DALHOUSIE UNIVERSITY
FACULTY OF ENGINEERING

Lithium-Ion Battery Thermal Control System

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Client: Mitchell Gregory
Mavio Technologies Inc.

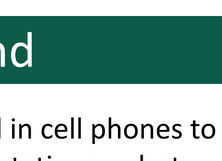
Background

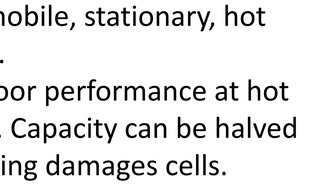
- Lithium-ion batteries are used in cell phones to school busses, and in mobile, stationary, hot and cold environments.
- Batteries suffer from poor performance at hot and cold temperatures. Capacity can be halved at -20°C and cold charging damages cells.
- Improving thermal control can enable use of lithium-ion powered systems in extreme climates such as Northern Canada and Marine applications.
- The goal of the project was to develop a thermally controlled, portable storage system.
- This project developed a standalone system which uses insulation and an efficient active thermal control system to improve efficiency.

Design Process

Concept:
- A 13-cell module of SKI E600 cells (originally from a Kia Niro EV) selected.

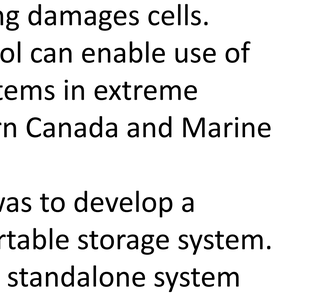
Preliminary:
- Over 30 thermal design configurations considered. Coolant plate, resistive heater, and refrigerant cycle chiller selected.



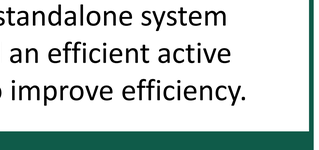


Detailed:
- Cooling system fluid flow simulations and detailed 3-D model completed.

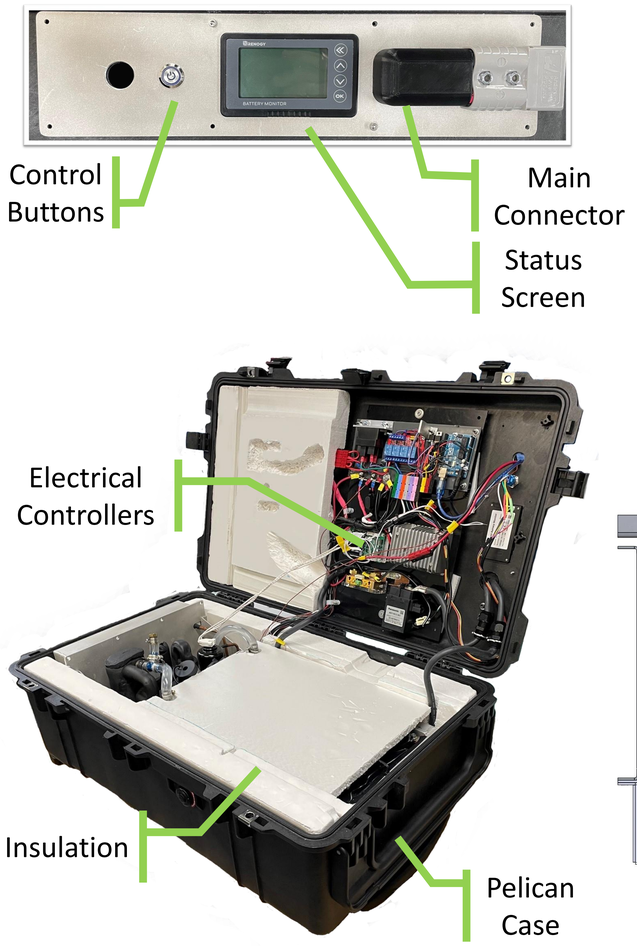
Fabrication:
- 3-axis CNC milling, Sheet metal operations, bonding, fastening, and welding used.

