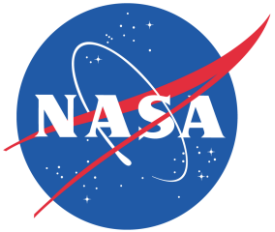
Team 27(ME)/18(ECE): Mars Lander Robot Recharger

QinetiQ



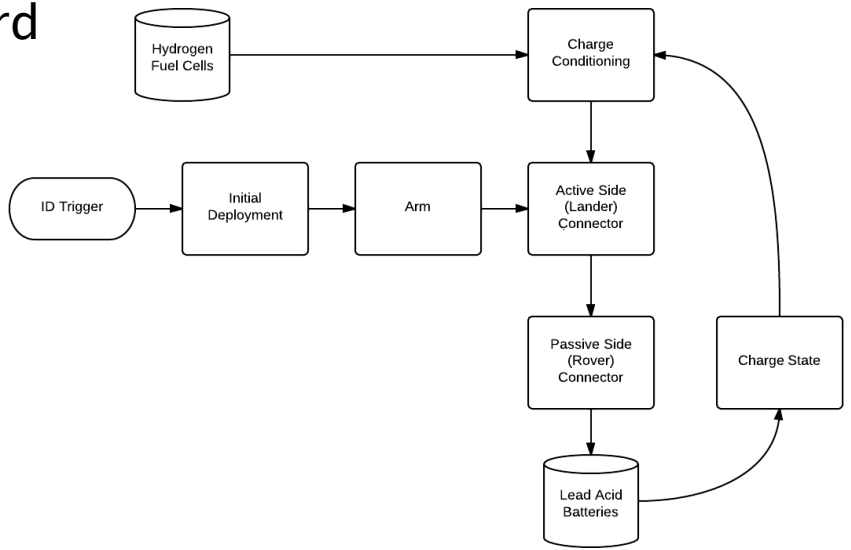
Spring Midterm 2

Team Members/Advisors

- Team Members
  - Itiel Agramonte
  - Dean Gonzalez
  - Lucas Kratofil
  - Tyler Norkus
  - James Whaley
- Advisors/Technical Contacts
  - Dr. Moore – ME Advisor
  - Dr. Arora – ECE Advisor
  - Van Townsend – Technical Point of Contact
  - Michael Solomon – Intellectual Property Point of Contact

Project Scope

- Get power from the stationary lander to the rovers
- Hydrogen fuel cell bank on board the lander
- Two 12V Lead Acid Batteries onboard the rovers
- Rovers drive up to be refueled
- Station records current charge state
- Fills batteries to 100%

