Prioritized Technology: High Specific Energy, Radiation Tolerant Primary Batteries Europa Lander

Capability Description

- **Summary of Primary Battery Cell Options**

Cell Chemistry	Cell Specific Energy (Wh/kg)	Vendor(s)	Flight Heritage
Li/SO_2	270	Saft	Huygens, Galileo Probe
$LiSOCl_2$	350	Saft	MER, Deep Impact
Li/MnO_2	210	Saft, Ultralife	None
Li/CF_x-MnO_2	560	Eagle-Picher	None
Li/CF_x	730	Ray-O-Vac, Eagle-Picher	None

Discharge Conditions: 0ºC and 50 mA

Li/CF_x based chemistry with aluminum cell casing only option that can meet requirement

Capability Status

- **Survey options to meet cell level specific energy target**
  - Review data sheet values
  - COTS cell testing and development of new cell designs with vendor
  - Iterate with the system teams to guide cell development and selection
  - Issued RFI after requirements had developed
- **Early testing focused on Li/CF_x-MnO_2 chemistries**
  - Can draw conclusions relative to Li/CF_x
  - Including more extensive evaluation of Li/CF_x for Lander going forward
  - Focusing more on higher temperatures (0 to 60ºC)
- **Constant current discharge testing at relevant rates and temperatures**
- **Initial heat evolution testing**
- **Initial radiation testing**

Mission Applications

- **Europa Lander Pre-Project**
  - Provides 20 to 30 day mission life for a 100 kg battery package for the landed system
  - In addition to power, the batteries dissipate heat that is harvested for thermal management
  - High radiation and Planetary protection sterilization are critical requirements
- **Also applicable to all short life mission concepts**
  - Small bodies (Comets and Asteroids)
  - Icy Moon landers and probes
  - Any application where MMRTG or Solar power is not viable
  - High radiation environments
  - Stringent Planetary Protection applications

Development Cost and Schedule