National Aeronautics and Space Administration

1961
1971
1981
1991
2001
2011
2021

RADIOISOTOPE POWER SYSTEMS PROGRAM

Technology Interchange Meeting

May 8-9, 2018

NASA Glenn Research Center

Dynamic Technical Interchange Meeting

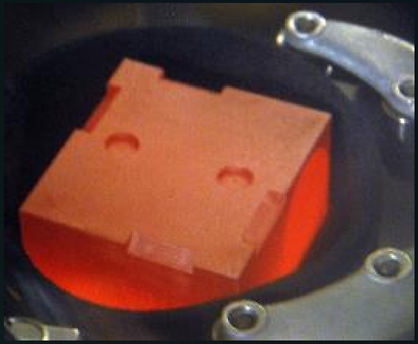
WELCOME!

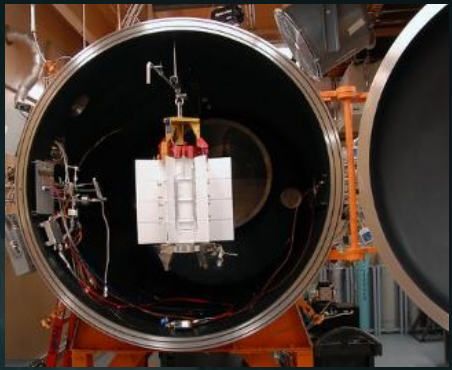
Why Are We Here?

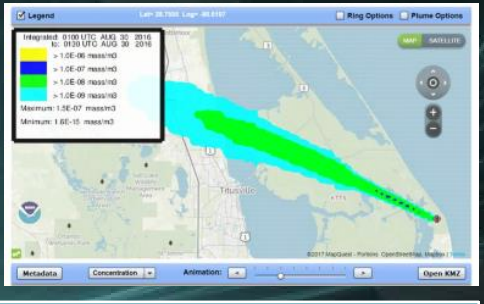
- Share with Industry NASA's
  - Background on RPS Program
  - Background on Dynamic
  - Investment To Date
  - Plans Forward
- Gather input from Industry/Missions
  - On current process
  - Current risks and future system risks
  - Generator
    - Robustness
    - Reliability
    - Manufacturability

Radioisotope Power Systems Program

- In partnership with the Department of Energy
  - Produces new plutonium 238 and heat source material for integration into flight RPS
  - Maintains the infrastructure necessary to produce flight RPS
- Develops new thermoelectric and dynamic power conversion technologies
- Conducts mission studies to ensure technologies are relevant to mission requirements
- Manage mission nuclear launch approval activities







The RPS Program provides a one-stop point of contact for the acquisition and integration of RPS for NASA Missions

RPS Program Organization

Radioisotope Power Systems Program (RPSP) Office
John A. Hamley, Program Manager (GRC)
Thomas J. Sutliff, Deputy (GRC)
Patty Gross, Support Assistant (ATS)
Jeffrey J. Rusick, Chief Safety Officer (GRC)

Center RPSP POCs
JPL –Ron Reeve
GRC- Tibor Kremic
APL –Paul Ostdiek
GSFC – Mike Amato

Level II

Program Control
Peter W. McCallum, Manager (GRC)

Systems Formulation and Mission Integration
June F. Zakrajsek, Manager (GRC)

DOE Production Operations (Insight)
Carl E. Sandifer, (GRC)

RPS Principal Engineer
Dave Woerner, (JPL)

Communications
Rachel Zimmerman Brachman, Lead (JPL)

Nuclear Launch Coordination
Peter W. McCallum, Manager (GRC)

Level III

eMMRTG Development

Next Gen Development

DRPS Development

Fundamental Research

Why Dynamic Radioisotope Generators?