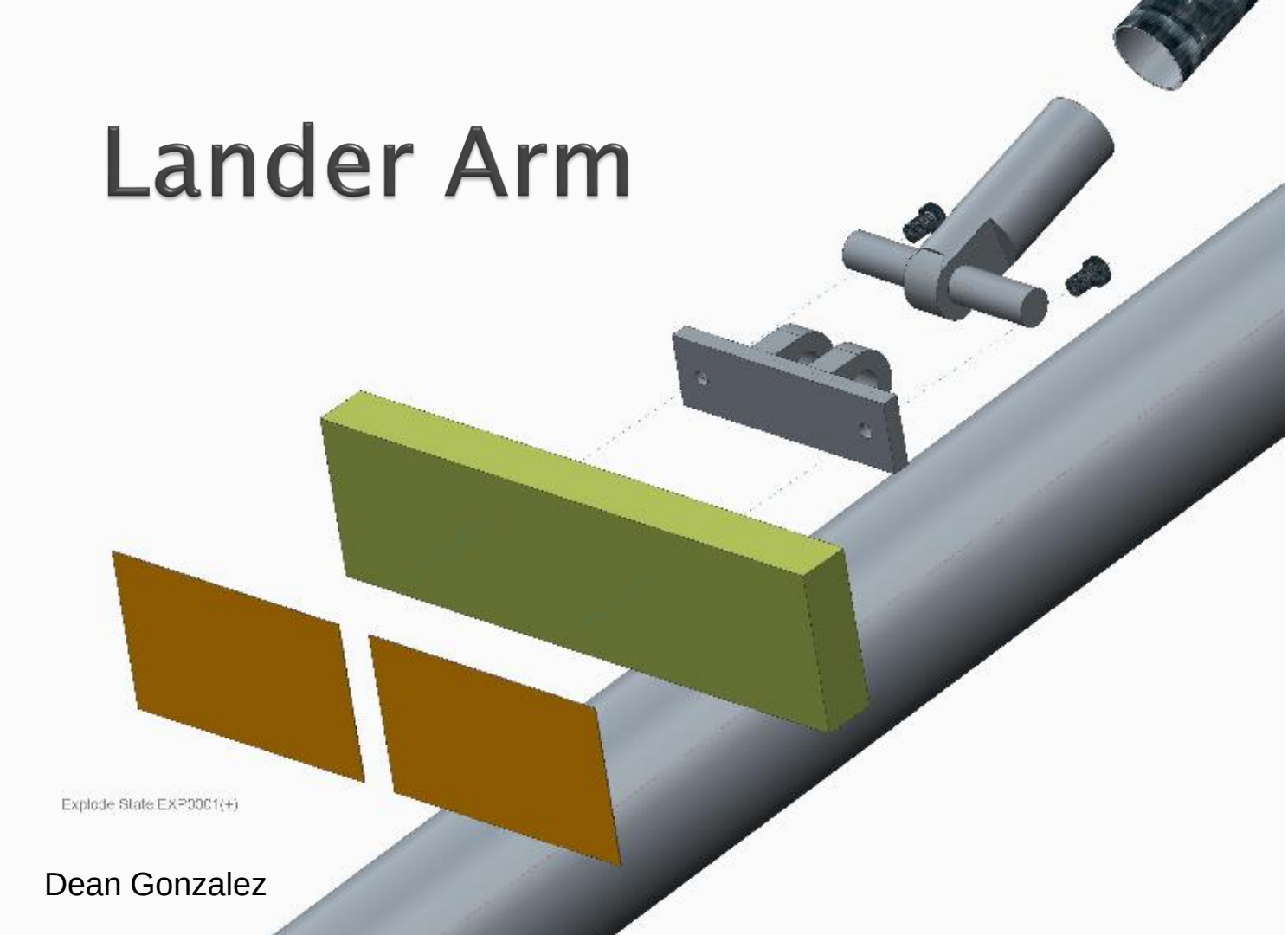


Fall Semester Accomplishments

- The arm and rover connections were designed according to constraints set forth by sponsor

