Mitigating Thermal Runaway Risk in Lithium Ion Batteries

OVERVIEW
The JSC/NESC team has successfully demonstrated Thermal Runaway (TR) risk reduction in a lithium ion battery for human space flight by developing and implementing verifiable design features which interrupt energy transfer between adjacent electrochemical cells. Conventional lithium ion (li-ion) batteries can fail catastrophically as a result of a single cell going into thermal runaway. Thermal runaway results when an internal component fails to separate electrode materials leading to localized heating and complete combustion of the lithium ion cell. Previously, the greatest control to minimize the probability of cell failure was individual cell screening. Combining thermal runaway propagation mitigation design features with a comprehensive screening program reduces both the probability, and the severity, of a single cell failure.

PIONEERING SPACE & LIFE ON EARTH
Historically, our ability to successfully mitigate the risk of cascading failure within a multi-cell lithium ion battery has been limited by a lack of understanding in how a single cell failure is manifested, and the mechanisms by which the single cell failure propagates within a multi-cell battery. With the development of an improved understanding of the single cell failure mode, and engineering controls suitable for use in high energy density batteries, we have developed verifiable engineering controls which have demonstrated significant severity reduction of the unpreventable, low probability, catastrophic event.

OUTCOMES
The JSC/NESC team characterized energy transfer mechanisms responsible for cascading cell failure, developed and validated a single-cell trigger and battery assessment methodology, and modified an existing lithium ion battery design to demonstrate repeatable tolerance to single cell thermal runaway propagation.