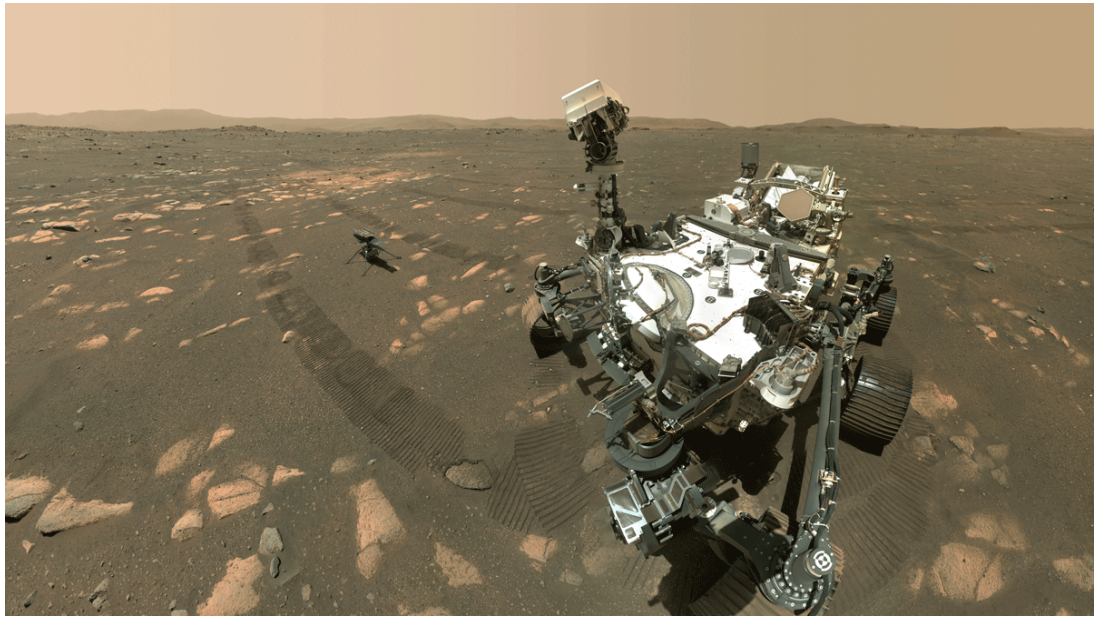
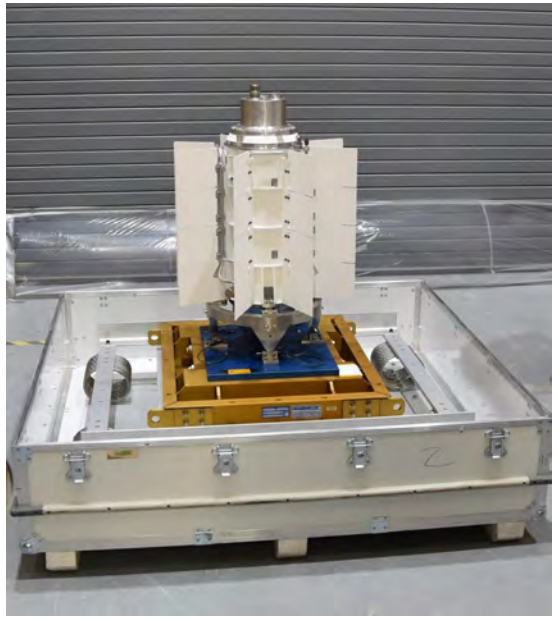
This work was done by Mission Support and Test Services, LLC, under contracts DE-NA0003624 with the U.S. Department. DOE/NV/03624--1149

MARS 2020 Contingency Planning Overview

MARS 2020 Mission Summary





- Mars Rover “Perseverance”
  - MMRTG Power Supply
  - 4.8 kg $^{238}PuO2$
- Launch Information
  - Space Launch Complex 41
  - Cape Canaveral Air Force Station
- Launch Window: July 17 – Aug 2, 2020

