ARES Detector for Radiation Monitoring on the HLS and Gateway Vehicles

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ARES

Active Radiation Environment Sensor (ARES) is designed to be a radiation monitor for vehicles in Artemis Program lunar mission, primarily HLS and Gateway.

- Funded by the NASA Mars Campaign Office to
  - Provide monitoring of vehicle real-time space environment radiation incident from Solar Particle Events (SPE) and Galactic Cosmic Radiation (GCR).
  - Meet the absorbed dose, the charged particle flux, LET distribution requirements for Artemis Program vehicles, per NASA-STD-3001.
  - Provide alarm information for high dose rate radiation events
  - Have minimal-interface operation requirements for connection to a vehicle computer
  - Be compatible with Artemis Program vehicles…crewed vehicles

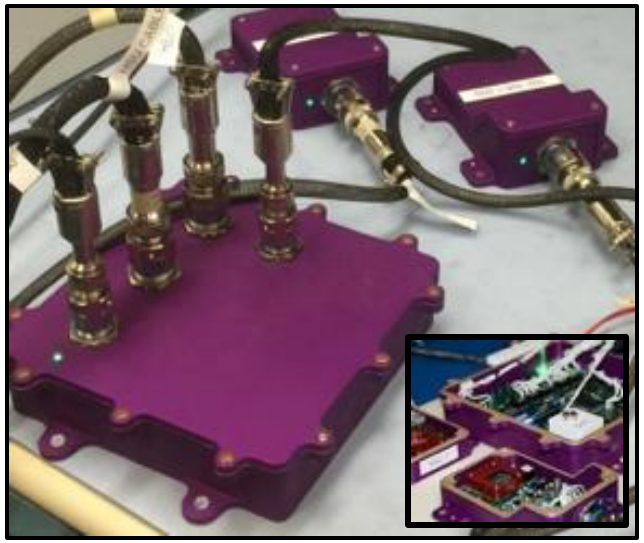
Challenges

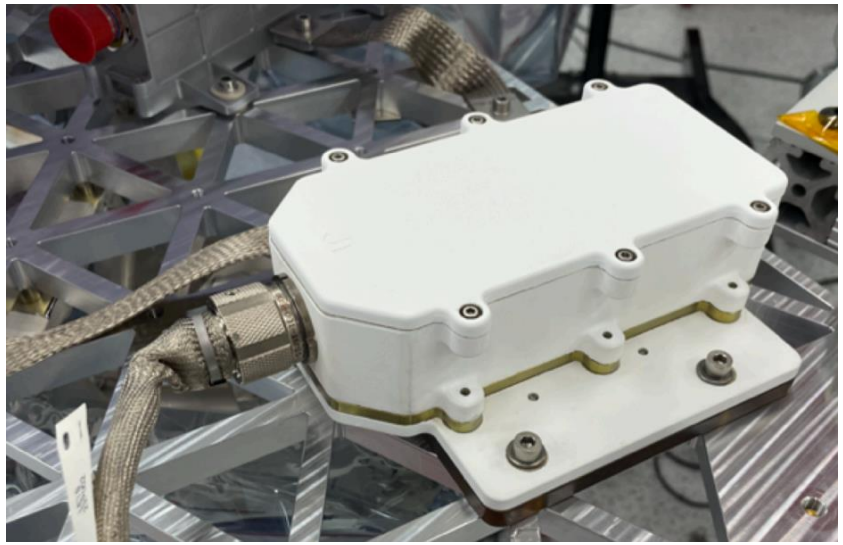
- Development had challenges from the start.
  - Define ARES interface and payload requirements for vehicles that did not have defined payload or environmental requirements defined.
  - Envelope expected requirements across the vehicles.
  - Reduced to a 2 year development to qualify the flight design ….
    support deliveries for the revised (March 2019)
    2024 Boots on the Moon.

  - The accelerated schedule refocused the development to meet the near-term needs of the Artemis.

