Fast charge algorithm for large Lithium Ion battery packs

November 15, 2017

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Agenda

- Introduction
- Battery used for testing
- Testing and data collection setup
- Algorithm overview
- Test results
- Conclusions

Introduction

- DRS has developed and fielded 3 very large Li Battery Pack systems for military applications
  - These battery pack systems required a 4 to 1 recharge time algorithm to meet their operational objective
- New charge algorithm developed requires 2 to 1 recharge time
- This briefing is focused on DRS Battery Management applications that can be applied to various battery / energy storage designs

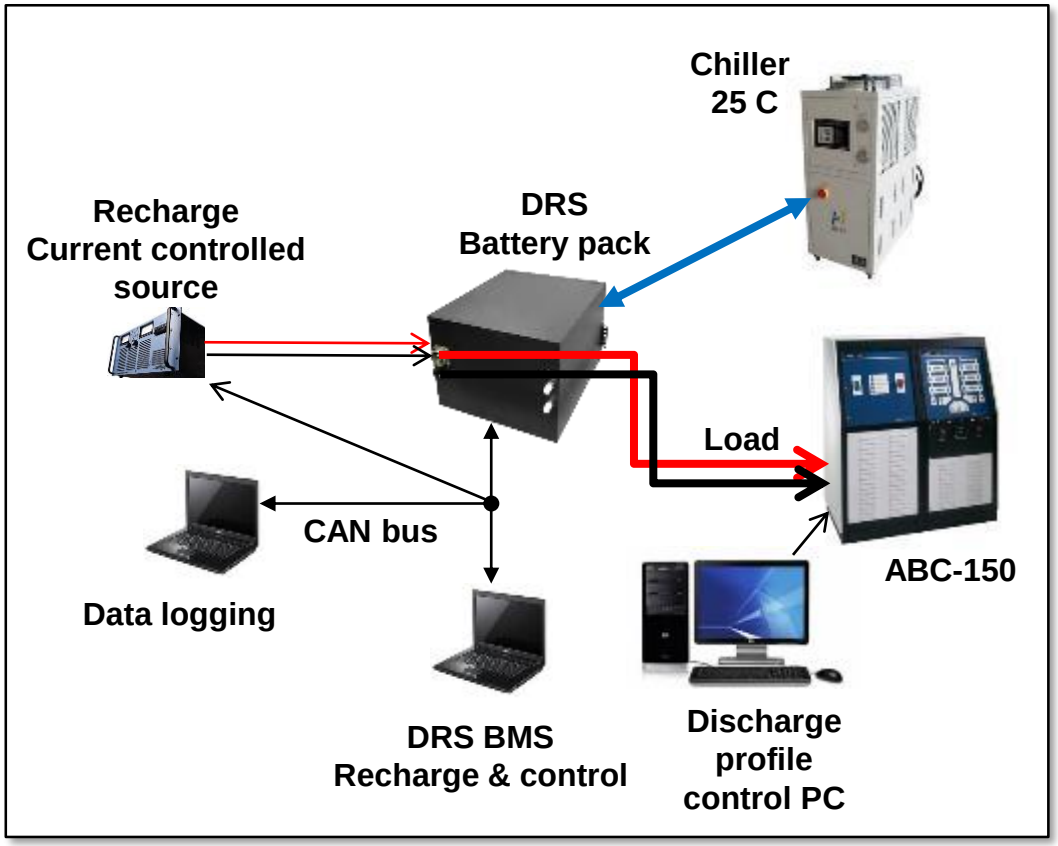
DRS developed battery used algorithm for testing

Specifications

- 268 – 404 VDC output @ 20% - 90% SoC
- 20 kW or more for 5 min
- Operating/storage temperature 0 to 57 C
- <= 7U standard 19” electronics rack enclosure
- Weight 110 lbs
- Liquid cooling <= 1 kW thermal load
- Max coolant temp 27 C
- Integrated BMS with CAN interface
- Splash proof connectors
  - High-Voltage Mating Connector P/N: MS3106E32-5S (Amphenol)
  - 28V Mating Connector: 13824784-B (Delphi)