Safety by Design

Performance & Safety Requirements

Performance
Non-Dispersible
Fracture/Crush Resistance
Low Solubility

Fuel
- $^{238}PuO_2$
- Ceramic
- Iridium Clad

Re-Entry Survivability

Impact Resistance

Heat Source
- Aeroshell
- Impact Shell

High Mass Efficiency

Break-up on Re-Entry

Converter
- Insulation
- Unicouples
- Aluminum Shell

Design Elements

PuO_2 Pellet

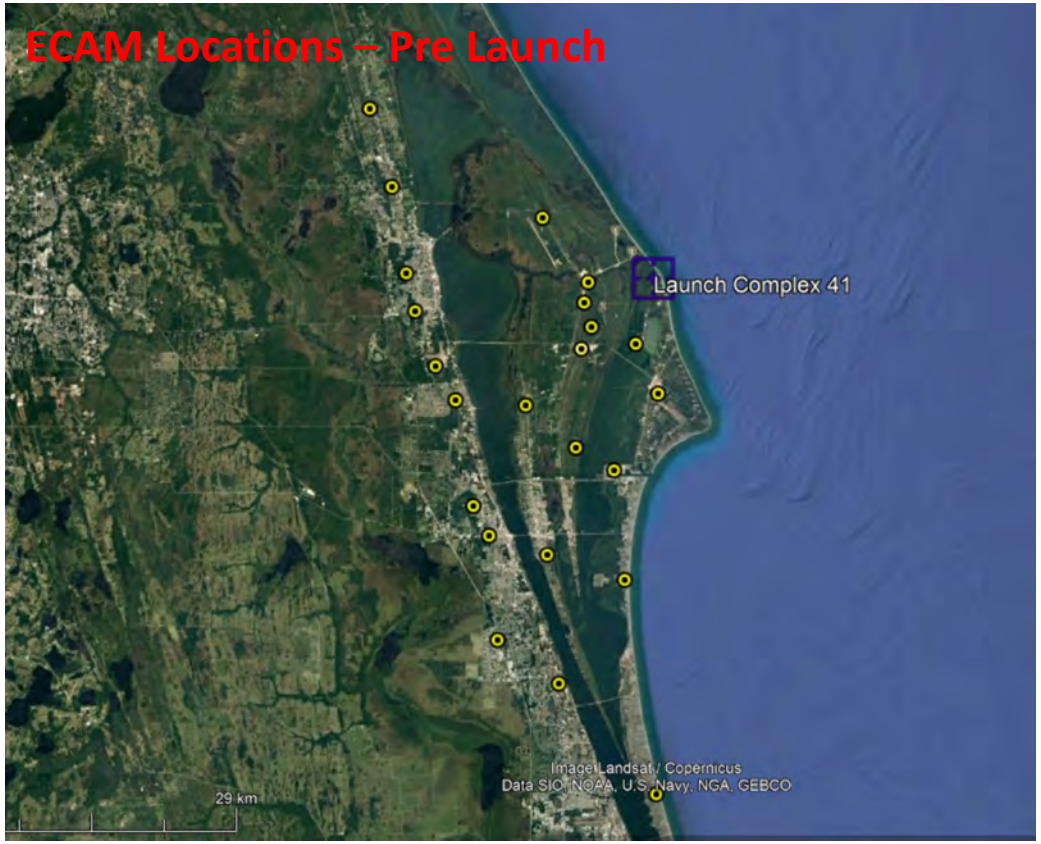
Ir Clad Pellet

Unique CM Mission

- “Pure” Alpha Emitter
  - Pu X-rays (17 keV,85 keV)
  - <0.02% ^{241}Am, trace other Pu
- **Time of Release Known**
  - Launch windows well known
    - Low risk before final fueling
    - Elevated risk from top-off to post launch (beach clear w/i 25 sec)
  - Can review potential impact scenarios’ with local governments
  - Can pre-deploy field teams
  - Can deploy air monitoring sensors