ARES Heritage

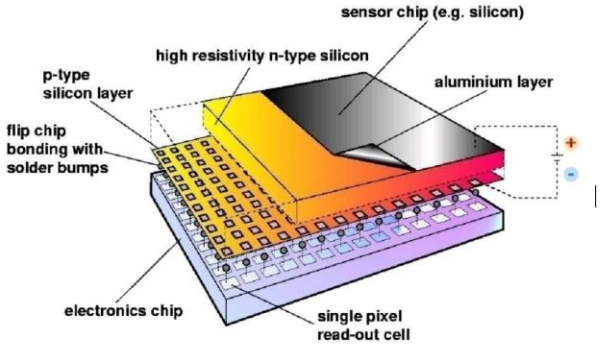
- Leverage knowledge gained with previous Si Timepix sensors.
  - REM on ISS
  - HERA –ISS missions and Artemis 1
  - LETS Biosentinel and CLPS missions

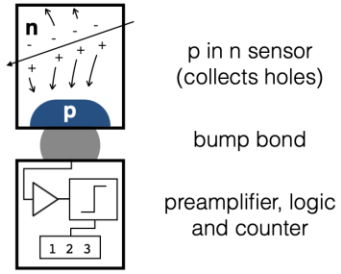


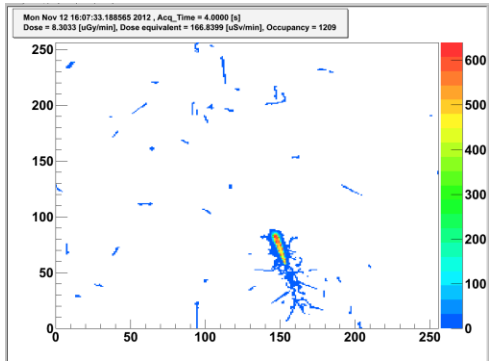


Radiation Sensor

- Timepix meets the sensor requirements for ARES on Artemis
- Timepix quantities were available even though production of wafer had stopped
- MCO procured enough Timepix mounted on NASA provided carrier boards in advance full system design