The pack uses standard18650 format Lithium Ion cell

Testing and data collection setup



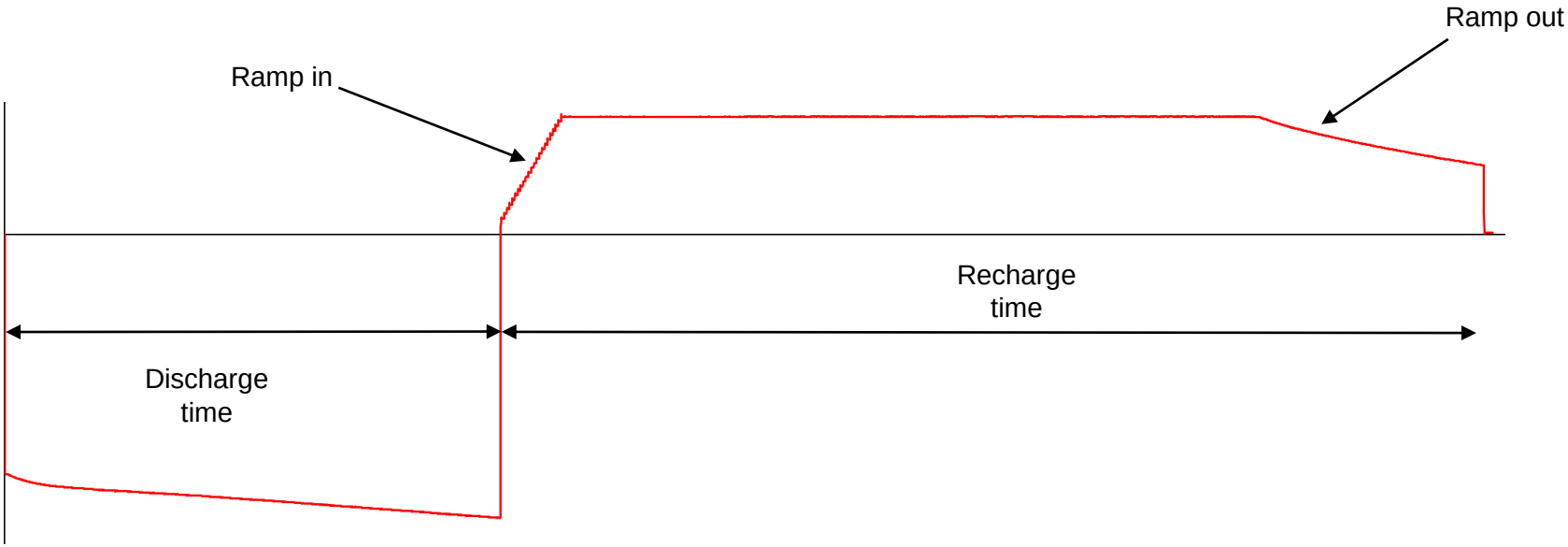
Data collection steps

1. Start chiller set to 25 C
2. Start logging
3. Run discharge script on ABC-150
4. Run **new fast recharge algorithm**
5. Stop logging
6. Stop chiller

