



RADIOISOTOPE POWER SYSTEMS PROGRAM

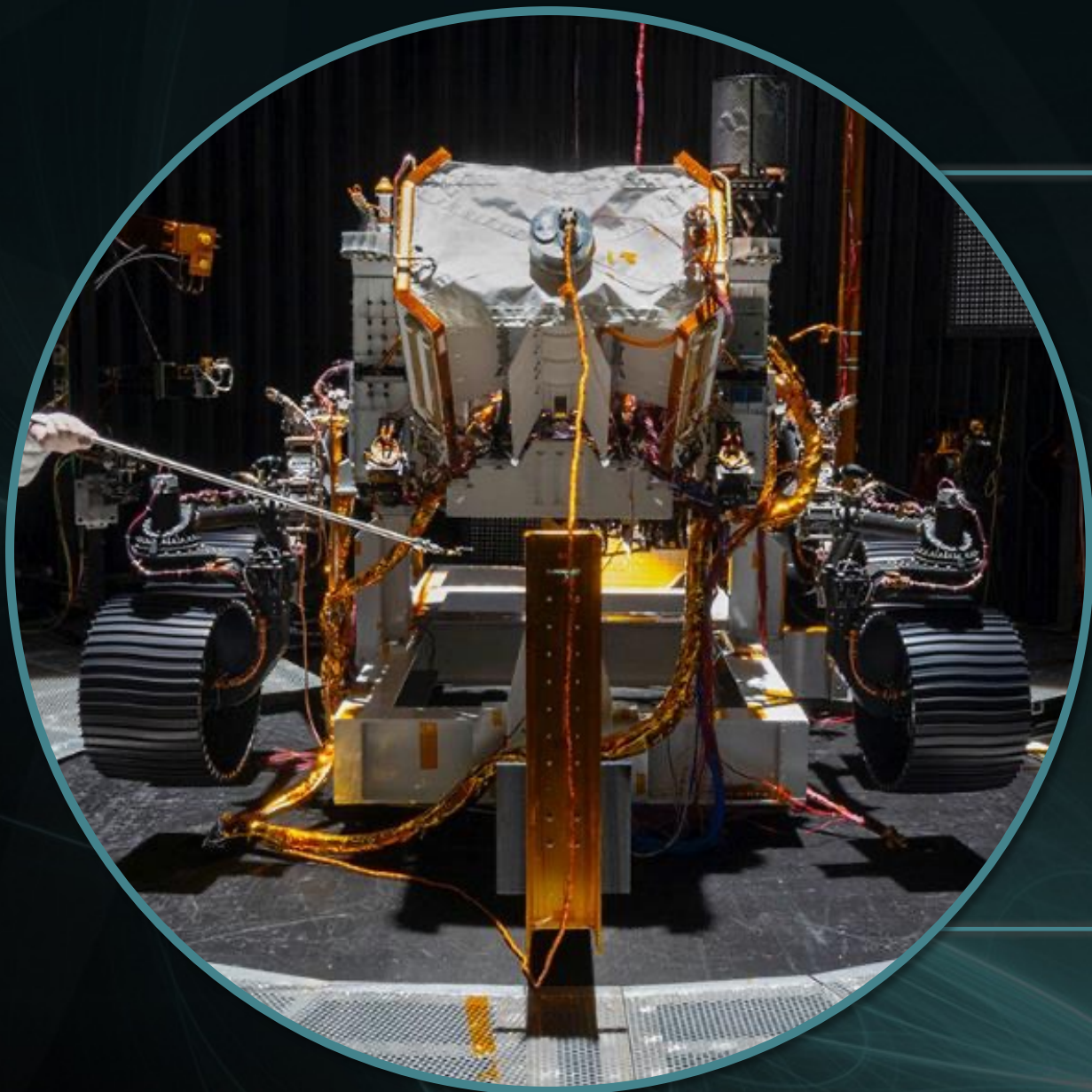
Outer Planets Assessment Group 2024

RPS Program Updates

June 12, 2024

Carl E. Sandifer II
RPS Program Manager

Power to...