- Dynamic Power Systems provide benefits that enable spacecraft to meet NASA objectives and PSD science objectives
  - Destination flexibility
  - Fuel efficiency/ Less Fuel
  - Less Waste Heat
  - Higher Potential Power at EODL
  - Path to higher power systems (Benefits to SMD and HEO)

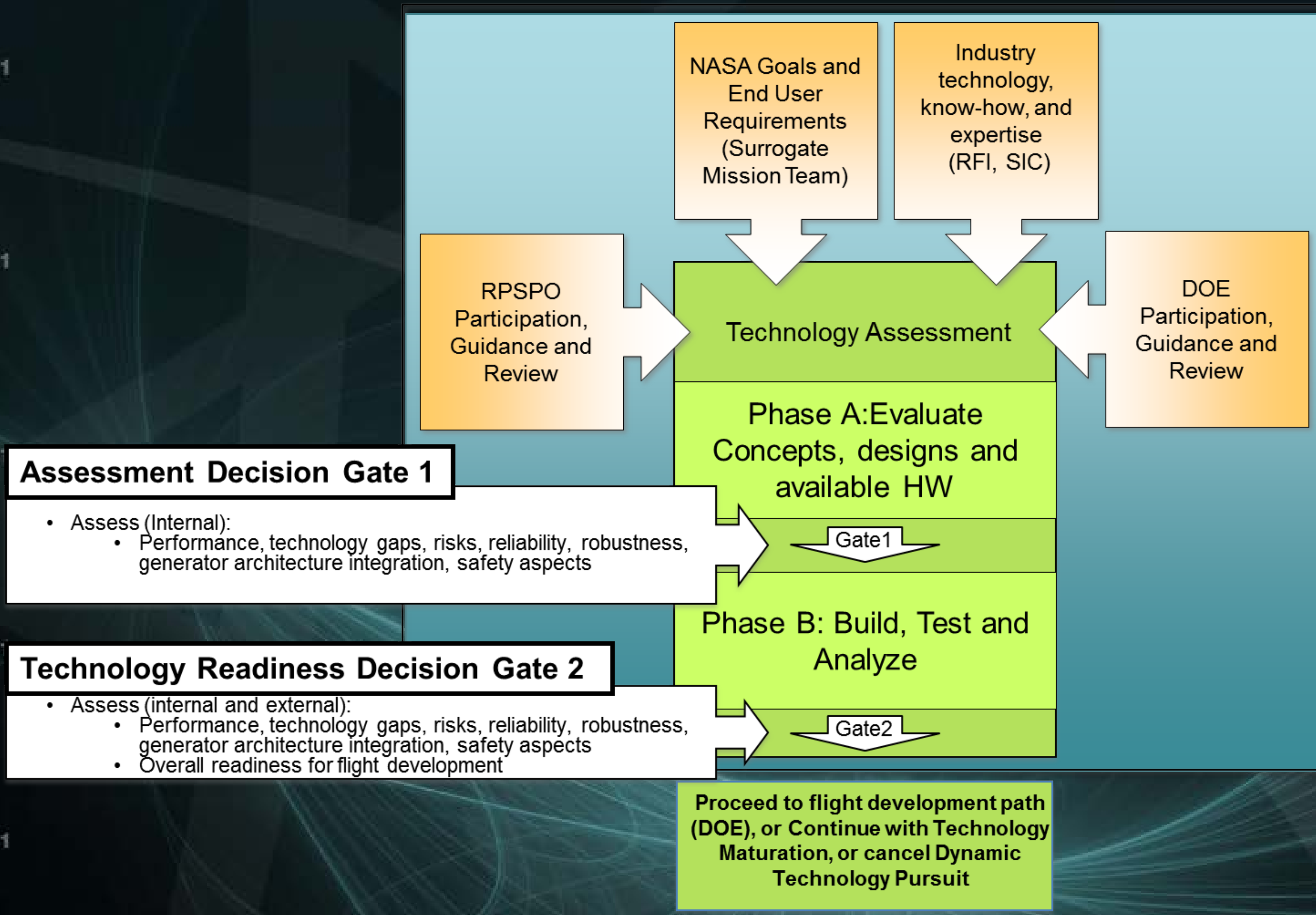
Dynamic Power Technology Objective

- In the context of developing a 100-500 W_e RPS determine the development readiness and risk associated with dynamic power conversion technologies.
- Key technology evaluation characteristics
  - Reliability
  - Robustness
  - Manufacturability
  - Life-cycle and sustainability costs
  - Performance
- Determine what are the conversion technologies to test and evaluate that would be most appropriate for a generator
- By the end of FY20 (or before) test and assess the technical and programmatic risks and decide to 1) start a DOE dynamic power generator contract , or 2) continue maturation, or 3) stop pursuing dynamic RPS

Dynamic Power Technology Approach

- Utilize the successful joint NASA/DOE and joint Program/Project team approach
  - Formed Cross-Organizational Team