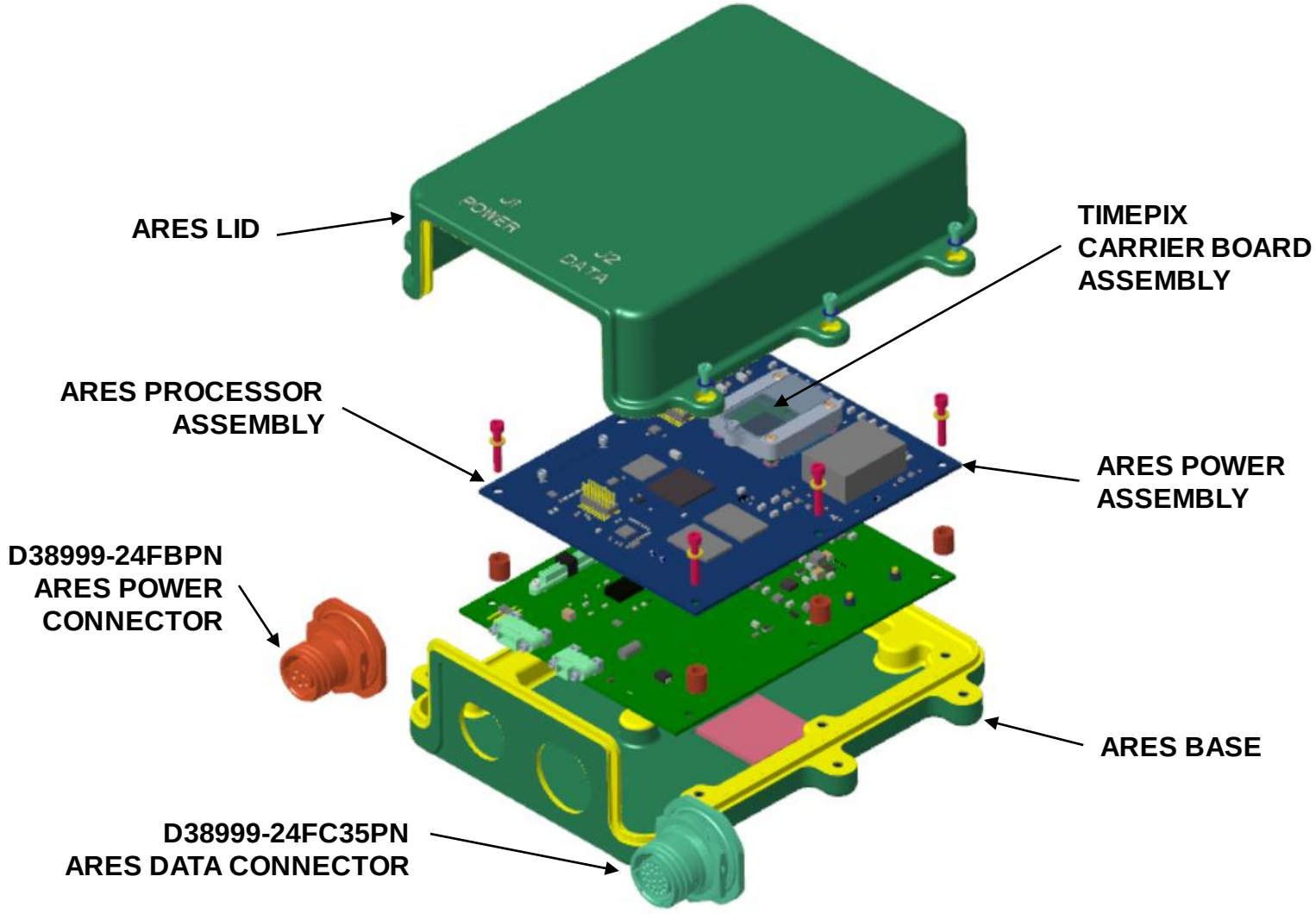






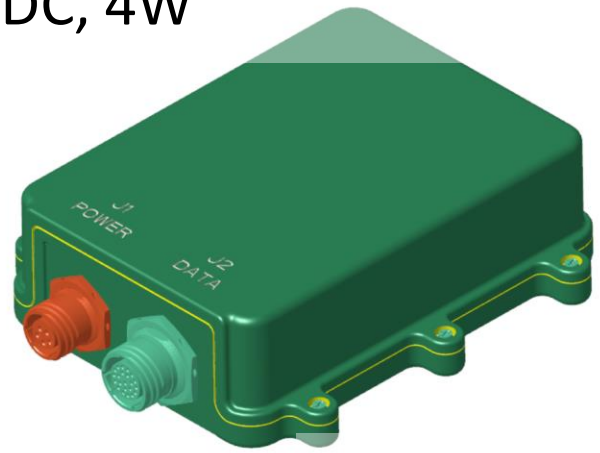
Design Goals

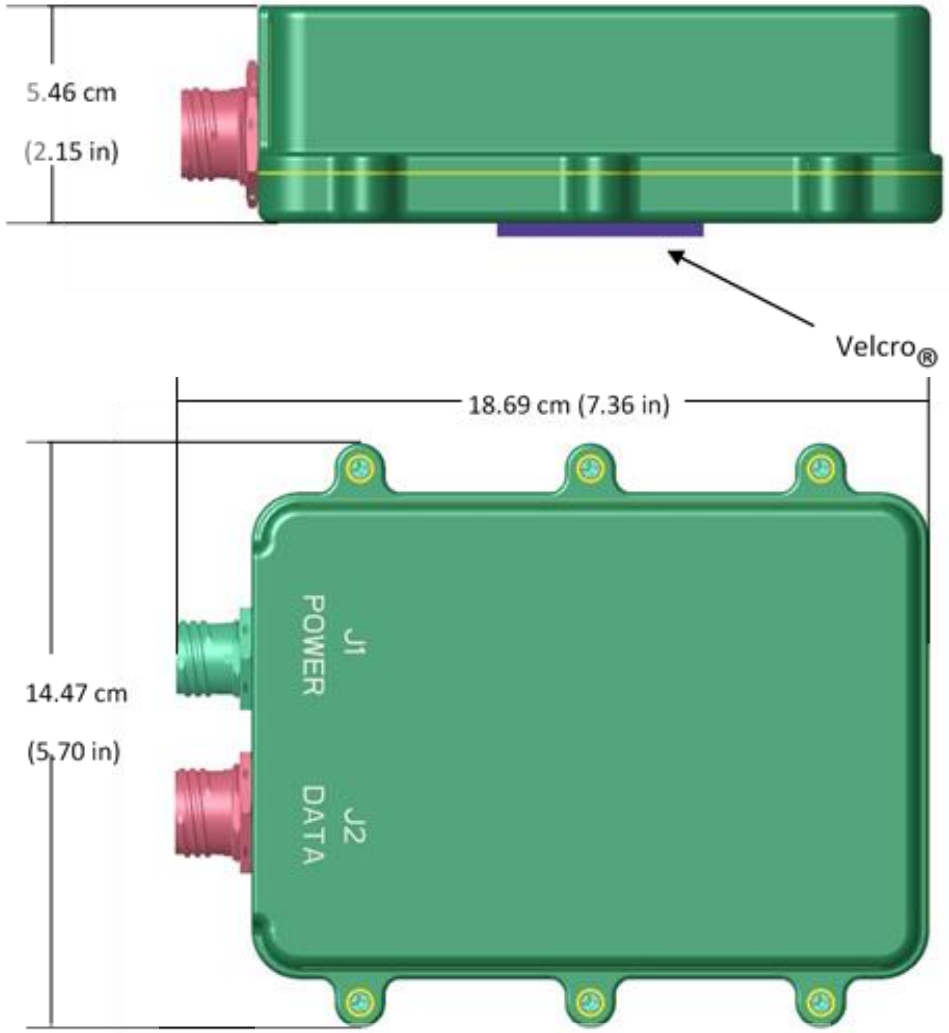
- EEE part upgrades were selected to increase reliability of heritage hardware
- New processor and memory
- New PCB designs to meet physical constraints
- Separation of power board to support active heating if required
- Better thermal management for Timepix heat transfer
- Housing design for soft stowed payload (no hard mount option)