EXPLORE



DISCOVER



UNDERSTAND



RPS Program Organization

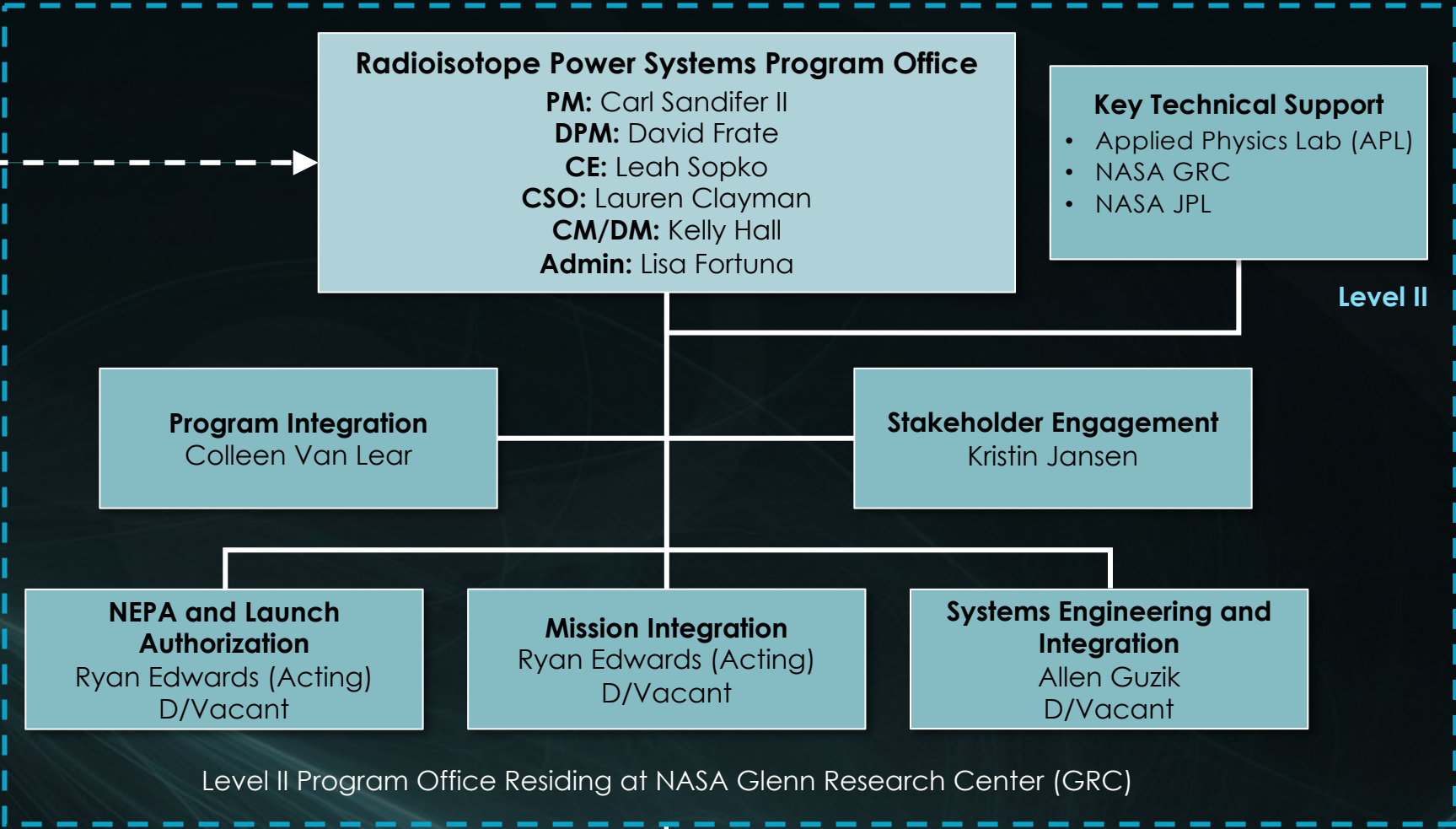


Department of Energy (DOE)
Tracey Bishop
Sujita Pierpoint
Emily Hsu

Radioisotope Power Systems Program Office
PM: Carl Sandifer II
DPM: David Frate
CE: Leah Sopko
CSO: Lauren Clayman
CM/DM: Kelly Hall
Admin: Lisa Fortuna

Key Technical Support

- Applied Physics Lab (APL)
- NASA GRC
- NASA JPL



Level II Program Office Residing at NASA Glenn Research Center (GRC)

