

# **GRIDbot Electric Vehicle Service Equipment Installation**

## **Task #1 Deliverable Report**

**for:**

**New Technology Research and Development  
Program**

**Contract # 582-11-11141-3264**

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## Table of Contents

<b>ABSTRACT/EXECUTIVE SUMMARY .....</b>	<b>1</b>
<b>INTRODUCTION / BACKGROUND .....</b>	<b>2</b>
<b>PROJECT OBJECTIVES / TECHNICAL APPROACH.....</b>	<b>3</b>
<b>TASKS .....</b>	<b>4</b>
DATABASE DEVELOPMENT AND DATA COLLECTION.....	4
MODELING AND SCENARIO ANALYSIS .....	5
EQUIPMENT AND SUPPLIES PROCUREMENT .....	5
INITIAL SITE ENGINEERING AND ASSESSMENT.....	6
FLEET MANAGEMENT SYSTEM .....	6
VEHICLE PROCUREMENT .....	7
TIMELINE AND DELIVERABLES .....	8
<b>DISCUSSION/OBSERVATIONS .....</b>	<b>8</b>
OBJECTIVES VS. RESULTS .....	8
CRITICAL ISSUES .....	8
TECHNICAL AND COMMERCIAL VIABILITY OF THE PROPOSED APPROACH .....	9
SCOPE FOR FUTURE WORK .....	9
<b>INTELLECTUAL PROPERTIES/PUBLICATIONS/PRESENTATIONS.....</b>	<b>9</b>
<b>SUMMARY/CONCLUSIONS .....</b>	<b>9</b>
<b>ACKNOWLEDGEMENTS .....</b>	<b>9</b>
APPENDIX A: UL LISTING.....	10
APPENDIX B: SITE PERMITTING.....	11
APPENDIX C: VEHICLE PURCHASE .....	12

## Table of Figures

Figure 1. Picture of the GRIDbot UP 100J.....	3
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## **Abstract/Executive Summary**

The planning and design of this electric vehicle service equipment (EVSE) demonstration has been completed and the team is scheduled to begin the installation the first week of April 2011.

This demonstration includes installing 28 charging stations in one centralized location to support the City of Houston'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 of Houston is purchasing all the vehicles that will make up the fleet, this demonstration project is providing and installing all the components of the charging infrastructure.

The planning and design phase included purchasing charging station equipment, setting up data collection and analysis methods, securing site engineering and site assessments, preparation for staff training, and application for required permit for the installation. This has been accomplished with the cooperation of various City of Houston staff, the principal investigators and contractors, all of whom have contributed their specific technical areas of expertise as well as their enthusiasm for being part of the first installation of this scope in the US.

## **Introduction / Background**

The City of Houston 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 of Houston’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 of Houston is purchasing all the vehicles that will make up the fleet, this demonstration project is providing and installing all the components of the charging infrastructure.

Key to this demonstration, information will be collected from the staff, the vehicles, and the charging stations to analyze the emissions reductions, and charging requirements of the various vehicles. Additional information from the staff will assess their acceptance of the centralized fleet concept, dedicated electric vehicles over traditional vehicles, and the use of the charging stations. All of these components and findings will be demonstrated, analyzed, and reported as part of this project.

GRIDbot’s first 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 has passed UL testing (Appendix A) and first run of manufacturing and is available for this field demonstration.

**Figure 1. Picture of the GRIDbot UP 100J**



## **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 of Houston (the City) to provide charging infrastructure for 25 dedicated electric vehicles which the City will purchase 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 shifting to adopt electric fleet vehicles. This project's infrastructure will provide the electric charging for the City's entire fleet 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 will collect information from the vehicles and the charging equipment and analyze 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.

## Tasks

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

### *Task 1: Planning and Design*

*2.1. Task Statement: The PERFORMING PARTY will complete all necessary work in preparation for the demonstration, including purchasing charging station equipment, setting up data collection and analysis methods, securing site engineering, site assessments, and all required permits for charging station locations, and training staff.*

Planning included various meetings to identify the goals of the project and the various stakeholders, contractors, and vendors to accomplish those goals.

### ***Database development and data collection***

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

*2.1.1. The PERFORMING PARTY will work with the HARC and the City to develop a project database and data collection interfaces to collect data from the cars and charging stations for emissions modeling and assessment.*

The HARC database will collect information from three sources: the GRIDbot charging stations, the City fleet of electric vehicles, and the fleet management software. The GRIDbot UP 100J EVSE charging infrastructure is capable of providing detailed information on charging events and its interaction with the vehicles. HARC has begun to examine the charging process and determine what data is available for collection during that process. Examples of available data from the charging stations would include time of day, time spent charging, energy per charging event, time plugged in but not charging, power demand, energy consumption per vehicle, and failure modes.