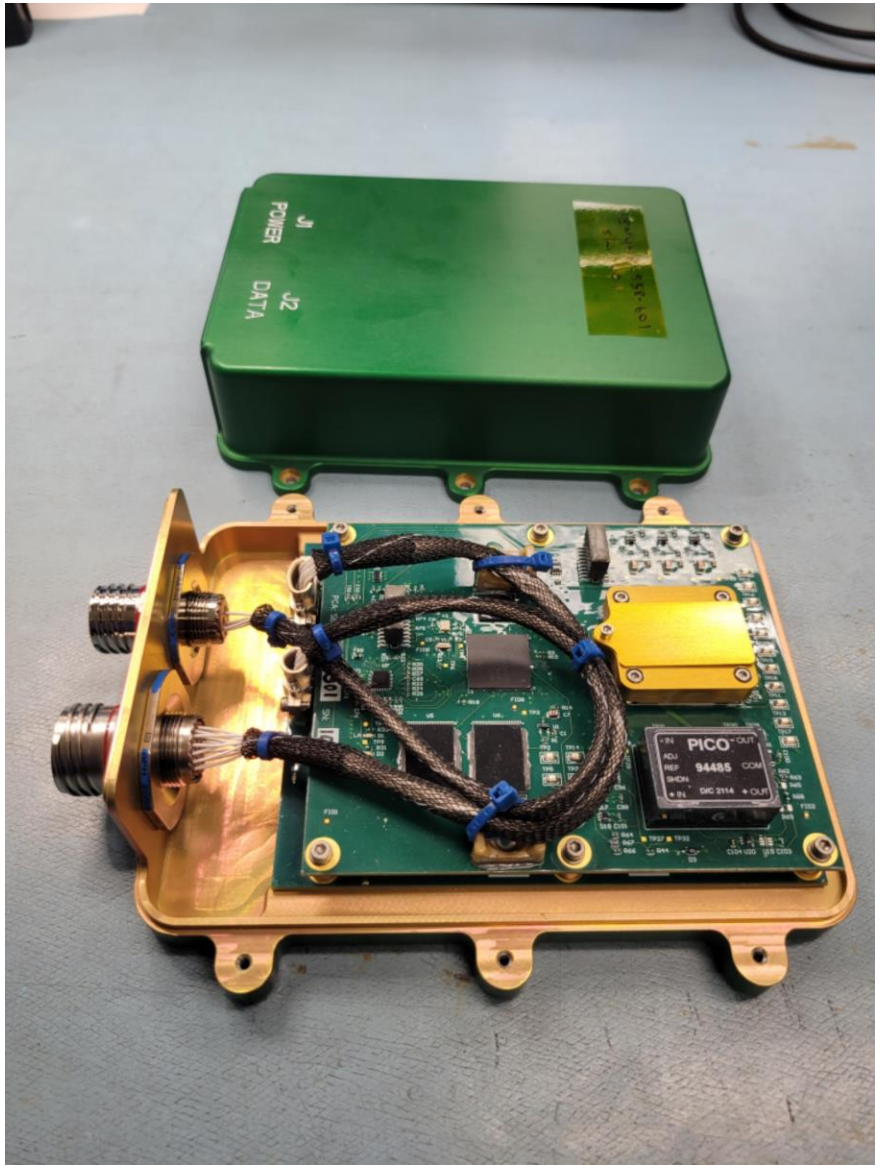
ARES

- **Mass: 0.8 kg**
- **Volume: 1054 cm³**
- **Housing:** Anodize/Alodine AL6061
- **Mounting:** Velcro
- **Power and Data Connectors:** D38999
- **Communication:** Ethernet command and data, 1/min cadence
- **Power:** 28 VDC, 4W