    - Radioisotope Power Systems Program (NASA)
    - Department of Energy (DOE)
    - Technology and Mission Centers
      - Glenn Research Center
      - Applied Physics Laboratory
      - Goddard Space Flight Center
      - Jet Propulsion Laboratory

Technology Readiness Process



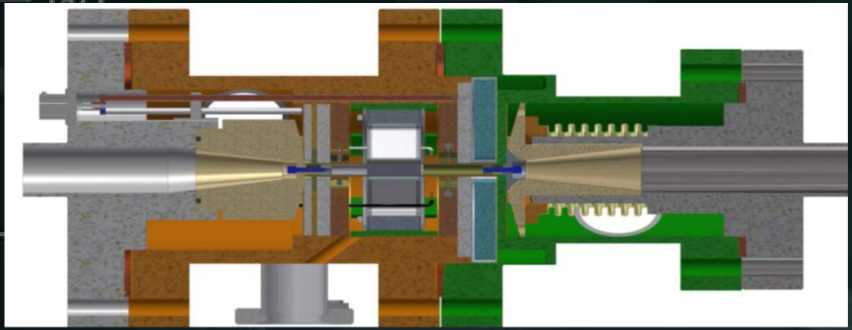
What Are We Looking For?

- Robust, reliable, available system or components that would have simple operation and long life for deep-space missions lasting 10 years or more
- Self-sustaining capability
  - Maintenance of capability without continuous demand from NASA
- Minimal risk and development challenges to reaching TRL of 6
- Understanding of requirements for eventual transition to flight
- Potential development of qualification unit and flight system

What Are We Looking For?

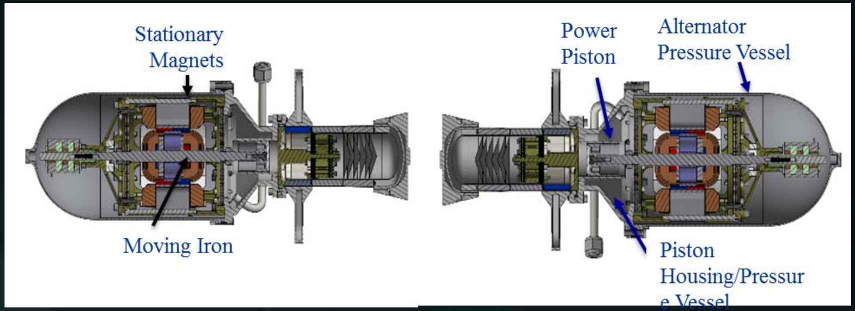
- System Characteristics
  - Reliability/fault tolerance
  - Robust (margins)
  - Spacecraft applicability / simplicity
    - Requirements for:
      - Power interface i.e. converter load shedding
      - Commands / Data needed to operate/monitor converter
      - ConOps in flight
      - Ease / simplicity of operation