**NASA GRC's
Space Science Project Office**



Technology Investments Enable New Radioisotope Power Systems

Radioisotope Power System
Heat Source



LWRHU

Light Weight Radioisotope
Heater Units

Multi-Mission Radioisotope Power System



MMRTG

Multi-Mission
Radioisotope
Thermoelectric Generator

Vacuum-Rated Radioisotope
Power System



Next Gen RTG

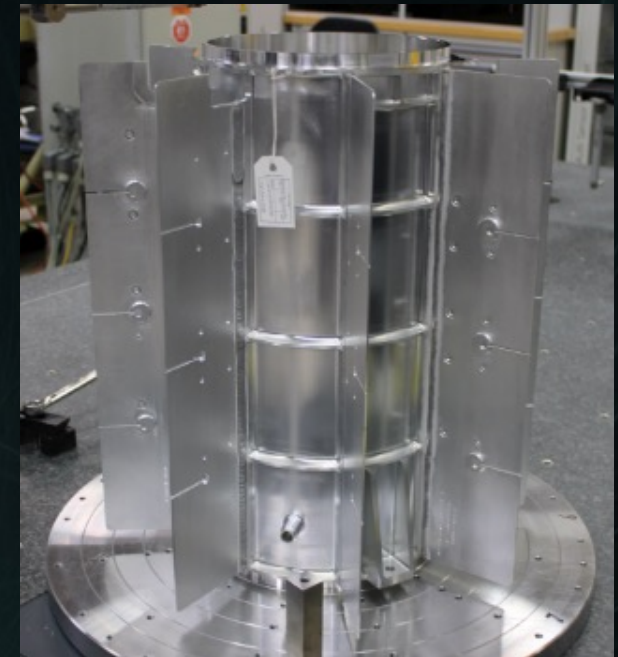
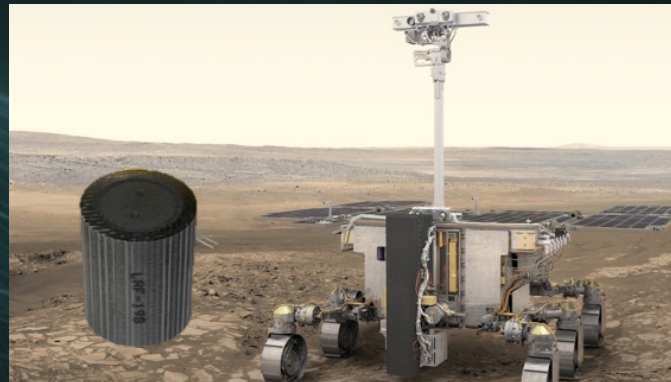
Next Generation
Radioisotope
Thermoelectric Generator

Current Flight Systems

New Flight System Development

Program Highlights and Accomplishments

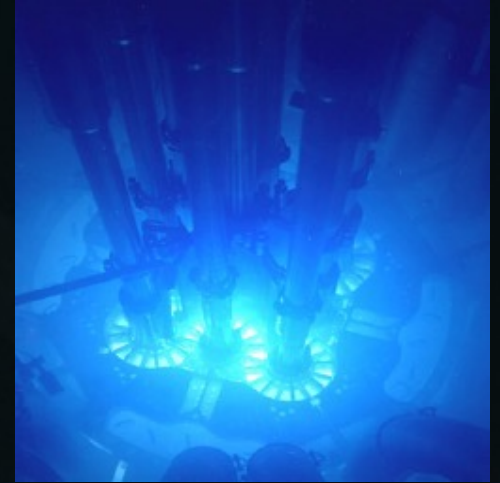
- Dragonfly
 - Launch Authorization on track with Interagency Nuclear Safety Review Board (INSRB)
 - MMRTG F4 on schedule with housing completed and thermoelectric modules completed (16 +2 spares)
- NASA Rosalind Franklin Project (NRP)
 - Completed Draft NASA Rosalind Franklin Project National Environmental Policy Act (NEPA) Compliance Plan
 - Processing NEPA extension letter
 - Drafted NRP Nuclear Launch Authorization Plan
 - NASA ESA MOU for the Rosalind Franklin Mission was signed on May 16, 2024