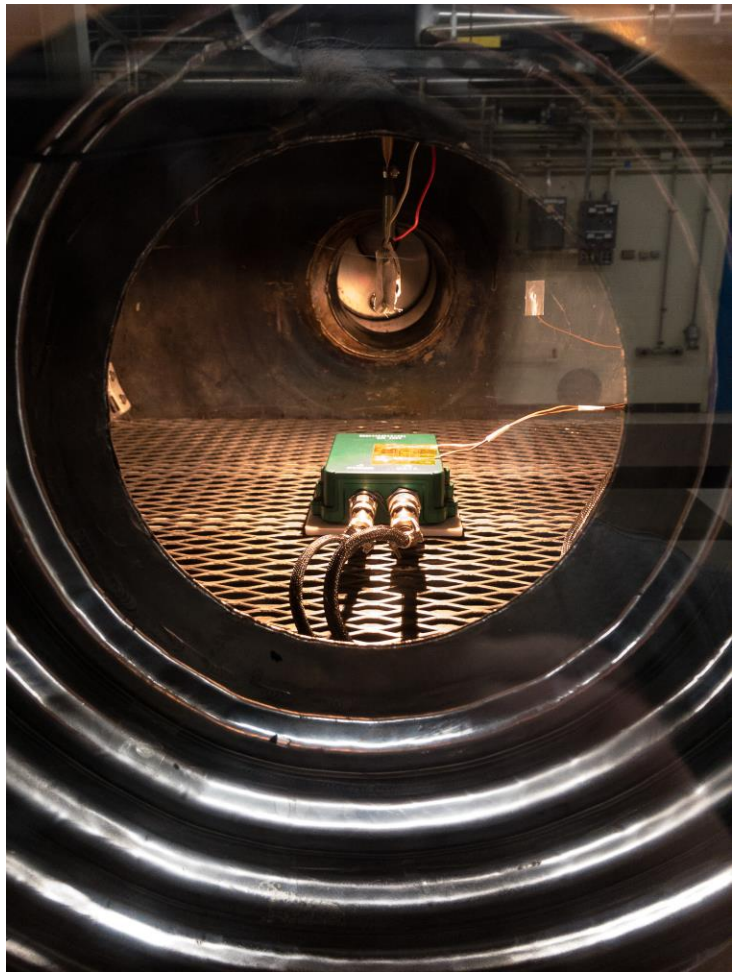




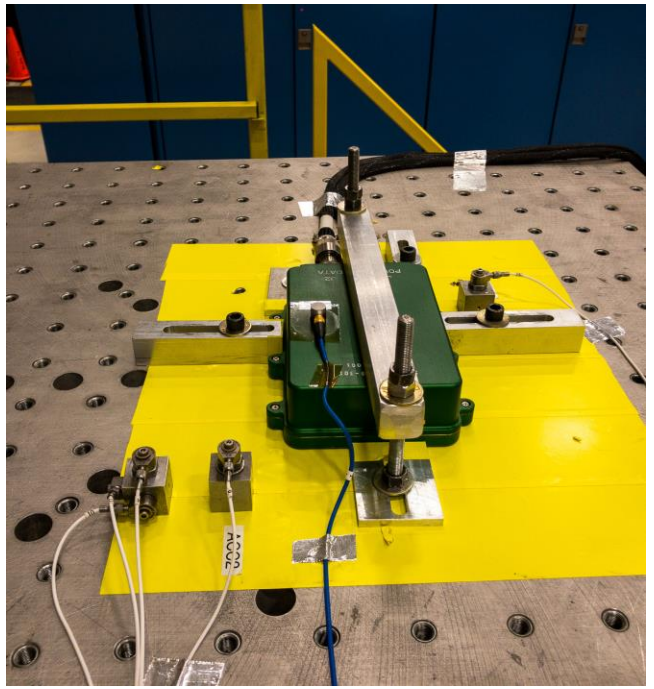
ARES Assembly

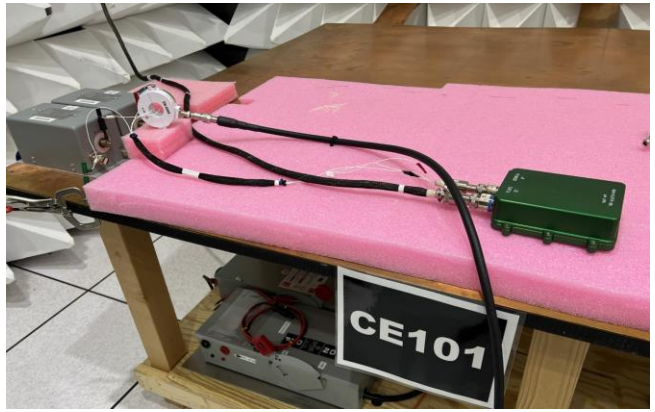


Test Environments



Test Event	ARES Testing (as performed)
Random Vibration	
Level	21.3 Grms / 10.2 Grms
Duration	3 minute per axis
Thermal Vacuum/Thermal Cycle	
Pressure	1X10 -5 Torr
Temperature	-34 C to 71 C
Cycles	20 Thermal/Vacuum
EMI/EMC	SMC-S-016
Power Quality	Per ISPSIS
Burn-in	200 Hours Duration. Temperature: +142°F (61.1°C)





ARES Assemblies

- Current Flight builds for Artemis
  - HLS (2 units for each)
    - Artemis III
    - Artemis IV
    - Artemis V
  - Gateway (3 units)
    - HALO Module
    - IHAB Modules
  - ISS Tech Demo
- Remaining assets do not have vehicles assigned at this time

ARES ConOps

The ARES primary function is to **monitor the radiation environment** in the habitable volume **during crewed mission phases**. Two units delivered per vehicle (prime and spare flight units)