Phase I Contractors



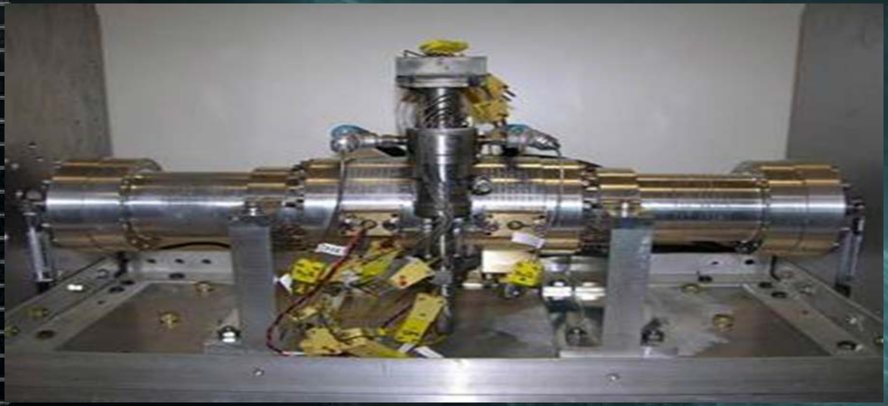
Creare LLC, Turbo Brayton

Key technical Advantage: high specific power and long life



American Superconductor Free Piston Stirling Engine

Key technical Advantage: robust operation and heritage



Northrop Grumman TAPC Design

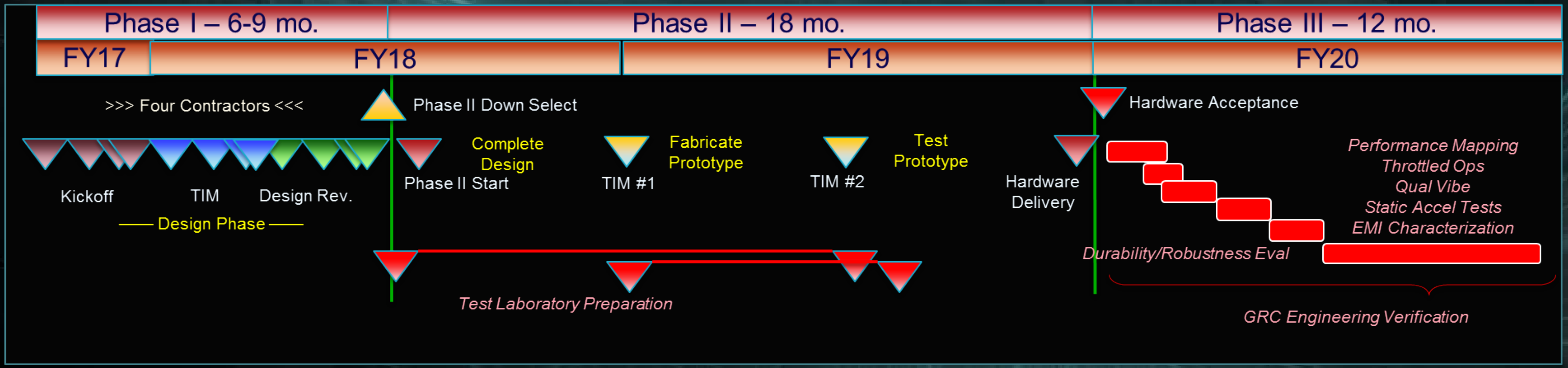
Key technical Advantage: high specific power and robustness

Sunpower Free Piston Stirling Engine

Key technical Advantage: robustness, heritage, and long life

Dynamic Power Schedule

- ✓ Design Phase complete by March 2018
- ✓ Down select contractors for Phase II
- ✓ GRC preparing laboratory space for prototype testing
- Receipt of prototype units by FY20
- GRC testing to characterize performance with support by contractors
- Document and support recommendation to DOE for future work



Radioisotope Power Systems

Glenn Research Center
Jet Propulsion Laboratory
Applied Physics Laboratory

Idaho National Laboratory
Los Alamos National Laboratory
Oak Ridge National Laboratory
Sandia National Laboratories

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