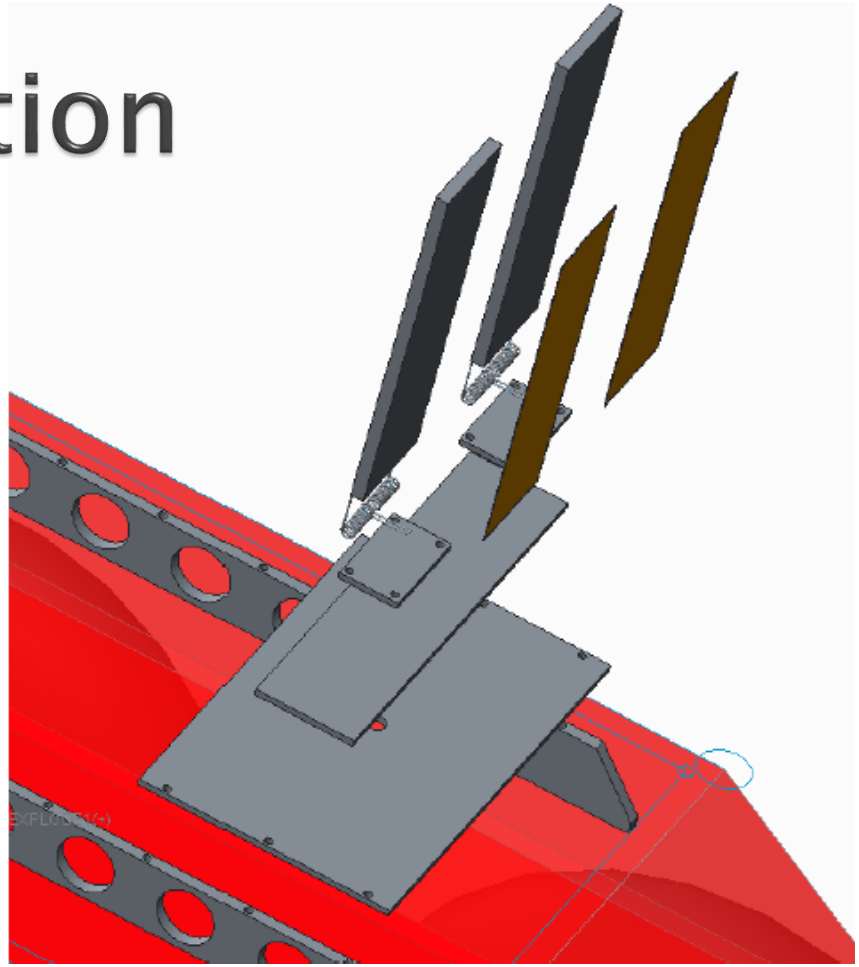
- Simplicity was very desirable

Lander Arm

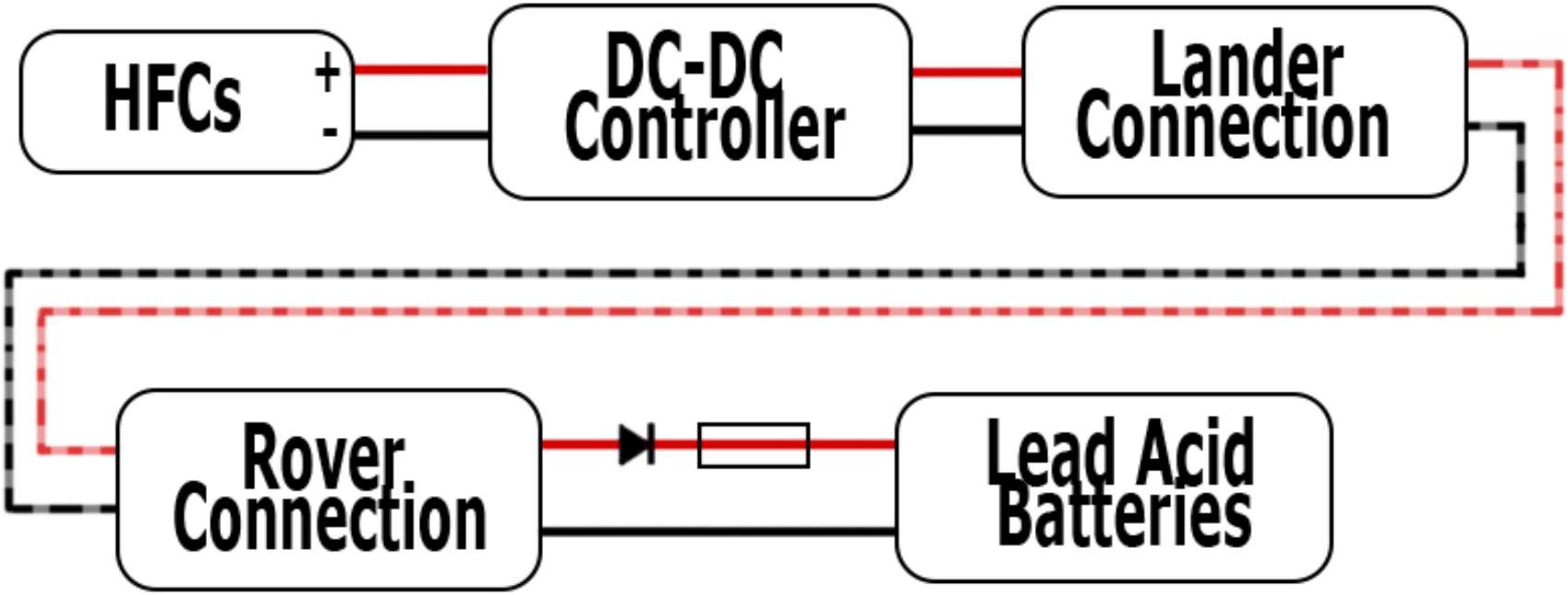


Dean Gonzalez

Rover Connection

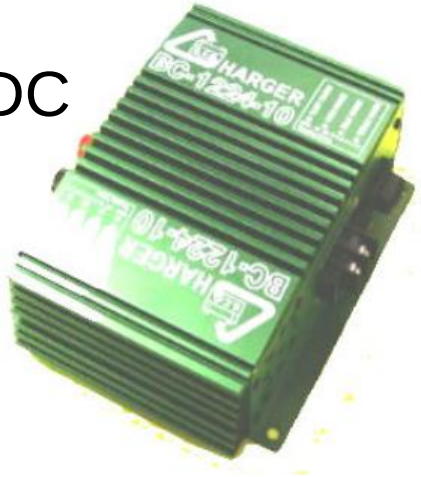


Electrical System

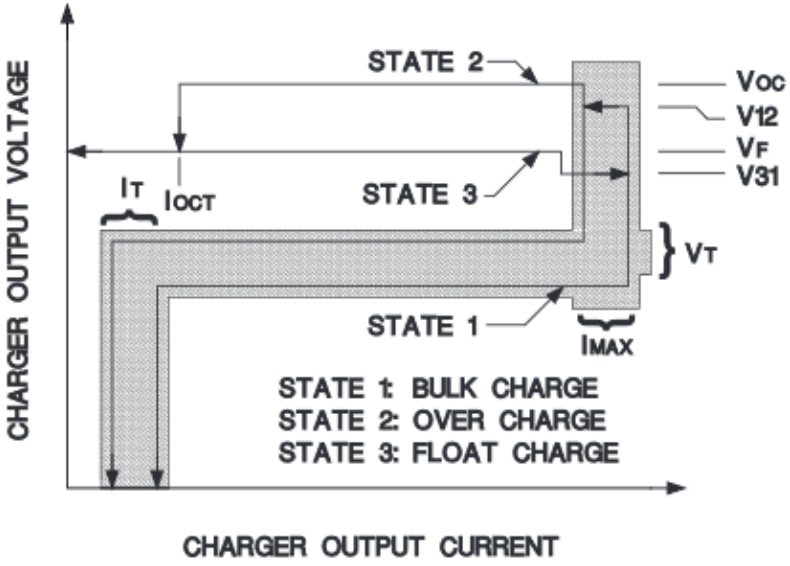


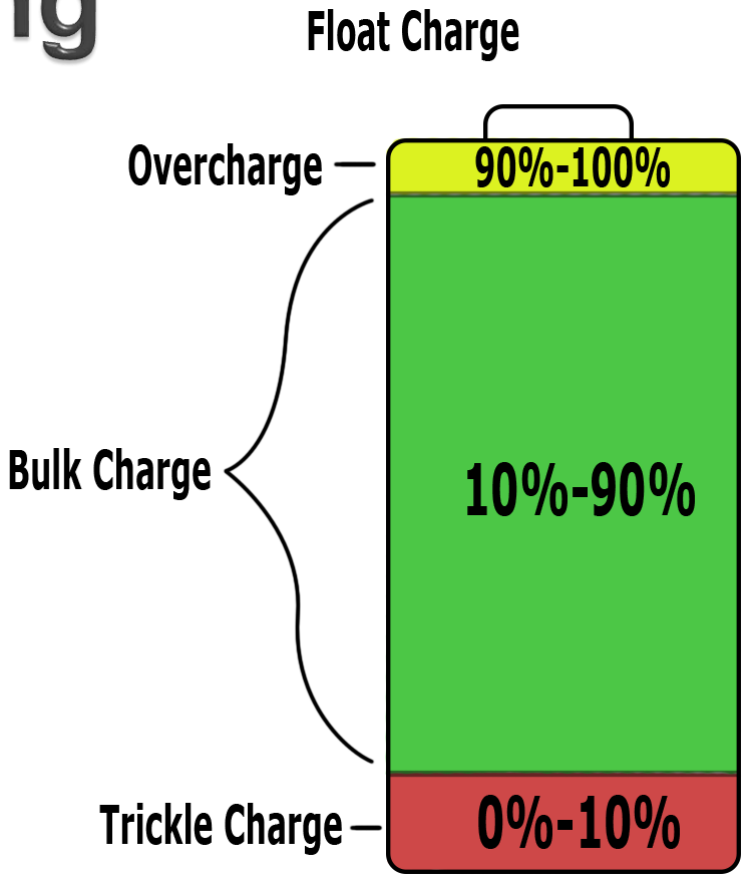
Charge Control

- Power Stream PST-BC2424-10 DC-DC
  - 24-32V input
  - Adjustable output current, up to 10 Amps
  - 4 stage charging algorithm
  - Short Circuit/polarity protection



Four State Charging





Safety and Ergonomics

- QinetiQ has asked for safety systems to protect workers in the Lab.

Risk:

- Possibility for shocks/burns to occur if human hand were to be placed on plate
- Possibility for metal tools to short plates creating a sudden large current that could burn out the lander circuit

Solution:

