



**BATTERY BARRIER BLAST PLATE INCIDENT
IMPULSE MEASUREMENT SYSTEM**

BACKGROUND

Development of human-rated batteries in part requires the design of an effective barrier that can contain the high-energy ejecta of a battery cell that fails due to thermal runaway and thermal propagation. Different materials, configurations, and observed collateral damage are assessed for efficacy. In turn, these inform the probabilistic risk assessment (PRA) for extended duration missions involving the use of batteries at higher States of Charge (SOC) for crewed space applications. In order to perform these assessments, testing of the barrier system requires instrumentation which measures the incident energy, impulse, etc. on the barrier blast plate.

PROBLEM DESCRIPTION

NASA JSC currently has a battery barrier blast plate test rig that is used to evaluate the effectiveness of battery barrier materials and designs. It is used to assess how well the barrier protects from battery ejecta and prevents collateral damage from ejecta to adjacent hardware, e.g., other batteries. It enables the ability to evaluate single cell ejecta responses and, in the future, multi-cell ejecta. Video and temperature data is obtained, but this can be improved upon by collecting additional data. The test rig is instrumented for temperature, but thermal energy is only part of the total energy incident onto the barrier. The proposed task is to design a thrust measurement system to determine how much force/impulse is being put into the test article (the barrier) when thermal runaway is induced by nail penetration into a single lithium-ion cell. It would require development of a math model to determine what impulse is transferred to the blast plate. Potential stretch goals are: 1) Identify how the existing test rig must be modified 2) Evaluate the design by testing 18650 and 21700 lithium-ion cells 3) Determine how the instrumentation would change for a multi-cell configuration. If the stretch goals are pursued, the test rig will be modified, and tests will be performed at JSC in the Energy Systems Test Area.

DELIVERABLES: 1) Project Management and System Engineering Plan, milestone schedule, budget plan, requirements document, 2) A white paper describing: development and documentation of the math model; the proposed instrumentation system; bill of materials (BOM) for the instrumentation system; other relevant specifications, e.g., de-rating analysis, schematics, etc., and 3) Prototyped instrumentation system

DESIGN TEAM PROFILE

NASA MENTOR:	Martin Martinez
LEVEL:	Upper levels
MAJOR / DISCIPLINES:	EE (Instrumentation Systems), ME
TEAMS:	Mentor is accepting one team
DURATION:	Two-Semester Project