

**Texas Commission on Environmental Quality
New Technology Research & Development (NTRD) Program
Monthly Project Status Report**

Contract Number: 582-11-13472-2019

Grantee: Transportation Power, Inc.

Report for the Monthly period: 04/06/13 – 05/03/13 **Date Submitted:** 05/10/13

Section I. Accomplishments

Provide a bulleted list of project accomplishments as well as a description of their importance to the project.

- Both yard tractors were delivered to HEB in San Antonio, Texas.
- Supported by visiting TransPower technicians, HEB personnel test operated the two tractors for three weeks, periodically making modifications to the tractors to improve their functionality and to enable them to meet specific operational needs unique to HEB. Testing included monitoring the effects of operating the tractors at high speeds under load on the rough roads surrounding the HEB warehouses. The tractors were also run through the HEB vehicle washing facility to verify that the tractors could endure these operations without suffering water damage.
- Visiting TransPower technicians provided training to HEB personnel on the operation and maintenance of the electric yard tractors. This and the above accomplishments were important to the project because they represented the final steps in enabling HEB to begin operating the yard tractors on a regular basis.
- Figure 1 is a photo of one of the tractors pulling a fully-loaded 80,000 pound (lb) refrigerated trailer during the first day of operational testing on April 16, 2013.



Figure 1. Yard tractor pulling a loaded 80,000 lb refrigerated trailer.

Indicate which part of the Grant Activities as defined in the grant agreement, the above accomplishments are related to:

- The first accomplishment described above relates to *Task 2.4.2.1, “The PERFORMING PARTY will deliver Tractors 1 and 2 to the field demonstration site, HEB’s primary distribution facility in San Antonio, Texas.”*
- The second and third accomplishments relate specifically to *Task 2.4.2.2.1, “The PERFORMING PARTY will provide on-site service and support for the duration of the field testing to help maximize vehicle availability. The PERFORMING PARTY will closely monitor all drive system components and functions during the first month of testing, using both data obtained by engineers on the vehicle and data transmitted to the PERFORMING PARTY’s facilities via wireless links.”*

Section II: Problems/Solutions

Problem(s) Identified: Report anticipated or unanticipated problem(s) encountered and its effect on the progress of the project

- a) The tractor suspension systems were determined to be insufficient to dampen shock and vibration effects likely to occur on rough roads near the HEB facility with the heavier weights created by the vehicle battery packs.
- b) Signs of chafing were notices on some electrical cables due to their rubbing against metal surfaces.
- c) Over the course of initial testing, the small motor used to actuate the automated shifting mechanism failed on one of the tractors.
- d) During the first attempt to recharge the tractors, it was determined that the inverter-charger unit was not charging on one of the two tractors.
- e) Following correction of the inverter-charger unit problem that was experienced on one of the two tractors, it was notice that one of the two battery strings on that tractors still wasn’t recharging.
- f) HEB personnel expressed their view that the large charging plugs were difficult to maneuver.
- g) On April 22, 2013, at the beginning of the second week of testing, a switching device used to protect the 12-volt battery from accidental discharging overheated and caused a small wiring fire. Figure 2 is a close-up photo of part of the battery protector switch that overheated and the adjacent wiring that was damaged.

