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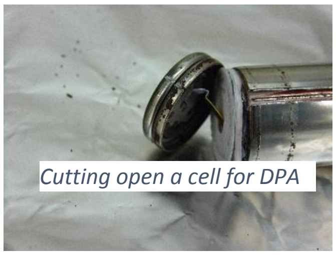
Fall 2015 Abstract

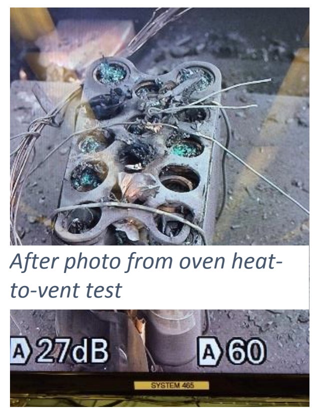
This Fall I worked on two different projects that culminated into a redesign of the spacesuit LLB (long life battery). I also did some work on the PLSS (personal life support system) battery with EC.

My first project was redlining the work instruction for completing DPAs (destructive physical analysis) on battery cells in the Branch. The purpose of this document is to create a standard process and ensure that the data is collected in the same way, no matter who carries out the analysis. I observed three DPAs, conducted one with help, and conducted two on my own, all while taking notes on the procedure. These notes were used to write the final work instruction, which will become the Branch standard.



Cutting open a cell for DPA

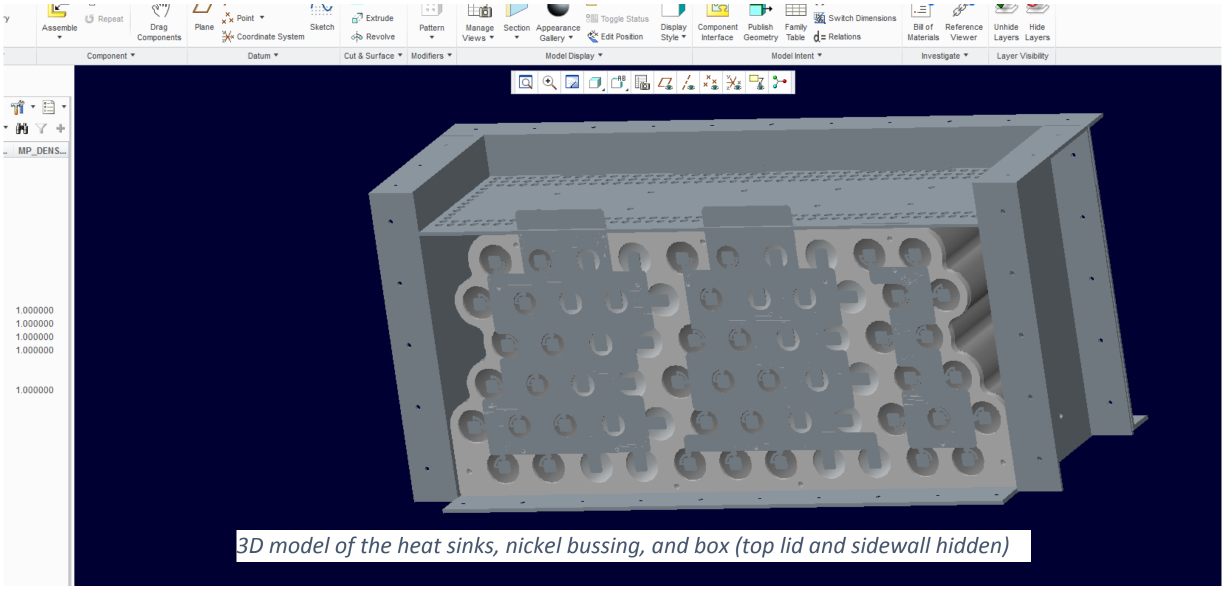
My second project continued the work of the Summer co-op before me. I tested aluminum heat sinks for their ability to provide good thermal conduction and structural support during a thermal runaway event. The heat sinks had been designed by the previous Summer co-op, but there was not much time for testing before he left. We thus ran tests with a heater on the bottom of a trigger cell to try to drive thermal runaway and ensure that it will not propagate to adjacent cells. We also ran heat-to-vent tests in an oven to see if the assembly provided structural support and prevented sidewall rupture during thermal runaway. These tests were carried out at ESTA (Energy Systems Test Area) and are providing very promising results, indicating that safe, high performing (>180 Wh/kg) designs are possible.



After photo from oven heat-to-vent test

My main project was a redesign of the LLB (Lightweight Lithium Battery). Another summer intern had done some testing and concluded that there was no simple fix to mitigate thermal runaway propagation hazards in the existing design. The only option was a clean sheet redesign of the battery. I was given a volume and ideal energy density, and the rest of the design was up to me. First, I created new heat sink banks in CREO, using the information gathered in the metal heat sink tests from the summer intern. After this, I made capture plates to hold the cells in place, and I worked on nickel bussings for the electrical connections between the cells. Finally, I designed the test box enclosure that included sections for flame arresting materials. The battery brick design, which is the heart of the battery, promises to become the first for a manned spacecraft application to achieve > 180 Wh/kg.

My work in redlining the DPA work instructions will also be used in selecting the cells for the battery. We had a few options for cells that would provide the necessary power output and needed to make a choice. We repeatedly charged and discharged cells for around a month until they went through 100 lifecycles. The plan was to compare the DPA results on fresh and cycled cells from each manufacturer to see if cycling introduces any differences. After the complete LLB design was approved, the parts were ordered and testing should begin the first week of December.



3D model of the heat sinks, nickel bussing, and box (top lid and sidewall hidden)

Some of my side projects included working on the CAD data for the PLSS with EC and attending the NASA Aerospace Battery Workshop in Huntsville. I was also a member of the Tours and Lectures Committee for the USRA and Pathways interns. I coordinated Apollo Evening and was on the committee for touring KSC and seeing an Atlas 5 launch.

I really enjoyed my time at JSC and I would like to continue working for NASA or another aerospace company in the future. I have worked other internships prior to this, but I think the heavy research and development focus is the best fit for me. I originally thought I would need to go to grad school to work in an environment like this, but I now see it is possible with a bachelor's degree and hard work. I would like to go into the workforce and maybe continue my education with night classes.

JSC and KSC students watching Atlas 5 from Cocoa Beach