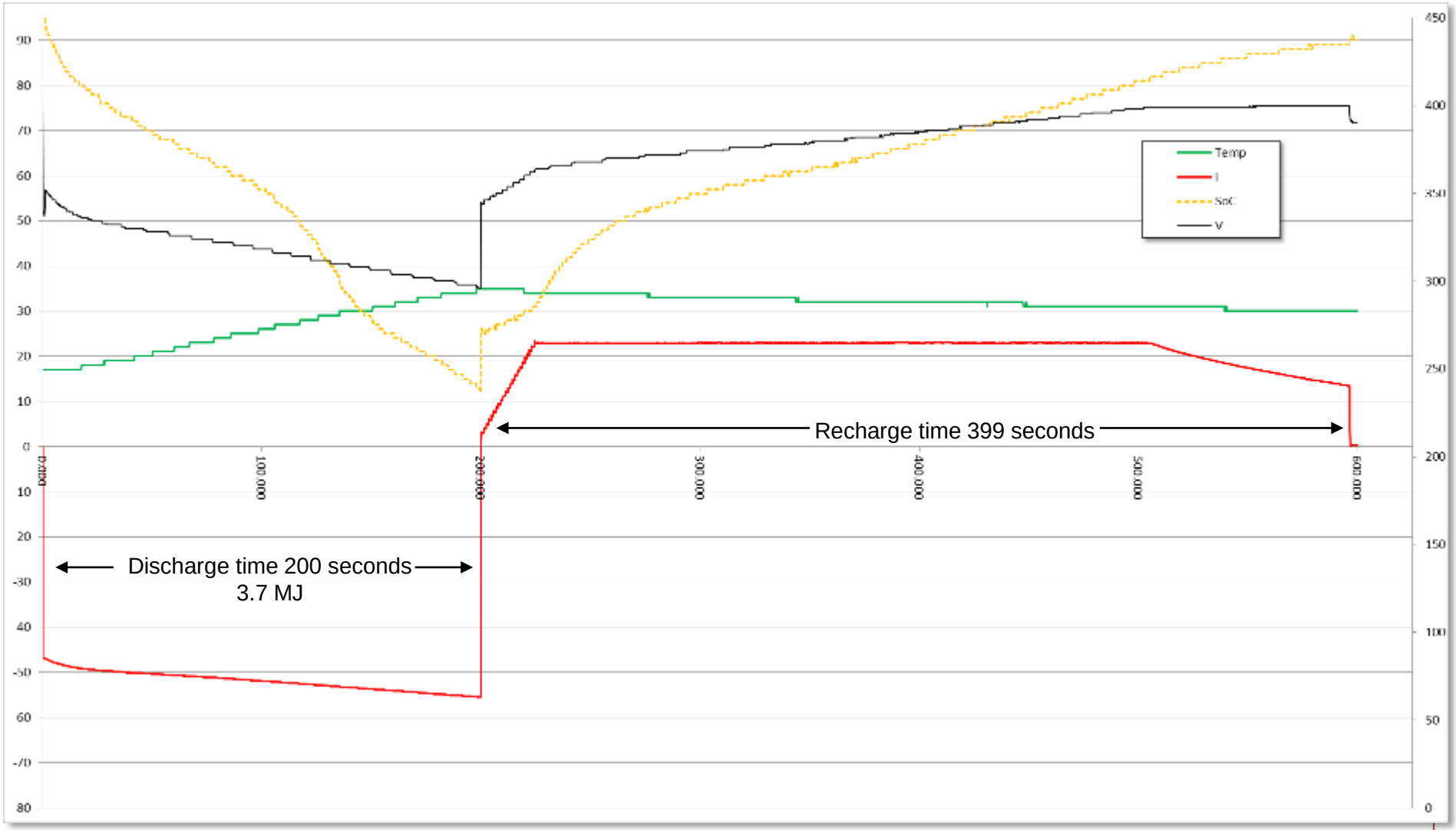
All testing performed at DRS's 20,000 sqft' System Integration Lab in Huntsville, AL

Algorithm overview

- **Discharge profile: The battery pack discharge is 3,705,682 joules supplied at ~18,528 joules per second for 200 seconds**
- **Recharge time: Time in seconds suppling current until 90% SoC is achieved**
- **Ramp-in: Current profile required to safely reach maximum recharge rate**
- **Maximum recharge rate: 3C**
- **Ramp-out: the current profile required to maintain cell balancing and prevent cell overcharging**



Test results



Conclusions

- DRS has developed and tested an improved Lithium Ion Battery Pack recharge algorithm that supports safely recharging in twice (2x) the discharge time.
- This algorithm manages the thermal and electrical safety of the pack while charging by integrating additional hardware to cool and monitor 18650 Lithium Ion cells
- The algorithm also manages cell to cell balancing of the series cells
- Energy Storage is a critical and necessary Mission Enabler!

THANK **YOU** FOR YOUR ATTENTION

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