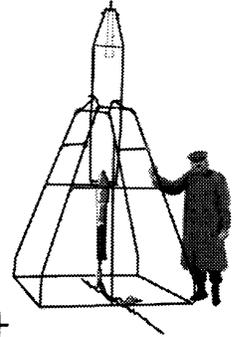


BINDING PROCUREMENT:



**NESC Directed NASA Aerospace Flight
Battery Systems Working Group Activity**

Gopalakrishna M. Rao

NASA/Goddard Space Flight Center

Power Systems Branch, Code 563

Greenbelt, MD 20771

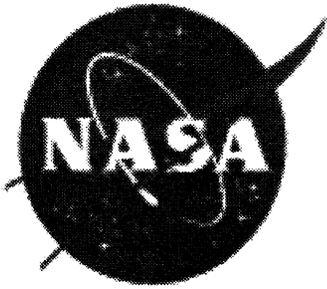
and

Hari Vaidyanathan

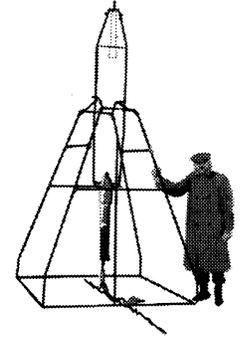
Lockheed-Martin Technical Operations

Comsat Technical Services

Clarksburg, MD 20871



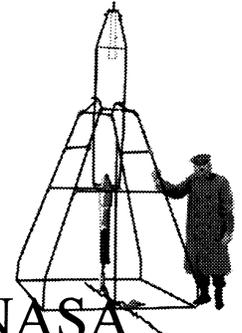
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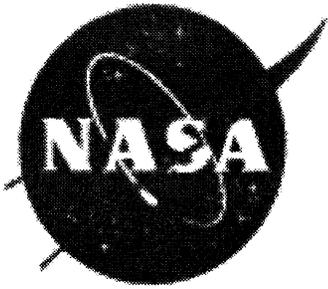
- Purpose
- Current Battery Procurement Practice
- Binding Procurement Document
- Technical Approach
- Current Status
- Future Plans



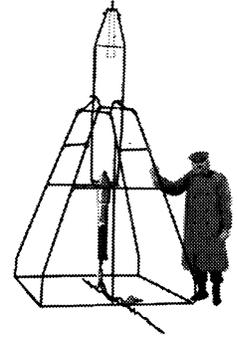
Purpose



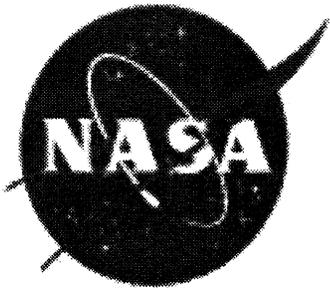
- NASA Engineering and Safety Center (NESC) requested NASA Aerospace Flight Battery Systems Working Group to develop a set of guideline requirements document for Binding Procurement Contracts
- GSFC was assigned lead role in this development
 - NASA is recently faced with complex battery issues for spacecraft such as TDRS, Calipso, GOES etc. due to not clearly defined procurement guidelines
 - Secrecy of procedures such as activation and cell balancing and the proprietary nature of cell design limit technology insight
 - Insufficient test data dissemination
 - Inconsistent recommendations about reconditioning, limits for charge/discharge rates and temperatures, the hundred percentage state-of-charge (SOC), the SOC calculation, and health check
 - Varying limits for temperature and SOC during integration
 - Inadequate recovery procedures
 - Frequent NASA Engineering and Safety Center (NESC) interventions at the late phase of the launch resulting in a costly launch delays