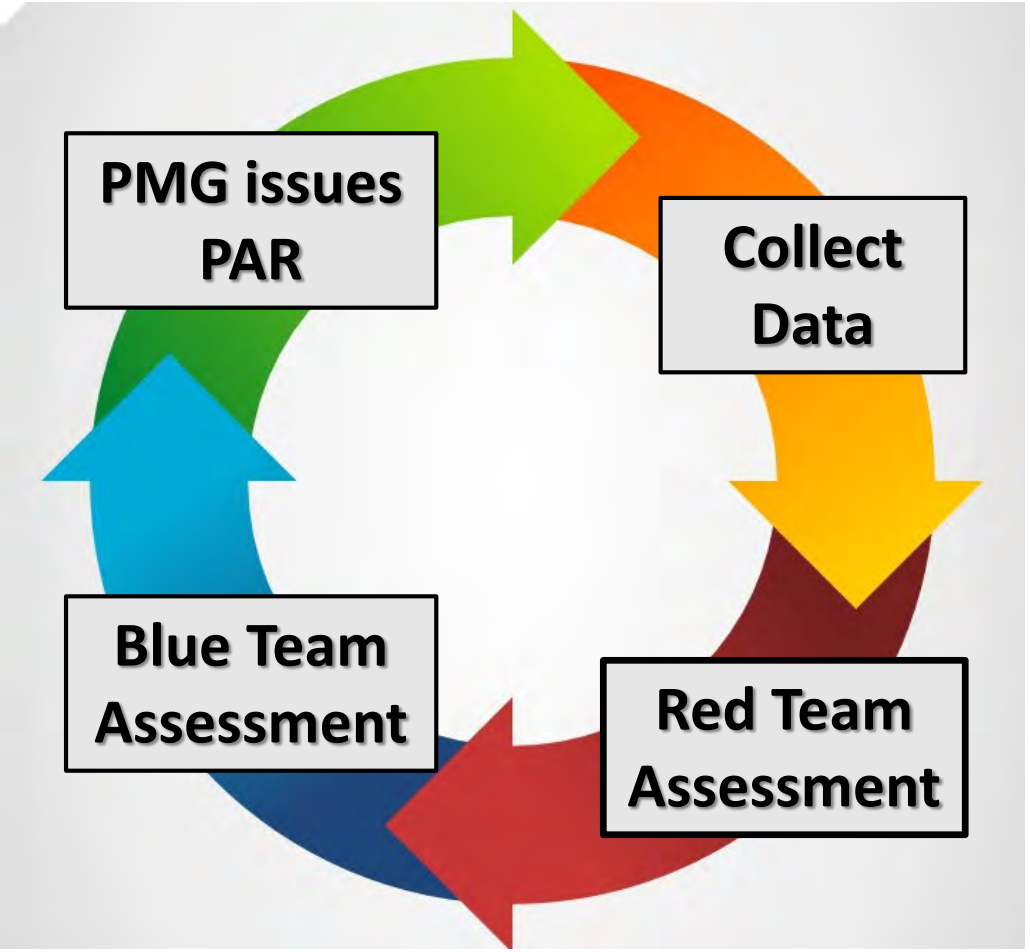
Roll-Out to Launch Complex 41 (2020)

Real Time Air Samplers (ECAMs)



Anatomy of a Bad Day…

- Confirm Anomaly
- Initiate On-Site Protective Actions
  - Based on L-1 plot or L-0 if changed
- Collect Data
  - Wait for ECAMs
  - Collect Range Observational data
  - Review NARAC L+0 plot
- Assessment of Data by Red Team
  - Recommendations to Blue Team
- Assessment of Recommendations by Blue Team (State & County)
- PMG Review and Response
  - Implement Safety Actions on KSC
  - Issue PAR to impacted counties



Points for Discussion/Consideration

- Impacts of a pure alpha-emitter release
  - Significant Inhalation Risk!
  - What equipment will your teams use?
  - Evacuation/Relocation limits?
- Advanced Planning
  - Pre-Deploy Field Teams? Why? Where? Missions?
  - On-Site Visitors? Workers?
    - Where do you Shelter them if you have a bad day?
    - When/how do you release them to go home?
  - What OILs do you use?
  - Are there scenarios where you don’t launch to protect public?

Poll Question

The 2025 Saturn Probe is being launched from your country. The probe uses an MMRTG for power and heating during the mission.

The MMRTG fuel is essentially pure Pu-238. If this material is released in an atmospheric explosion, how would you rank the exposure pathways from most to least significant?

A. Groundshine, Inhalation of plume, Ingestion of contaminated water, Ingestion of contaminated food
B. Ingestion of contaminated water, Inhalation of plume, Groundshine, Ingestion of contaminated foods
C. Inhalation of plume, Ingestion of contaminated foods, Ingestion of contaminated water, Groundshine
D. Inhalation of plume, Groundshine, Skin dose from immersion, ingestion of contamination food and water.

Poll Question

The 2025 Saturn Probe is being launched from your country. The probe uses an MMRTG for power and heating during the mission.

Do you deploy field teams into the projected impact area before launch? Why?

A. Do not deploy teams before launch. Keep sheltered to protect from the plume and deploy after plume settles.
B. Deploy in advance to collect air samples of the plume in order to quantify the release
C. Deploy in advance near worker and visitor shelters to assist after release
D. Deploy outside expected impact area. Move teams in after plume passage to quantify deposition

Poll Question

The 2025 Saturn Probe is being launched from your country. The probe uses an MMRTG for power and heating during the mission.

What is your top priority for coordinating your response to a launch anomaly?

A. Protect the field teams from the inhalation risks in the active plume.
B. Confirm the release of radioactive material in the plume and measure extent of plume
C. Evacuate site workers and visitors as soon as it is safe from shelters
D. Locate and secure the MMRTG and/or major fragments to minimize further release

Questions?