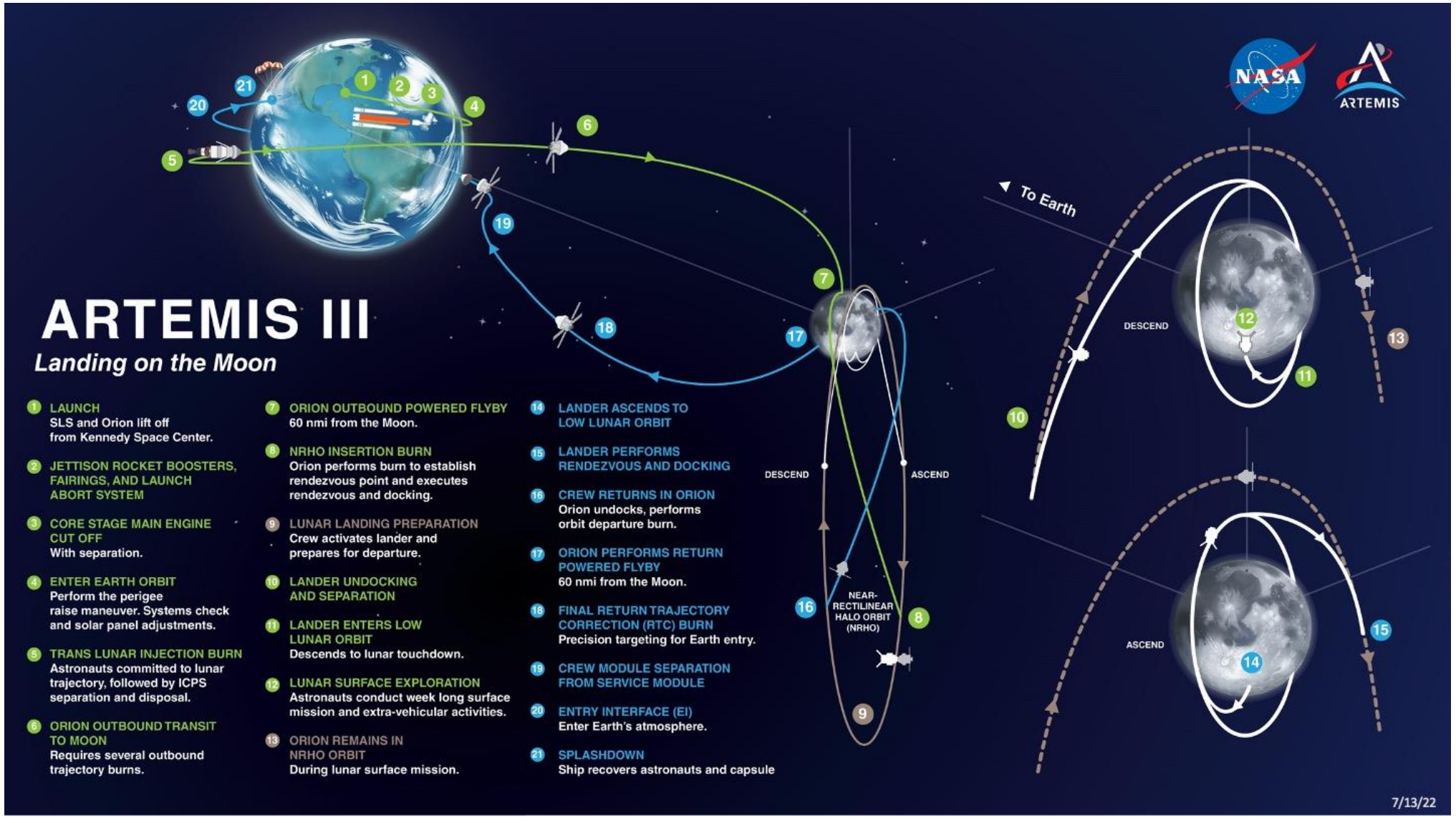
- **Launch, Stowage and Logistics**
  - ARES is soft-stow for launch.
- **Installation and Checkout**
  - Crew will retrieve the ARES from stowage for installation and checkout.
  - Installation is a shirt-sleeve operation, max
    - two cable install (one 28VDC for power, one Ethernet for data),
    - vehicle mount via Velcro.
  - Upon installation, vehicle provided power will initiate autonomous start and operation.