Dragonfly flight unit after final housing machining

Program Highlights and Accomplishments

- Constant Rate Production (CRP)
 - Scaling up production
 - Completed irradiation campaign in Advanced Test Reactor (ATR) resulting in the production of additional heat source plutonium oxide
 - Additional Np targets ready for irradiation in ATR
 - Functional testing initiated on second generation Np pellet press
 - Completed about half of the Light Weight Radioisotope Heater Unit (LWRHU) cap/body sets at Oak Ridge National Laboratory
 - Hot Press 4 construction complete at Los Alamos National Laboratory, turnover to operations imminent

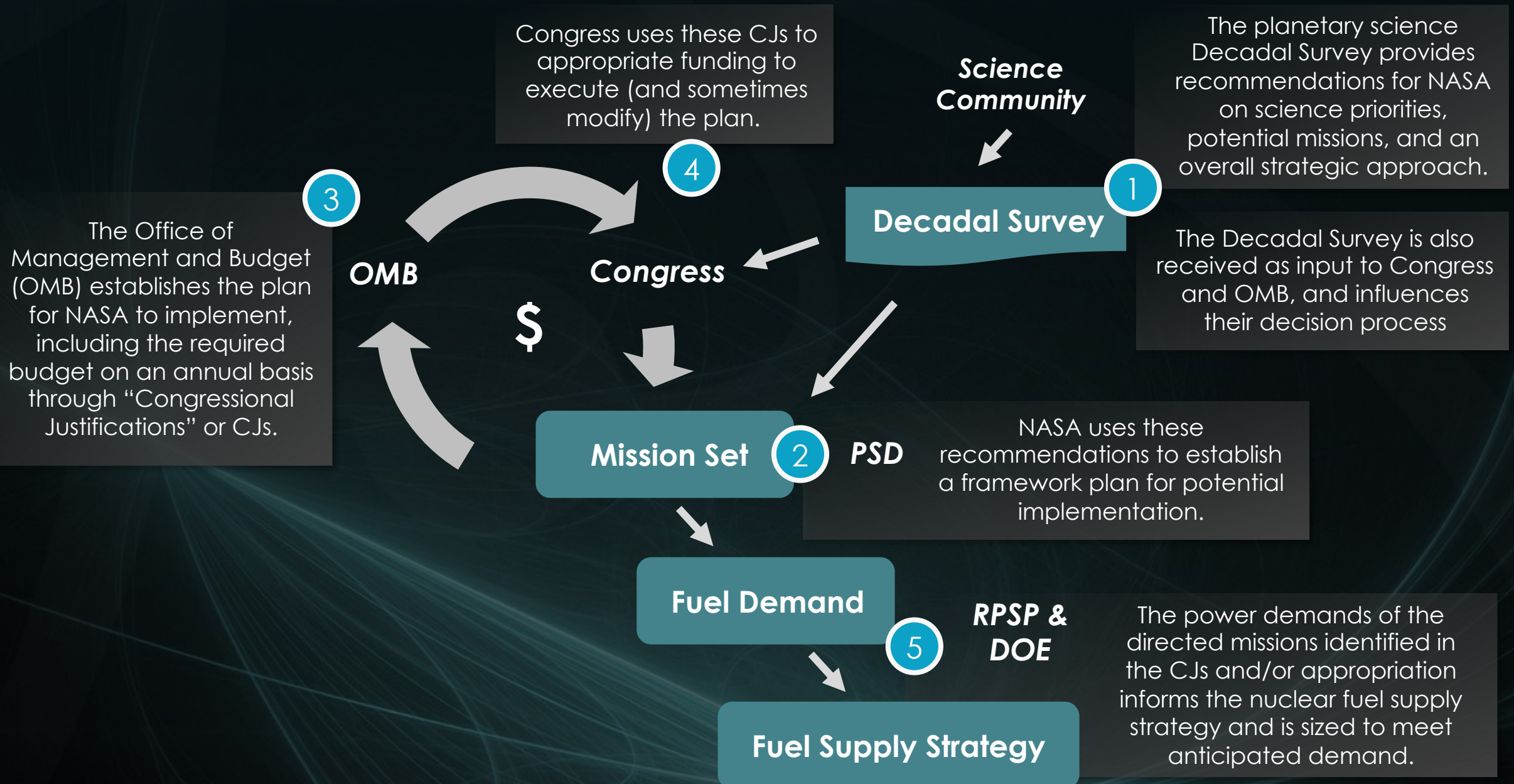


Advanced Test Reactor
supporting isotope production



Lightweight Radioisotope
Heater Unit

Radioisotope Power Systems: Constant Rate Production



Program Highlights and Accomplishments

- NEPA and Launch Authorization Management (NLAM)
 - RPS support to NASA NEPA Working Group resulted in new NASA NEPA rule, baselining the use of an Environmental Assessment (EA) instead of an Environmental Impact Statement (EIS)
 - Approach saves \$1.5M per mission if EIS is not required.
 - Leading White Paper on Range Contamination Impact Statement to support Space Nuclear Systems Harmonization between NASA, FAA, and USSF
 - Initiated evaluation of launch authorization processes using commercial RPS on NASA missions
 - Initiated LOX Methane testing for propellant characterization required to understand environments needed to perform safety analysis for launches using new launch vehicles such as Vulcan