The vehicle provides information about driving activity. Vehicle/trip variables, user differences, and operating conditions will impact the tail-pipe emissions produced by both gas-fueled and PHEV's, thus impacting the emissions reduction of the EV's. Trip data will also include

ambient conditions that impact vehicle performance, including air temperature, rainfall, or high winds.

The third source of potential information may be the City's fleet management software. The systems being considered include an online reservation system, electronic key-less entry, active vehicle tracking, and onboard wireless data reporting that could provide additional information for our analysis.

### ***Modeling and scenario analysis***

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

*2.1.2. The PERFORMING PARTY will work with HARC to develop a modeling and scenario analysis to be used to evaluate air emissions impacts of the use of a dedicated electric vehicle fleet. The modeling and scenario analysis will include use of EPA emissions standards and the GREET model.*

HARC is developing the modeling and scenario analysis that will utilize the data collected from the fleet vehicles, the charging stations and the City's fleet management software. The purpose of the scenario analysis is to identify and estimate the emissions of concern under different existing and future conditions associated with the adoption of EV's and the electric charging infrastructure. HARC will also model the impacts on the electric power system when implementing various protocols, such as varying time of day charging to avoid peak demand or balancing loads with sequence charging. The GRIDbot UP 100J EVSE allows for managing the charging, even slowing or restricting the charging, which may be implemented by the City.

HARC will collect and analyze the data collected throughout this demonstration utilizing modeling tools which include GREET, eGRID, and Mobile6.

### ***Equipment and supplies procurement***

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

*2.1.3. The PERFORMING PARTY will procure all necessary equipment and supplies for the project as detailed in the Approved Grant Budget, including the manufacturing of the GRIDbot charging stations.*

Manufacturing was begun in February 2011 and GRIDbot has arranged to pay for all the charging stations for this demonstration over the four months of this installation. Delivery of the charging stations is scheduled for April 29, 2011. The electrical equipment that will be needed, including the distribution panels and transformer, are being purchased by the installation contractor. Vehicle data monitors will be purchased, if necessary, after HARC has an opportunity to evaluate the information that can be obtained from the vehicles directly. Contractors have been identified to install the wheel stops and the security equipment, but these will not be paid for until they are installed.

## ***Initial site engineering and assessment***

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

*2.1.4. The PERFORMING PARTY will work with the City to complete a site engineering and assessment, including permitting, for the first of the two sites.*

The location for the centralized fleet was selected by the Project Team in collaboration with the City Fleet Management Department. The selected site at the Tranquility Garage is centrally located for the various employees and provides some visibility to the public. This 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 Project Team discussed several locations and found that the Aqua Level – Rows F & G would provide easy access for the staff and has nearby access to the electrical supply. The dedicated space for the electric fleet will eventually encompass 28 spaces in these two adjacent rows. The location was certified by a Master Electrician to have adequate electric capacity for 28 charging stations to support the City's plan for a centralized pool.

GRIDbot has provided technical support to the installation contractor for the electrical plan and the installation layout. The plans include detailed electrical support for the project, installation instructions for the charging stations, and troubleshooting information for the staff. Plans were submitted to the City Permitting Department on April 19, 2011 and are filed under Project # 11035456 (Appendix B). The installation will be permitted as one project but will occur in two phases:

- Phase I will include all the electrical support (installation of transformers and distribution panels) and concrete coring for the entire project, as well as the installation of the first 14 charging stations (May 2011).
- Phase II will be the installation of the second 14 charging stations (July 2011).

To protect this significant capital investment and to collect information on user error, during Phase I security cameras will be installed in parking areas with the charging stations. Bids were collected by the City Facilities Department for the cameras' installation and data storage.

Good Company is coordinating with the City Facilities Department for the camera installation and the wheel stops that will be installed to protect the charging stations, as well as striping that will reserve the spaces for the fleet.

## ***Fleet management system***

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

*2.1.5. The PERFORMING PARTY will work with the City to set up a fleet management system that its staff will use with the vehicles. PERFORMING PARTY will work with the City to set up the web interface and vehicle data collection for this system. Under contract with the PERFORMING PARTY, Good Company will work with the City to develop policies and procedures for City*

*staff who will be using the vehicles and recharging stations, and education materials for the staff regarding the charging and fleet management system.*

To manage this consolidated centralized fleet, the City plans to purchase a software fleet management tool that will enable online reservation of the fleet cars, will keep records of employee use, and will provide radio frequency identification (RFID) card access to the vehicles. This access system will eliminate the need to pick-up or return keys to a central location. Keys will be kept in the vehicle and the “access system” will only be enabled for card carrying users who make a reservation. Systems for the employees to be registered, have access, and make reservations will be managed by the City Fleet Management team.