- First charge stage is current-limited, <100mA.
- Diode at the base of the rover connection.
- Fuse in the rover.

Budget/Procurement

	Cost (in USD) to Prototype as Designed
Prototyping	
TOTAL COST TO PROTYPE	1099.84
Testing	
TOTAL COST TO TEST	119.27
SHIPPING AND HANDLING CHARGES	250.00
UNFORESEEN EXPENSES	530.89
GRAND TOTAL	2000.00

- Procurement began in November.
- Final purchase orders have been placed.

Conclusions/Analysis

- Full arm design completed
  - Simple/Robust/Reliable
  - NASA Approves
- Completed lander and rover connection designs
  - Effective design for the application, efficient, and safe
- Materials selection process
  - Lightweight, within mass constraints of <4kg
  - Low forces/stresses experienced
- Procurement completed (with complications)

Future Work

- Build final prototype
  - Simulate Lander deck using wood
  - Working prototype of arm
  - Initial deployment successful
  - Test using ATRV-Jr at acceptable angles of approach and elevation angles

- Test circuit (measure efficiency to ensure within requirement of >75%)

References

- [1] http://www1.eere.energy.gov/hydrogenandfuelcells/fuelcells/fc_types.html
- [2] http://www.afcenergy.com/technology/advantages_of_alkali_fuel_cells.aspx
- [3] http://www1.eere.energy.gov/hydrogenandfuelcells/fuelcells/pdfs/fc_comparison_chart.pdf
- [4] http://en.wikipedia.org/wiki/Atmosphere_of_Mars
- [5] http://ieeexplore.ieee.org/xpls/abs_all.jsp?arnumber=1554624&tag=1
- [6] http://www.jameco.com/Jameco/Products/ProdDS/178597.pdf
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- [9] http://quest.nasa.gov/aero/planetary/mars.html
- [10] http://www.jpl.nasa.gov/news/press_kits/MSLLaunch.pdf

Questions, Comments?