitive equipment or cause sensitive processes to malfunction. One known side effect from these loads are harmonic frequencies. Harmonics frequencies are currents or voltages with frequencies that are multiples of the fundamental frequency of either 50 or 60Hz. While new battery chargers are more efficient due to their non-linear characteristics, their electronic components may produce harmonic frequencies.

Acceptable harmonic limits have been established by the International Electrotechnical Commission (IEC) and Institute of Electrical and Electronic Engineers (IEEE). In order to avoid potential adverse system impacts, the charger manufacturers should; 1) be made aware of the possible harmful affects of the chargers and; 2) develop products that will reduce harmonic frequencies. Publications from the IEC and IEEE should be referenced to determine specific equipment specification.

## **3.0 Electric Grid Health**

In past years, the national electric grid has experienced growing pains. In many instances, the load growth has exceeded the electric system growth. This has led to isolated incidents of power interruptions nationwide. The positive outcome is that many electric utilities have invested in improving the health of their transmission and distribution infrastructure. Southern California Edison (SCE) has made a commitment to upgrade our system over the next 5 years to ensure a safe and reliable infrastructure to serve our more than four and one half million customers.

To maintain a healthy energy system, it is vital that customers contact their electric utility during the planning stages of their construction projects to ensure a timely response for electric service.

## **4.0 Communication with Electric Utilities**

To allow the electric utility to adequately plan for growth, a dialog between the customer and the electric utility is imperative. This is true for both residential, commercial, and industrial customer expansion. To ensure the timely installation of the electric service, the utility needs to be included in discussions early in the process. This early dialog will provide the utility ample time to prepare their system to serve the new loads. In some instances, special ordered equipment (i.e. transformers, switches etc.) requiring substantial lead time may be needed. This early notification will allow the utility to ensure the equipment will be in stock when the project begins, eliminating project down-time.

In addition to current projects, the communication of any future projects to the utility will enable the utility to accurately forecast future circuit demands, avoiding the possibility of power outages.

## **5.0 Back to the Grid**

Selling excess power back to the electric utility is not a new concept. This concept has been in operation since the early seventies with the introduction of co-generation facilities to the present distributed resource facilities including solar power generation. However, it is taking a new direction - vehicle-to-grid (V-2-G) reverse power flow.

PHEVs have the potential of being a mobile source of electricity. As PHEVs are developed and made commercially available, the trend to use these rolling power suppliers for emergency and peak shaving episodes will be very attractive. However, caution should be taken with a V-2-G energy source scenario.

Each utility grid operator will have their own distinctive set of rules governing how and when an outside power source can be connected. These may include, but are not limited to:

- Closed Transition Return (paralleling) verses an Open Transition Return (non-paralleling)
- Preventing back-feed
- Anti-islanding
- Phase Rotation, Synchronization
- Frequency Stabilization.

To ensure utility compatibility and authorization to send power to the utility, it is very important to contact the utility during the planning stages of any project connecting to or feeding the grid to ensure all safety requirements are met, and the appropriate interface (relay protection) is installed.

## **6.0 Conclusion**

We can say with some assuredness that new electric transportation loads will be available in the near future and possibly on a large scale. These new loads will find their way into all customer arenas – residential, commercial and industrial.

We realize that new technologies in transportation could manifest into problems for the electric utilities and customers as new load is connected to the grid. We need to realize the variables that

can affect the safe and reliable operation of the utility distribution systems and what steps can be taken to avoid any adverse impacts.

The customer plays a significant role in assisting the utility to better serve all customers. By including the utility in all project discussions from preliminary planning to completion can be the difference between a healthy grid or one fraught with obstacles.

It is the responsibility of the electric utilities to serve all loads connected to the grid in a safe, efficient and cost-effective manner. The more we learn about new mobile electricity consumers, the better able we will be to make accurate energy growth forecasts for our future.

## **7.0 Author**

Mr. Sisco has over 40 years of electric utility industry experience specializing in the areas of transmission and distribution construction and maintenance and service planning. He is currently a Technical Specialist/Scientist in the Electric Transportation Division of Southern California Edison and is responsible for the planning and installation of electro-drive infrastructure charging system for SCE customers as well as SCE's alternative-fueled vehicle fleet. His area of responsibility includes the coordination of infrastructure installation and maintenance, conducting power quality assessments of charging equipment to detect potential impacts on the utility distribution system, and identifying potential safety issues relating to the operation of electric transportation charging infrastructure.

Mr. Sisco represents Southern California Edison on the Electric Power Research Institute (EPRI) Infrastructure Working Council (IWC) Committees. He chairs the Truck Stop Electrification /Port Electrification committee that is addressing connectivity standardization issues for truck stops and cold ironing. In addition, Mr. Sisco is a member of the EPRI Infrastructure Steering Committee (ISC) and Hybrid Electric Vehicle Working Group (HEVWG), and the IEEE P1572 sub-committee.