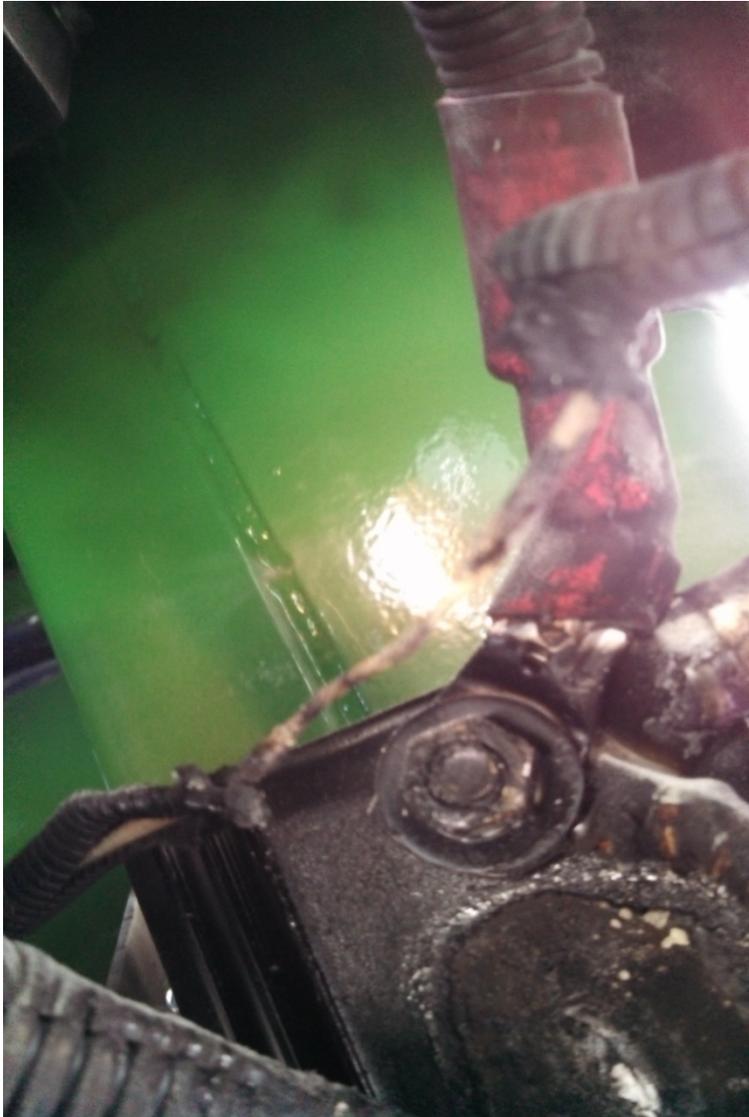


Figure 2. Battery protector switch and adjacent wiring following damage caused by overheating.

Proposed Solution(s): Report any possible solution(s) to the problem(s) that were considered/encountered

- a) It was determined that installation of new, heavier duty springs into the tractors was the only viable solution to countering the heavier weight of the batteries.
- b) Two potential solutions were considered: wrapping cables in areas where chafing is likely to occur and rewiring the tractors.
- c) Using a heavier duty motor and adjusting the software to reduce torque on the motor were both considered as solutions.
- d) The failure to charge was determined to be a failure within the inverter-charger unit or a wiring problem.
- e) The subsequent failure of one battery string to charge was determined to be either a problem within the battery modules or a wiring problem.

- f) Improving the maneuverability of the charging plugs could be achieved by redesigning the charging mechanism or adding handles to the plugs.
- g) The overheating and subsequent fire clearly originated within the protector switch and potential solutions included replacing this with a different switch, inserting a fuse into the circuit to cut off power before a similar event could occur, or removing the switch entirely.

Action(s) Conducted and Results: Describe the action(s) taken to resolve the problem(s) and its effect

- a) Heavier springs were installed into both tractors. This provided the desired level of damping and is expected to enable the tractors to be operated with an adequate degree of driver comfort and protection of tractor components.
- b) Wires and cables seen as prone to chafing were wrapped for added protection. A major rewiring effort would have been prohibitively expensive. No chafing problems have been reported since.
- c) A torque adjustment was made and both shifting motors have been functioning reliably since.
- d) It was originally believed that there was a fault within the inverter-charger unit that was not working and an engineer from the unit's manufacturer, EPC, visited HEB to troubleshoot the device. It was subsequently determined that the inverter-charger unit was fully functional and was not working because the charging plug had been improperly wired. The wiring was quickly fixed and the charger unit began functioning properly.
- e) The failure of the one battery string to recharge was found to be due to a cabling connection that was not made properly. This was subsequently fixed and both battery strings then recharged normally.
- f) TransPower engineers designed and built handles for both charging plugs, which were then shipped to San Antonio and attached to the plugs by HEB technicians.
- g) A thorough investigation of the wiring fire concluded that the battery protector switch overheated under load and that the quickest, safest way to avoid future incidents was to simply remove these devices from both tractors. This was done and both tractors subsequently performed without any similar incidents. Removal of the switches leaves the 12-volt battery in each tractor susceptible to inadvertent discharging when tractors are left idle for extended periods, but this risk is seen as minimal due to the fact that the tractors are expected to be operated more or less continuously. The manufacturer of the battery protector switch will be contacted and an effort will be made to determine if there were any measures TransPower could have taken to prevent it from overheating. TransPower conducted a formal safety review and evaluated the safety of its drive system wiring in general to determine if there are other areas where such overheating could pose difficulties and to assess whether wiring changes or addition of fuses or other protective devices are warranted. It was determined that there weren't any urgent requirements of this nature on the two yard tractors, but that to the extent practical, additional fusing and protection may be included in future drive system installations..

Section III. Goals and Issues for Succeeding Period:

Provide a brief description of the goal(s) you hope to realize in the coming period and identify any notable challenges that can be foreseen

Goals for the next reporting period include:

- Continue monitoring operation of the two electric tractors by HEB.
- Provide additional remote and on-site support as required.
- Achieve routine, every-day service of both tractors.
- Prepare final report and other materials required to close out grant agreement.

HEB personnel seem generally very pleased with the performance of the two electric tractors to date. They have been proactive in helping to make the improvements and corrections determined to be needed during the first three weeks of testing, and have been sharing information internally and doing their own training in preparation for placement of the tractors into routine, every-day service. This is expected to occur before the end of the grant at the end of May 2013.

Date: 5/10/2013

Authorized Project Representative's Signature

NOTE: *Please attach any additional information that you feel should be a part of your report or that may be required to meet the deliverable requirements for tasks completed during this reporting period.*