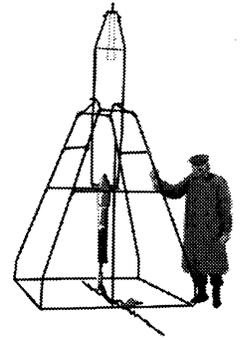
Current Battery Procurement Practice



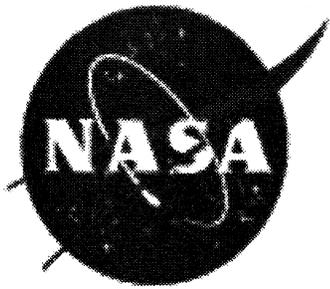
- In-house
 - Well defined Specification, Statement-of-Work and Deliverable Items List
- Out-of-house
 - Well defined Specification, Statement-of-Work and Deliverable Items List at spacecraft level
 - Government Review and Approval at subsystem level
- Binding
 - Commercial spacecraft bus, Cataloged bus, Cooperative Agreement with International Agencies, Small Explorer spacecraft through Universities, Science data etc.
 - No defined requirements at subsystem levels



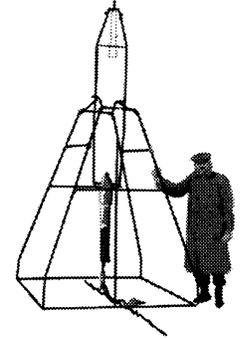
Binding Procurement Document



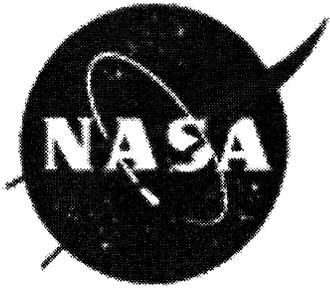
- An effective means to ensure that NASA battery specific issues and concerns are formulated at the time of procurement
- Procurement vehicle for spacecraft batteries as a part of the satellite bus
- Defines oversight and handling requirements from NASA system engineering perspective
- Incorporates a greater level of NASA involvement
- Clarifies the purpose and aligns the process to reduce contradictions and complexities at the launch site and during in-orbit battery management



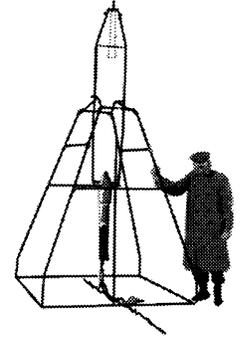
Technical Approach



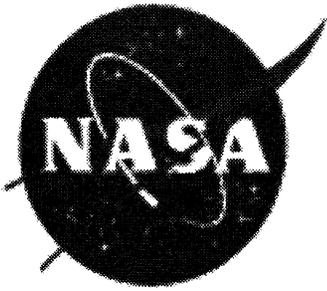
- Review current procurement practices for batteries
- Discuss issues – the design, schematics, manufacturing and test procedures, compliance matrix, and timely delivery of test data and hardware
- Procedures relevant for Charge/Discharge and for storage and handling that includes launch site and during transportation
- Adequacy of data/information to develop in-orbit battery management and to resolve in-orbit anomalies



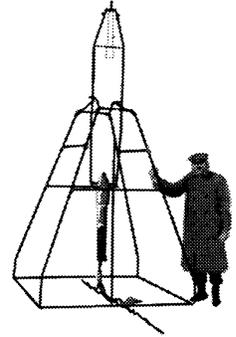
Current Status



- Lockheed Martin/Comsat Technical Services was tasked through NESC funding in July 07 to prepare a document
- Identified the limitations of the current practice when applied to binding procurement
- Compared manufacturers' recommendations on Cell/Battery Designs, Acceptance Testing Procedures (ATP), Battery Charging, Battery Handling, Reconditioning and In-orbit Battery Management
- Reviewed relevant manuals and guidelines



Future Plans



- Contact system leads, program managers, contractors and vendors and discuss the definition of Name Plate Capacity, ATP procedures, the charge voltages, thermal model, schematics, degradation models and requirements, battery data and launch site handling/reconditioning procedures
- Summarize the lessons learned from past programs
- Complete a binding procurement document by January 31, 2008, and first present it to NESC and then to disseminate the report