ConOps

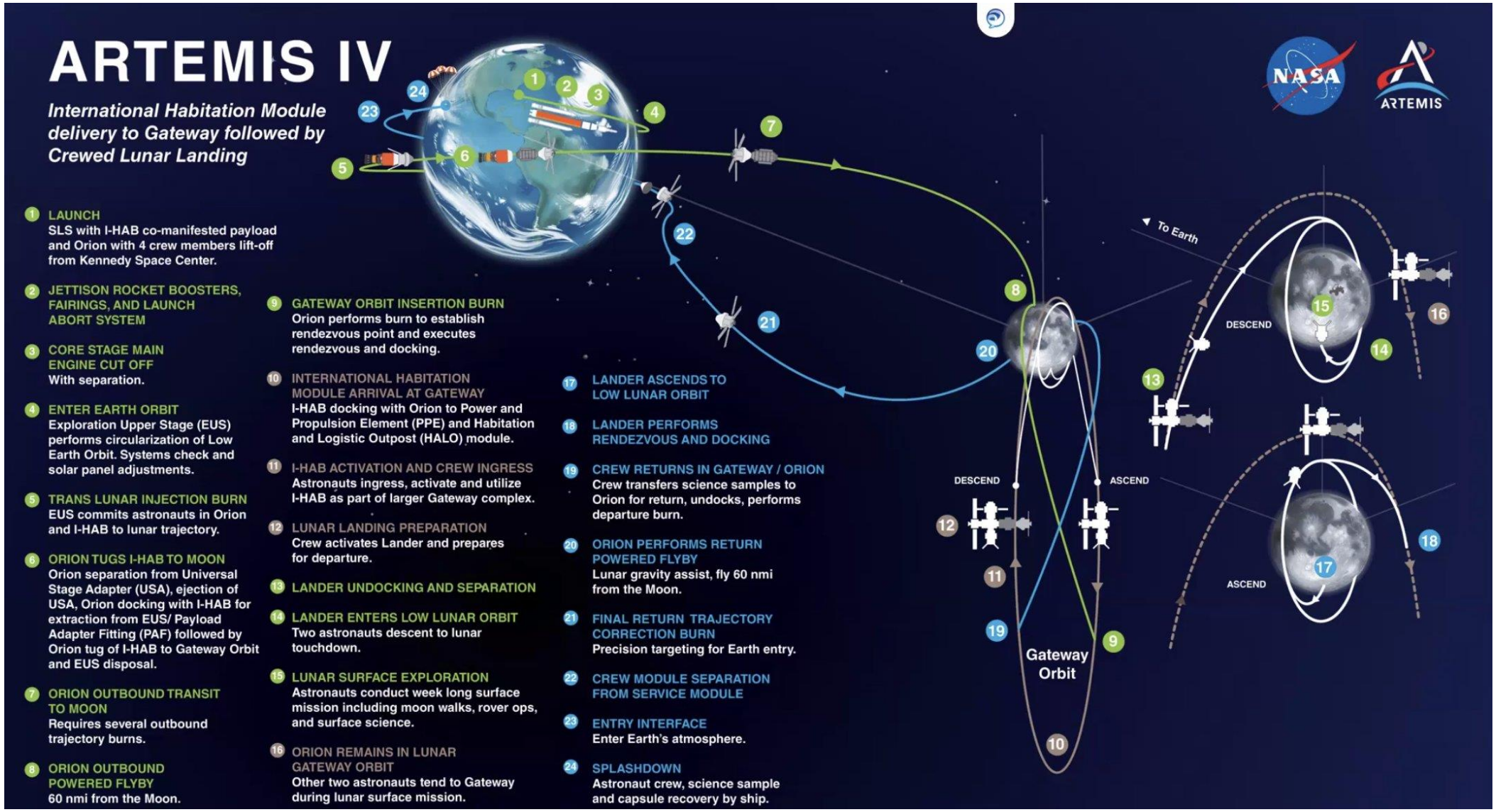
- **Nominal In-Flight Operations**
  - ARES is activated for 24/7 radiation monitoring when crew is in the vehicle
  - Hands free startup and operation after installation
  - The cumulative dose rate and absorbed dose is transmitted to the vehicle for communication to the crew and ground.
  - ARES will send an *alarm flag* to vehicle for high dose rate detection
  - The vehicle will downlink ARES data to the ground for analysis.

- **Quiescent Phases**
  - Powered off

ARTEMIS III



ARTEMIS IV



What's Next….

- For ARES, Deliver the units to the vehicle providers and support integration
- Console product development
- Wait for the flight and data
- For the project team, already working on the next generation of low power, low mass radiation detectors for MCO.
  - ARES2 will have 10 years operation life for cis lunar and beyond
  - CEPS Space Weather Radiation sensor