PACCAR E-Truck: Retrofit Packaging & Optimization

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SUMMARY

Introduction:
- The goal of this 4-year project is to convert a Class 7 Peterbilt 337 ICE truck into a fully battery electric vehicle.
- We are working closely with 3 other E-Truck capstone teams: Controls Architecture, Electrical Architecture, and Systems Definition & Modeling.
- We also collaborate with the E-Truck Registered Student Organization (RSO).

Objective:
- Select appropriate components based on industry performance metrics using Market Research, Six Sigma Decision tools, and Supplier consultations.
- Ensure structural integrity and safe mounting of electrical components through Static Beam Analysis and Finite Element Analysis (FEA), including Modal Analysis.
- Modify CAD model to package battery/electric powerplant into the ladder chassis.
- Modify auxiliary systems to operate without ICE power.

STRUCTURAL ANALYSIS

- Breaking truck into parts to find axle loads
- Max front load: 12,000 lbs / Max rear load: 21,000 lbs
- Add payload to bring gross weight to 35,000 lbs (Class 7 Max)
- Maximum shear (per frame rail): 3.6 mm
- Maximum bending moment (per frame rail): 501,400 in-lb

DECISION ANALYSIS

This Process Flow Chart is used by PACCAR for Design Selection

COMPONENT SELECTION

DANA—Spicer Zero-B E-Axle & Inverter
- Power: 530 kW
- Voltage: 400-800 V
- Torque: 28,000-130,000 Nm
- GCW: 16,000-70,000 kg

AKASOL—AKM 150 CYC HV Battery (x4)
- Energy: 98 kWh
- Weight: 560 kg
- Voltage: 665 V
- Cycles: 4,000

AirSquared—P17H043D-BLDC-LC Air Compressor
- Pressure: 425 psi
- Flow: 130 L/min
- Weight: 18 kg

DC Airco—DC 6001 Heat Pump
- Power: 3.4 kW
- Voltage: 400-850 V
- Flow: 25-40 L/min
- Weight: 21.5 kg

GUCHEN—Electric Truck AC Compressor
- Power: 2.82 kW
- Cooling: 3.175 kW
- Weight: 6.1 kg

CONCLUSION

Summary:
Throughout the two quarters, our team made substantial progress. We conducted comprehensive market research based on the requirements developed in collaboration with the 3 other capstone teams. Through supplier consultations and the application of Six Sigma tools like the Decision Analysis and the Pugh Matrix, we generated rankings for all components. We successfully analyzed the chassis structure to ensure structural integrity and safe mounting of the high voltage batteries. Our team also modified the CAD model to incorporate the selected high-voltage batteries.

Future Work:
- Finalize the selection of all components and maintain ongoing supplier engagement
- Conduct a Decision Analysis to affirm the High Voltage Battery selection
- Confirm decisions regarding the necessary auxiliary components for the cooling system
- Refine FEA, including Modal analysis with all components selected
- Update the CAD model to incorporate the E-Axle, auxiliary components, and component mounting brackets

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