GRIDbot Electric Vehicle Service Equipment Installation

Task #4 Deliverable Report

for:

New Technology Research and Development Program

Contract # 582-11-11141-3264

Submitted by:

GRIDbot, LLC

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Abstract/Executive Summary

This demonstration includes installing 28 charging stations in one centralized location to support the City of Houston's (City) centralized fleet concept. The location is an underground parking garage in downtown Houston that encompasses 18 city blocks of parking space, is three levels deep and contains over 3,000 parking spaces. The City is purchasing all the vehicles that will make up the fleet, and this demonstration project is providing and installing all the components of the charging infrastructure.

The engineering, planning, and permitting for the second group of charging stations was mostly completed with the initial installation to reduce the overall cost of the project. A second contractor was identified to complete the second installation and was scheduled to be completed just prior to the delivery of the fleet of vehicles, which were expected in the fall. While this was completed and ready for use in October 2011, the project has seen additional delays.

Modeling and analysis of data has been collected weekly and analyzed on a monthly basis by HARC to determine mileage, reduction in tail-pipe emissions and point source emissions, time of charging sessions, and length of time charging.

Introduction/Background

The City developed a plan to reduce the number of fleet vehicles owned by the City and used by employees located in the downtown Houston area. Part of this plan is to increase the per vehicle use of a smaller fleet, and to replace the current gasoline vehicles with electric vehicles (EV) to reduce the tail-pipe emissions of the fleet. The City determined that the concept of a "pooled fleet" would enable them to monitor the vehicles more efficiently through an online reservation system and enable easy access for various departments.

This demonstration includes installing 28 charging stations in one centralized location to support the City's centralized fleet concept. The location is an underground parking garage in downtown Houston that encompasses 18 city blocks of parking space, is three levels deep, and contains over 3,000 parking spaces. The City is purchasing all the vehicles that will make up the fleet and this demonstration project is providing and installing all the components of the charging infrastructure.

GRIDbot's first electric vehicle supply equipment (EVSE) product, model UP 100J, was developed to target this type of fleet installation. It has both a Level-1 outlet which supports plug-in hybrid electric vehicle (PHEV) conversions and scooters and a Level-2 outlet which will provide faster charging for vehicles developed for the mass market, such as the Nissan LEAF or Chevy Volt. It also incorporates networking and reporting capabilities that will continue to enhance the fleet management of these vehicles beyond this demonstration. This product is now ready for full commercialization.

Project Objectives / Technical Approach

From the grant contract Grant Activities (Scope of Work):

> *"1.2 The objectives for this work are:*
>
> *1.2.1. Demonstrate the effectiveness and acceptance of GRIDbot's electric vehicle charging station technology in conjunction with a dedicated electric vehicle fleet."*

GRIDbot, Good Company Associates (Good Company), and the Houston Advance Research Center (HARC) agreed to partner with the City to provide charging infrastructure for 25 dedicated electric vehicles which the City purchased in 2011, as well as other plug-in electric vehicles included in the City's fleet. The City's goal is to consolidate its fleet, as well as replacing standard combustion engine vehicles with electric vehicles. This project's infrastructure will provide the electric charging for the City's entire electric and support many of their plug-in hybrid vehicles and will be located in the City parking facility at Tranquility Park.

Good Company is providing project management for the installation of the equipment and providing equipment user training to the City staff. Once the equipment is in use, Good Company will collect information from the staff to evaluate user acceptance of the centralized fleet, the dedicated electric vehicles, and charging equipment.

HARC is collecting information from the vehicles and the charging equipment and analyzing this data regarding charging station performance, vehicle use, and vehicle emissions, and will extrapolate the emissions impact based on this data using air quality modeling.

GRIDbot is providing the necessary technical oversight for all production, performance, and installation of the charging stations for the various contractors involved in the project. In addition, GRIDbot will work with the City staff to modify the customer interface and network operation based on project findings. This demonstration will enable GRIDbot's first EVSE product, the model UP 100J, to move quickly to broad product commercialization.