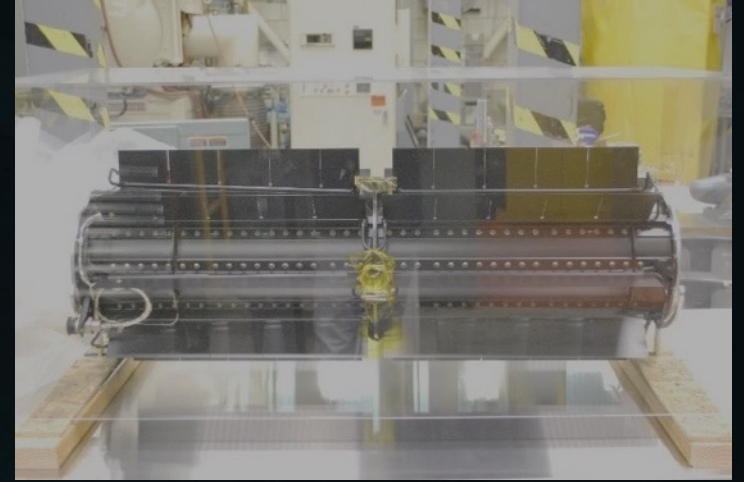
Propellant Reaction Characterization Test Setup



Propellant Reaction Characterization Test

Program Highlights and Accomplishments

- Refurbishment of GPHS RTG Flight Unit 5 (F5) to make flight worthy (Mod 0)
 - F5 thermopile molybdenum frame repair complete
 - F5 Converter/ETG, flight hardware, and support equipment certification plans, assembly procedures, and acceptance test plans drafted, in validation, and/or approved
 - On track to support “Go-No-Go” decision and testing with electrical heater assembly planned for late summer 2024



Readiness for Peltier cooling testing

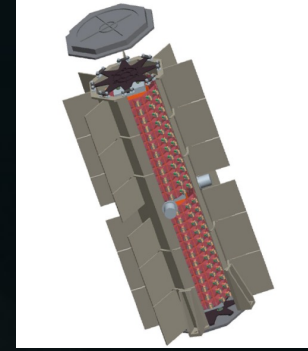


Peltier cooling testing

Program Highlights and Accomplishments

Next Gen Project (Mod 1)

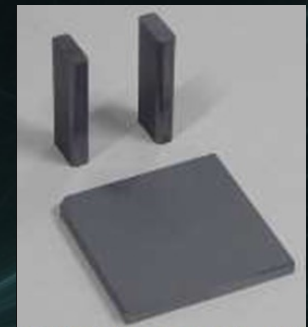
- Objective: Establish a production line to manufacture a vacuum-rated General Purpose Heat Source (GPHS)-RTG by 2030
 - Using Cassini heritage design with Step-2 GPHS fuel modules instead of Step-1
 - Additional changes will be driven by obsolescence to design and manufacturers
 - BOL Power estimate: 252 W_e
- Flight Hardware developed by DOE, their national laboratories (INL, LANL, ORNL), and contractors (Aerojet Rocketdyne, Teledyne Energy Systems, BAE Systems, RGS Development, UDRI)
- Standing Review Board being established reporting to the Science Mission Directorate Associate Administrator
 - Targeting first quarter FY25 for PDR
- One step away from establishing uncouple production capability



