

**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. (Transpower)

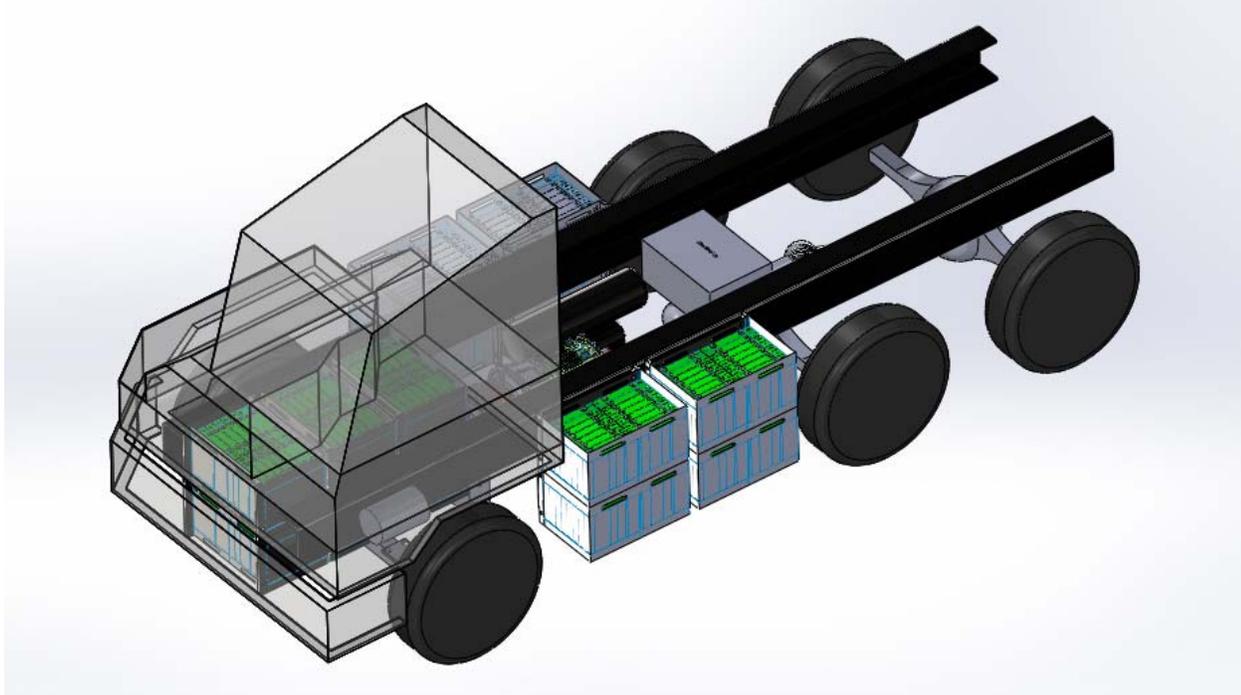
**Report for the Monthly period:** 12/10/11 – 01/06/12 **Date Submitted:** 01/10/12

**Section I. Accomplishments**

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

- All major components of the electric drive system were identified and computer models of each component were generated. Figure 1 is a computer assisted design (CAD) illustration of the Kalmar terminal tractor with the locations of major components identified. As indicated, batteries are installed into modules attached to the frame rails on both sides of the vehicle, just behind the cab, and installed under the cab. The main drive motor, driveline, and inverter-charger unit (ICU) are visible between the frame rails. This is an important accomplishment because it has verified that the components will all fit into the vehicle in an orderly way and paves the way for ordering of the components.

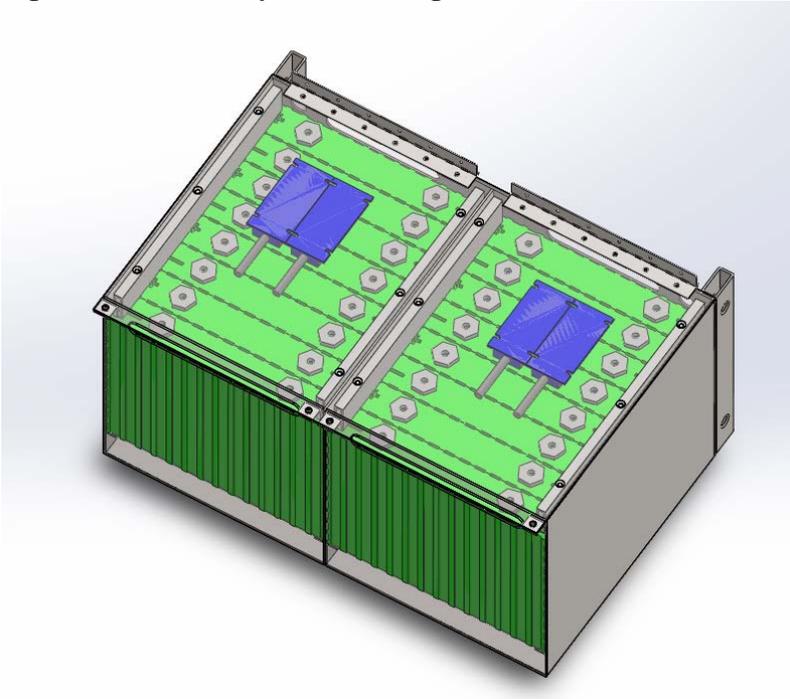
**Figure 1. CAD rendering of Kalmar terminal tractor showing electric drive component installation**



- The Kalmar vehicle Controller Area Network (CAN) bus was successfully deciphered with the assistance of representatives from Allison Transmission, using TransPower’s Vector CANalyzer tool. This information will enable TransPower to control key vehicle components such as the anti-lock braking system (ABS) and to display the status of its components on the vehicle’s instrument cluster.