Task 4: Site Installation and Data Collection for Second Group of Charging Stations

From the grant contract Grant Activities (Scope of Work):

> *"2.4. Task Statement: The PERFORMING PARTY will install the second group of charging stations and collect data on their use".*

With the completion of the initial installation of all 28 charging stations, GRIDbot completed testing on the communications and reporting software and firmware from the stations. While waiting on the delivery of the rest of the fleet of LEAFs, the two LEAF's and 5 Prius' that have been using the charging stations, and their drivers, have provided us with information to finalize training materials and adjust the software reporting to the Fleet Management Department.

Second Installation

From the grant contract Grant Activities (Scope of Work):

> *"2.4.1. The PERFORMING PARTY will work with the City to complete a site engineering and assessment, including permitting, for the second site.*
>
> *2.4.2. The PERFORMING PARTY will install 14 more UP100J charging units at a second City of Houston motor pool site, a total of 28 stations."*

Installation of the additional 14 charging stations was delayed until Fall 2011 so that we could have them in place in time for the delivery of the fleet of cars, but not too far in advance. The initial contractor used for the first installation was not available, so a second contractor was identified to complete this work. Engineering, planning and permitting were reviewed and updated with this contractor and the installation was completed in September 2011, in the adjacent row of the garage, ROW G. The entire installation passed the electrical inspection on September 29, 2011. GRIDbot tested communications mechanisms and ran performance tests on all 28 of the charging stations. The project team reviewed the reporting templates with City Fleet Management Staff.

Cars Arrive

From the grant contract Grant Activities (Scope of Work):

> *"2.4.3. The City of Houston will take delivery of and place into service the remaining 23 Nissan Leaf fleet vehicles and assign the additional Prius Plug-in Hybrids for staff use and actively encourage use of these vehicles by all eligible staff".*

The actual delivery of the vehicles was delayed several times due to negotiated leases, insurance, and staff turnover at the City. Subsequently we have twice amended our timelines to delay the final completion of this project, while the original two LEAFs and 5 Prius' provided a small study sample.

Cars actually began to arrive at the site on March 23, 2012. Within a three week period, all 23 vehicles were delivered, but then faced some additional delays to be fully assigned and put into service by the City. Documentation of matching funds has been provided to TCEQ. The fleet now is a total of 25 LEAFs and 5 Prius'.

The City was able to negotiate the lease/purchase of Nissan LEAFs, which allowed the city to take advantage of the Federal Tax Credit, but created some additional challenges with the insurance company. It was expected that the entire fleet could be a pool for as many as 500 employees, but with the insurance the use is limited to 7 assigned drivers per car. This not only will limit the use of the cars, but also the number of employees that will have the opportunity to drive them. It also limits, somewhat, the effectiveness of the online fleet management and reservation software. Since this fleet management software was not purchased until April 2012, it has not been put into use with these vehicles. We have continued to use the key-fob radio frequency identification (RFID) cards for access to vehicle charging.

Figure 1. Photograph of cars in Row F

Figure 2. Photograph of cars in Row G

HARC Air Modeling Data

From the grant contract Grant Activities (Scope of Work):

> *"2.4.4. The PERFORMING PARTY will work with HARC to collect and compile data from the GRIDbot charging stations every two weeks during the demonstration."*

HARC is compiling data on charging from GRIDbot stations, OBD data loggers, and CARWINGS online reports, to create a summary report on charging activity by station and by vehicle. They have also acquired Houston-Galveston-Brazoria (HGB) area emissions factors for MOBILE6 and MOVES, and the most recent eGRID data for emissions estimates.

HARC had installed four GPS units (2 in LEAFs and 2 in Prius') plus 2 OBD data loggers in the 2 Prius'. HARC has added five more, so we now have 7 GPS units in LEAFs. We're not collecting this data from the Prius' at this point but continue to report all charging activity.

These loggers add to the available information collected from the cars and the charging stations, regarding miles driven and number of trips taken between charges. We are gradually seeing additional use of these cars, as they are put into service, but as of the date of this report, there are several that are still not in use. The Fleet Department has provided HARC with the list of vehicles being replaced with these electric cars, so that the appropriate comparisons can be made in our analysis.

Charging activity data is compiled and reported to HARC every 30 minutes, with a secure interface developed between GRIDbot and HARC to enable the download of this information automatically. Reporting formats and the information provided to the Fleet Manager was further developed into an expandable format which allows either a quick glance at total usage numbers or an expanded database identifying every charging session on every charging station.