Next Generation Radioisotope Thermoelectric Generator



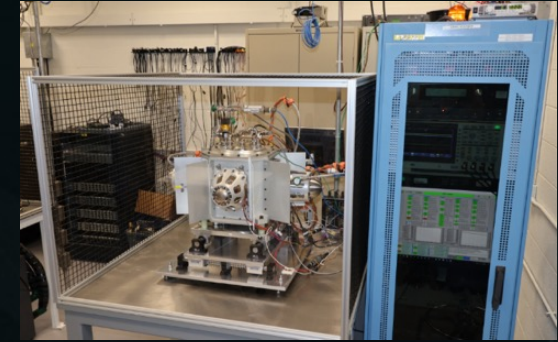
Dual 100-ton Hot Press installed at Teledyne Energy Systems, Inc.



Newly Fabricated SiGe Unicouple Pellets and SiMo Hot Shoe

Program Highlights and Accomplishments

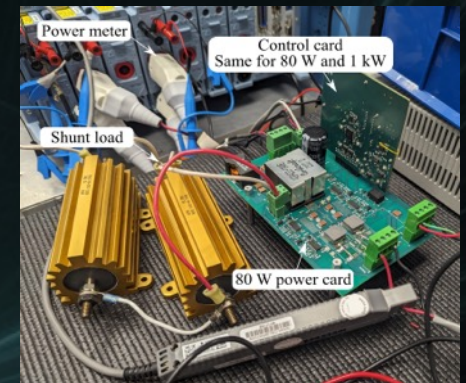
- High-Efficiency Power Generation Technology (HEPGT)
 - Converter
 - Procured 2 SunPower Robust Stirling Convertors (SRSCs) to sustain SunPower and for potential future applications
 - TDC#13 surpassed 17 years of continuous testing
 - Completed 95% of IV&V testing with robust performance for SRSC #4
 - Controller
 - Controlled Advanced Stirling Converter (ASC) using Capless NASA Analog Controller (CNAC) at full temperature including power up to steady state conditions
 - Successfully demonstrated open bus fault & shorted bus fault truly representing generator to spacecraft bus conditions
 - Stirling Generator Testbed
 - Initiated operations on May 17, 2023
 - Achieved 17% efficiency
 - Operated all four convertors simultaneously; no issues due to differing operating frequency between converter pairs
 - Working on the development of an electrically heated flight demonstration of an alternative isotope dynamic system



Stirling Generator Testbed



Capless NASA Analog Controller



Controller (80 W_e) under test

Alternative Isotopes

- In addition of plutonium-238, research and development in alternative fuels are underway across the industry, both domestic and international
- Technology investments in conversion efficiency has enhanced the viability of alternative isotopes

HQ Program Commitment Agreement (PCA) update includes focus on commercial and international RPS development opportunities

Engagement Highlights and Accomplishments

- Goal: Increase the positive public awareness of nuclear power in space
 - NASA's Power to Explore Student Challenge – a 250-word essay challenge for students k-12 telling us about their proposed RPS-powered mission and what their “super-power” is that would make them successful
 - 4,094 signups, 1,787 entries from 48 states, plus Puerto Rico and the U.S. armed forces
 - Augmented Reality Beta Program for high school students, providing a real-world mission design experience
 - Strong presence at Technical Conferences (IEEE Aerospace, Nuclear Emerging Technologies for Space)
 - Public Engagement at the Total Eclipse Event



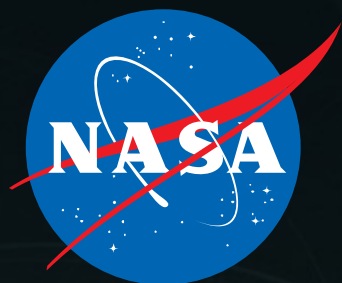
Winners of NASA's 2024 Power to Explore Student Challenge



Shasta High School Students Presenting



Total Solar Eclipse Event



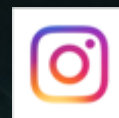
NASA



NASA



@NASA



NASA

POWER TO EXPLORE

<https://rps.nasa.gov>

nasa-rps@mail.nasa.gov