For access to the charging stations, GRIDbot RFID cards assigned to the vehicle will be kept in the vehicle rather than with the drivers. This will enable the data collection on specific vehicles that is vitally important to both this project and to the fleet management. This demonstration will only allow these City Fleet cars to have access to the GRIDbot stations. GRIDbot has contracted with both a software engineer and a firmware engineer to make any necessary adjustments in the charging stations to support both data collection and access.

Good Company is working with the City to develop the policies and procedures for staff use of the management system, the vehicles, and the charging infrastructure. Good Company is also working with the City staff to develop instructional training materials for the staff to make the transition to the EV's as simple and straightforward as possible.

### ***Vehicle procurement***

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

*2.1.6. The PERFORMING PARTY will work with the City to ensure that the City procures 25 Nissan LEAF dedicated electric fleet vehicles for delivery within the required timeline.*

The City selected the Nissan LEAF as the vehicle of choice for this fleet because it is a dedicated electric vehicle, meaning there is no other alternative fuel. Both from a cost basis and from a maintenance consideration, this vehicle will be superior to any of the bi-fuel or extended range vehicles.

As a result of delays in the delivery of LEAF's to the US, to date the City has only been able to purchase 2 of the planned 25 LEAF's that will make up the largest share of this fleet (Appendix C). These two vehicles are expected to be delivered by the first week of May. It is anticipated that the LEAF's will be more readily available after July 2011. In addition to the dedicated EV's, the City currently has 15 PHEV converted Prius' and have recently purchased another 5 conversion kits that will be installed in their existing vehicles. The City plans to assign 6 to 8 of these PHEV's to the centralized fleet location where this demonstration will occur, enabling increased information collection and testing of the GRIDbot charging stations.

## ***Timeline and deliverables***

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

*2.1.8. Schedule: The PERFORMING PARTY shall complete this task within 2 months of the signed Notice to Proceed Date as issued by TCEQ.*

The project is about a month behind schedule due to delays in the UL listing tests and the procurement of vehicles; however the Project Team has adjusted the timeline and plans to complete the project in the remaining time without further delays.

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

*2.1.9. 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 a full description of all preparatory work and a copy of the first site engineering and assessment.*

This concludes the Deliverable Report. The engineering plan for the installation and the site assessment have been provided or made available to TCEQ.

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

*2.1.10. Approval to Proceed with Further Tasks: The TCEQ will determine whether additional tasks will be approved and funded depending upon the success of completing this task. No additional funding will be provided under this Agreement unless the PERFORMING PARTY receives written approval from the TCEQ to proceed with further tasks.*

GRIDbot requests TCEQ approval to proceed with the installation and completion of this project.

## **Discussion/Observations**

### ***Objectives vs. Results***

Other than timing changes there have been no significant issues or barriers to the success of the project. As with all new technologies, the Project Team is learning through this field demonstration and solutions have been incorporated into this project plan.

### ***Critical issues***

Early discussion about the installation with local utility representatives can reduce concerns and costs that could come up in some situations. Traditionally, parking structures do not have significant electrical capacity as they routinely provide only lighting and security systems, so this must be evaluated. This was a critical first step in project planning.

## ***Technical and commercial viability of the proposed approach***

This consolidated fleet plan appears to be technically and commercially viable for large municipal areas or large commercial fleets. The incorporation of this centralized fleet concept along with the move to electric vehicles will reduce significant tail-pipe emissions from the City's current fleet vehicles. A full cost/benefit analysis for the project in will be included in the final report.

## ***Scope for future work***

GRIDbot and Good Company are working very closely with the City staff to ensure a successful experience for the City and to become an example for other cities to follow. GRIDbot is currently looking for other organizations in Texas who are interested in doing a similar project, to enable us to use the lessons learned in other locations of the state.

## **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. GRIDbot is looking forward to the next step in realizing this vision and demonstrating this new technology and its viability in future markets.

## **Acknowledgements**

In addition to the matching funds that have been provided, the City of Houston has provided this project with assistance and cooperation of their staff in the following departments:

- Mayor Anise Parker's Office,
- Office of Sustainability,
- Finance Department,
- Fleet Management Department,
- Convention Facilities Department, and
- Electrical Permitting Division.

## ***Appendix A: UL Listing***

## ***Appendix B: Site Permitting***

*Appendix C: Vehicle Purchase*