HARC has continued site visits to the garage weekly to download vehicle data, and has provided analysis of the findings each month. In spite of the limited data due to the limited use, the information has been useful in developing reports and user information to both GRIDbot and to the Fleet Management Department.

Feedback

From the grant contract Grant Activities (Scope of Work):

> *"2.4.5. The PERFORMING PARTY will work with Good Company to collect feedback from vehicle and charging station users monthly during the demonstration. Feedback will include surveys, focus groups, educational forums, vehicle user data, and other forms of information that may become available."*

Good Company has been in regular contact with City staff of the various departments, although the users have been too few to successfully provide either surveys or focus groups. Security and Maintenance Staff have all received training and are contacting GRIDbot if and when there are issues with the charging stations, indicated by the red light, or reported by users. Fleet Department Staff have been provided the user information and they have been providing the user training in small groups, as the new drivers are assigned to the vehicles. Information received from the drivers or users of the first two LEAFs has helped us in crafting the information for the Fleet Department to provide for future drivers as they are assigned.

In addition to the assigned drivers, the Parking Management office has begun receiving requests from some of their parking contract clients to find out whether they could access these charging stations either during the day or in the evenings when visiting the Theatre District of Houston. While no public access is provided to the charging stations during this demonstration, it is evident that the technology at this location is getting public attention.

Timeline and Deliverables

From the grant contract Grant Activities (Scope of Work):

> *"2.4.6. Schedule: The PERFORMING PARTY shall complete this task within 16 months of the signed Notice to Proceed Date as issued by TCEQ."*

Due to the various delays the above schedule was determined through our submissions for amending the project. We have been able to extend this timeline within the budget of the original grant. We anticipate having enough information to complete the Final Report now by June 2012.

From the grant contract Grant Activities (Scope of Work):

> *"2.4.7. Deliverables: The PERFORMING PARTY shall submit a report to the TCEQ upon completion of this task. This report will include but is not limited to documentation, including photographs, of the installed charging outlets and in-service electric fleet vehicles."*

This report is the final Deliverable Report that will be submitted prior to the Final Report, which will include more photographs, full analysis of the data, and staff feedback.

Discussion/Observations

Objectives vs. Results

Given the delays in getting vehicles used by the various staff, we will not be able to compile as much data as we had hoped from the users. However, the extended period that we have had only a few users has been used to improve communications, educational materials, installation guidelines, and fleet use reporting.

When the City negotiated the lease/purchase of Nissan LEAFs, this allowed the City to take advantage of the Federal Tax Credit to reduce the capital cost of the vehicles, but created some additional challenges with the insurance company. It was expected that the entire fleet could be a pool for as many as 500 employees, but the insurance limits the use to 7 assigned drivers per car. This not only will limit the use of the cars, but also the number of employees that will have the opportunity to drive them. It also limits, somewhat, the effectiveness of the online fleet management and reservation software.

Critical issues

The fleet management software will be incorporated into the City's procedures after the completion of this project, so will not be available for our evaluation. While this was an interesting addition to our demonstration, it will not limit the analysis of air quality impacts or the success of the charging infrastructure.

Technical and commercial viability of the proposed approach

The manufacturer has identified several small changes to their production line that have been identified through this demonstration project. The benefit of this demonstration to the commercial viability of this product cannot be underestimated. This project has enabled GRIDbot to field test a large number of charging stations in one location, which would have been unlikely otherwise. The cooperation of the various Principals has been very helpful. GRIDbot is now offering three variations of the product in limited supplies on the commercial market, while developing a distribution framework for the USA and Canada.

Scope for future work

HARC is working on their data analysis and their findings will be incorporated into our Final Report. This Report will also include the photographs at the site, copies of reporting formats that have been produced, and educational materials provided.

Intellectual Properties/Publications/Presentations

No new IP has been developed, no publications identified, or presentations planned at this time.

Summary/Conclusions

With this Deliverable Report, GRIDbot has demonstrated the ability to bring together the appropriate technologies, resources, and personnel to proceed with the field demonstration. HARC has identified the data sources needed and provided the interim findings and analysis of the emissions estimates for these

electric vehicles. GRIDbot is looking forward to completing this demonstration of their new technology and its viability in future markets.

Acknowledgements

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- Mayor Anise Parker's Office,
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