

National Aeronautics and  
Space Administration



Department of  
Energy



# RADIOISOTOPE POWER SYSTEMS PROGRAM

## Radioisotope Power – An Update on Missions, Systems, and Pu-238 Production

Presenter: Thomas Sutliff, RPS Deputy Program Manager, NASA

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Power Systems Architecture Session  
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# Outline

- Interagency Program Content
  - Acquiring Flight Systems
  - Preparing for Mars 2020
  - Nuclear Production Capabilities
    - The Constant Rate Production approach
- Operational Considerations
  - Supporting Future Missions
  - Nuclear Launch Coordination
- Summary

# Acquiring Flight Systems

- Historically
  - NASA matured non-nuclear component technologies
  - DOE managed nuclear flight system projects
  - DOE Acquisition was used to acquire a system integrator
- Currently
  - NASA manages integrated technology maturation/flight system projects, with early DOE support
  - DOE Acquisition is still used to acquire a system integrator
- Methodology – starting with the end in mind (and looking toward the beginning)
  - A fueled system is prepared for deployment to a mission
  - A qualified (flight and nuclear) system design emerges
  - A system integrator identifies design solutions to meet the need
  - Viable energy conversion technologies exist/can be matured
  - An need is identified for a different system than what is available

# Systems in Concept/Design/Development

- Needs were identified in three areas:
  - Improvement to the end-of-life performance to the MMRTG
  - A modular deep space (vacuum-environment) thermoelectric system with full-size performance akin to the heritage GPHS-RTG
  - A higher performing system using opportunities of dynamic energy conversion technologies
- Three Projects are underway
  - The enhanced MMRTG Project (eMMRTG)
  - The Next Generation RTG Project (Next Gen RTG)
  - The Dynamic RPS Project (DRPS)
- Approach:
  - Program identifies driving requirements and needs
  - Projects plan around Programmatic and functional requirements
  - Each project transitions through a development and maturation of technologies (Phase B)
  - Projects transition into systems development resulting in a qualified flight system capability

# Preparing for Mars 2020

- Unfueled MMRTGs (F2 and F3 units) have been completed and are stored at INL
  - Mars 2020 has assessed F2 and F3 performance, NCRs, etc. and has chosen one unit for future fueling
- Fueled Clad fabrication has been completed
- Fueled Clads are on safe long-term storage at INL in Graphite Impact Shells (GIS)
- Two GIS will be installed into each GPHS Module
- Eight GPHS Modules will be installed into the MMRTG for Mars 2020
- Final flight and nuclear acceptance testing will be conducted at INL, in preparation for delivery to KSC and mission integration



*Fueled Clads*



*MMRTG unit F2* 5

# Nuclear Production Capabilities

- CRP strategy accounts for potential NASA mission needs in the 2020's and 2030's
- Isotope allocation for civilian space applications is about 35 kg
  - Roughly half meets NASA specifications
- Based on the current allocation, DOE will deliver 128 fuel clads to fuel four Multi-Mission Radioisotope Thermoelectric Generators (MMRTG)
  - Sufficient to power the Mars 2020 Mission and three additional MMRTGs for the possible 2025 New Frontiers mission and others



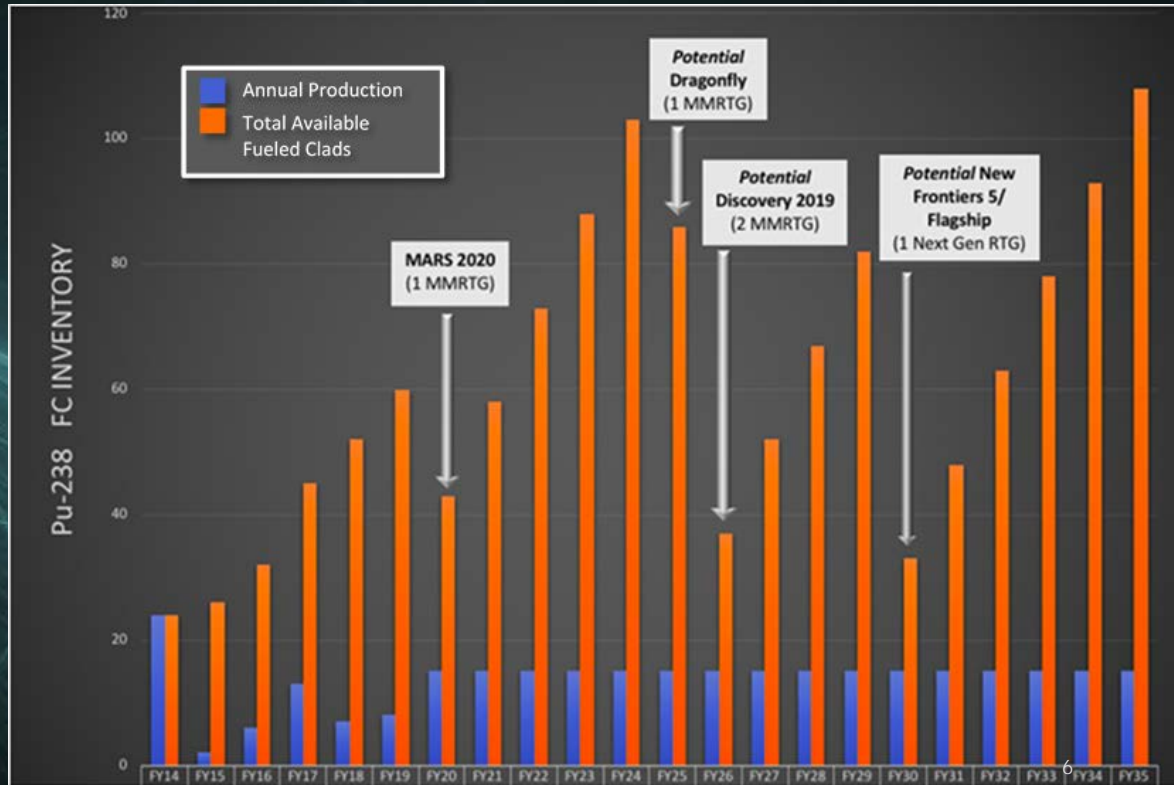
Newly produced plutonium-238



Aqueous Processing Line at Los Alamos



10-15 fueled clads/year



# Operational Considerations

- Supporting Missions
  - Proposed missions
    - New Frontiers-4 Dragonfly Concept Study; potential 2025 launch
    - Discovery 2019 AO; cost and scope inputs
    - Consistent information for Decadal Survey
  - Operational missions
    - Curiosity has experienced intermittent power drops; performing “battle shorts” clearing issues. Not a constraint to operations
    - Power prediction status (EOM predictions) continue
- Nuclear Launch Coordination
  - NEPA
    - Ensuring compliance with standards
    - Working to improve/streamline NEPA reviews
  - Nuclear Launch Safety
    - Maintaining safety is top priority
    - Working here also to streamline and improve products

# RPS Program Summary

- RPS Program and DOE working together to provide NASA a robust, end-to-end program capability
  - Strong NASA & DOE partnership
  - NASA is
    - Acquiring flight systems and preparing for future RPS-based missions
    - Conducting Nuclear Launch Coordination
    - Innovating and maturing technologies through fundamental research and focused technology maturation
  - DOE is
    - Enhancing Nuclear Production Capabilities
    - Implementing the Constant Rate Production Strategy
    - Preparing to fuel the upcoming Mars 2020 MMRTG





# *Power to Explore*