- A new battery enclosure concept was developed, which is more advanced than those previously developed for TransPower’s first on-road Class 8 truck. The new design, shown in Figure 2, holds 16 large (300 ampere-hour) battery cells and provides active cooling and quick high-voltage disconnecting in a flexible, modular package. Among various unique features of the enclosure design, the battery management system (BMS) modules are mounted into the lid of the enclosure. This improved enclosure design is expected to provide adequate structural strength with minimal use of space, while enhancing maintainability and controlling costs. This is a key accomplishment because the battery modules will be the largest and most expensive of the drive system elements installed into the yard tractors, and because vehicle performance will be greatly impacted by the batteries.

**Figure 2. New battery module design.**



- Issued a Purchase Order to Quantum Technologies for the drive motors and inverters to be used in the two electric tractors. This is an important step because the lead times for these items are fairly long. All efforts are being made to accelerate shipment of these items.
- Removed the motor and transmission from the first Kalmar terminal tractor, along with all other major components that will not be used as part of the electric drive system. This is allowing more precise measurements of the space available for TransPower components and will enable integration of components to begin as soon as they are received. Figure 3 shows the engine and transmission following their removal, with the tractor visible in the background.

**Figure 3. Engine and transmission after removal from first tractor.**



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

- The second, third, and fourth accomplishments listed above relate to Task 2.1.1, “Final Component Selection and Procurement.”
- The fifth accomplishment above relates to Task 2.2.2, “Tractor Installation.”
- The first accomplishment relates to both of these tasks, but is principally part of Task 2.1.1.

## **Section II: Problems/Solutions**

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

- a) Continued testing of the Navistar on-road Class 8 electric truck identified additional problems with the Quantum inverters required to control the system's drive motors. These problems delayed procurement of the Quantum inverters to be used as interim inverters in the electric terminal tractors. This may delay initial testing of the tractors, depending on TransPower's progress in developing the ICU, which is intended to be the inverter used in the vehicles in the long term. It also limited the amount of drive testing that could be performed with the Navistar truck, reducing the amount of data on drive system components that could be acquired prior to making final component selections for the terminal tractor. This may not affect the progress of the project, but represents a lost opportunity for further risk reduction.
- b) Facility modifications required for venting of diesel exhaust were initiated but not completed as expected due to continued delays by the contractor. These delays are no longer affecting the project because we removed the diesel engine and transmission from the tractor without the facility improvements being completed. In the longer term, these facility modifications need to be completed if we are to continue working with diesel engines and fuel systems at our present site.

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

- a) TransPower considered various efforts to resolve the problems with the Quantum inverters, and also considered acquiring inverters from other suppliers.
- b) The ducting for the required facility improvements was installed but we are still awaiting placement of an exhaust fan on the roof. As discussed above, this process is no longer affecting the project.

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

- a) TransPower determined that acquiring a different inverter was an impractical approach because of the time and expense required to customize it to work with the motors selected for TransPower's trucks and tractors. Since we will eventually have our own Inverter-Charger Unit (projected to be fully functional by about mid-year), a decision was made to expend considerable resources (from our other contracts and our own investments) attempting to resolve the problems with the Quantum inverters, including paying a Quantum consultant \$13,000 to attempt numerous inverter repairs in December. This has provided one sporadically working inverter that is allowing us to conduct testing of our Class 8 truck under partial power from time to time, but until we get two working inverters, we will not be able to perform full-power testing of this vehicle. This does not have a significant impact on the terminal tractor project because the electric terminal tractors will use only one inverter and operate at lower power than TransPower's on-road trucks. However, the frustrations with the Quantum inverter do raise questions about how reliably this component will perform when used as the interim inverters in the electric yard tractors. It is expected that the tractors will need to utilize these inverters for at least 2-3 months before the TransPower ICU is ready for full use. Efforts on

completing ICU development in a timely manner are being redoubled in response to the issues with the Quantum inverters.

- b) As the facility modification issue is not affecting the project at this time, we are not taking any action other than working with the contractor to make the final exhaust fan installation as soon as practical.

### **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*

- We have finally removed the diesel engine, transmission, and fuel system from the first terminal tractor, have completed the electric drive system layout, and have ordered the motors and interim inverters for the two electric tractors, so progress is accelerating greatly.
- During the next period we expect to order the remaining major components, including transmission, batteries, and electrically-driven accessory components. Our goal is still to achieve a high level of completion of the first electric tractor by the end of the first quarter of 2012.
- We are in the process of preparing a request for a modification of the project schedule that reflects the delays we've encountered and that has more realistic completion dates for each of the project tasks. While these delays are frustrating, the extra time has allowed more R&D to be completed on other projects, preserving the resources of this project and generally reducing the level of technical risk to be encountered once the electric tractor integration and testing tasks are fully underway.

Date: 1/10/12

---

*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.*