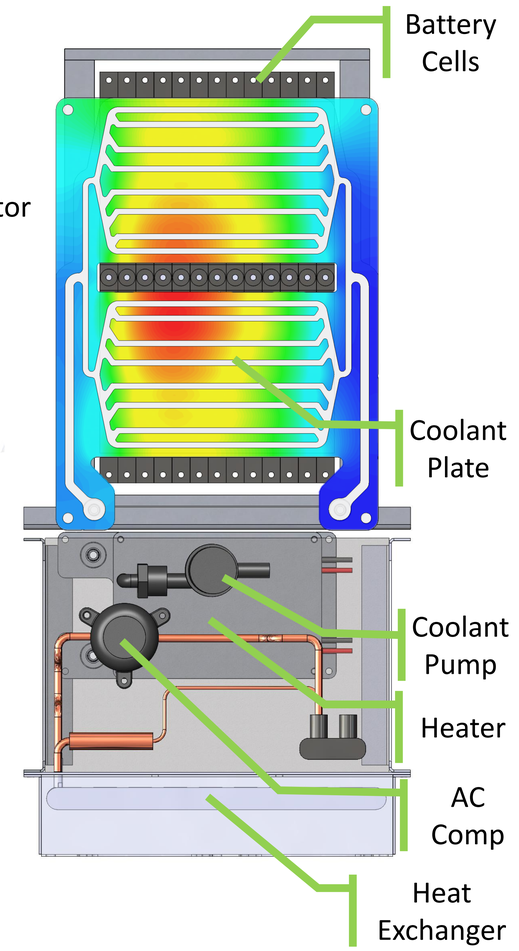


Testing:
- The completed system was tested in a thermal chamber at -20, 0, 30°C.

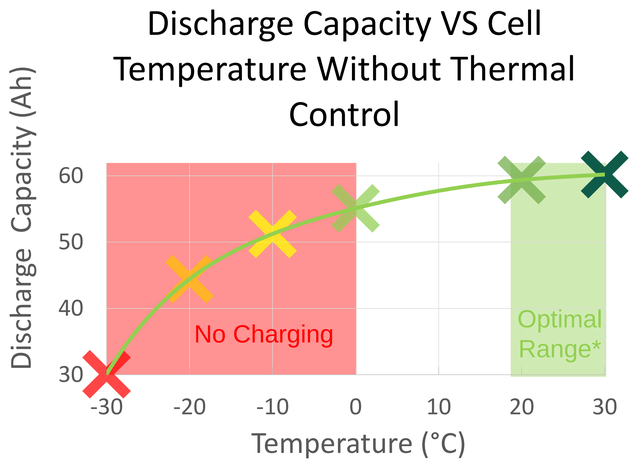


System Layout

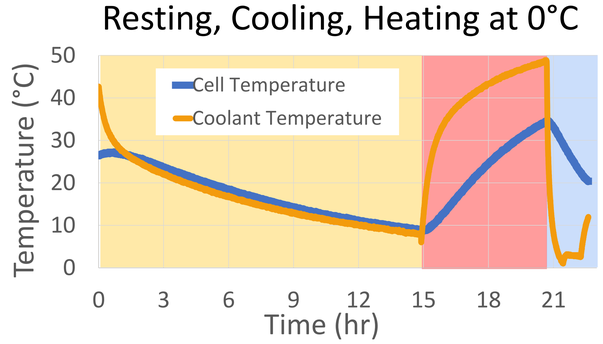




Testing



The optimal operational range may vary per application but it is generally above 20°C and below 50°C



State	Resting	Heating	Cooling
Linearized Temp Change °C/hr	-1.3	+2.8	-4.5
Average Power Draw (W)	0	70	83

Key Features and Specs

Features:
- Programable controller
- Battery state of charge screen
- Quick connect main terminal
- Operable in different modes:
  - Long term storage
  - Heating
  - Cooling
- Ergonomic carry handles
- Extendable handle and wheels

Specification	Value (Units)
Nominal Voltage	48 V
Max Heating Power	80 W
Max Cooling Power	400 W
Battery Capacity	2.8 kWh
Max Battery Discharge Power	2.8 kW
Temperature Range	-20°C to 30°C
Container Size	790 X 490 X 285 mm
Total Weight	37 kg total (35% cells)

Next Steps

- Improve heat exchanger air flow
- Modify AC to operate in heating mode
- Increase sensor suite and data collection
- Conduct power cycle testing

Acknowledgements

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Mitacs
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