
National Aeronautics and
Space Administration
EXPLORE
MARS SAMPLE RETURN
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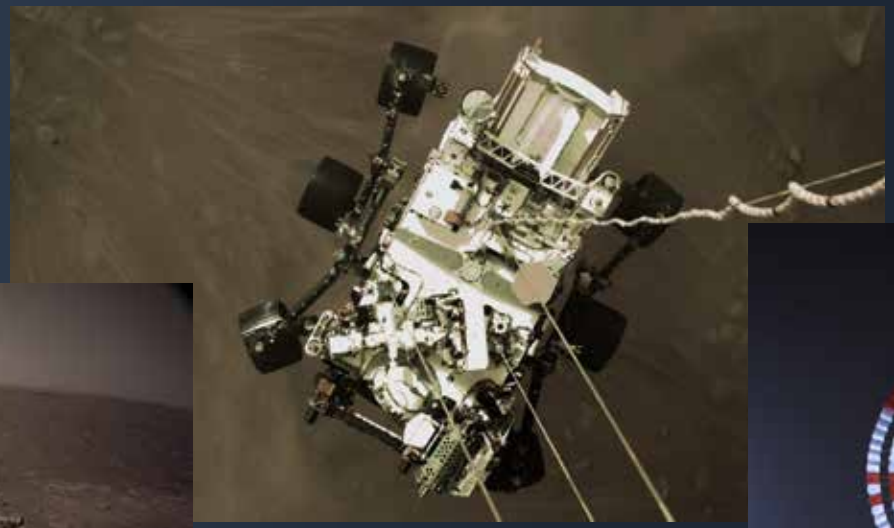
Introduction

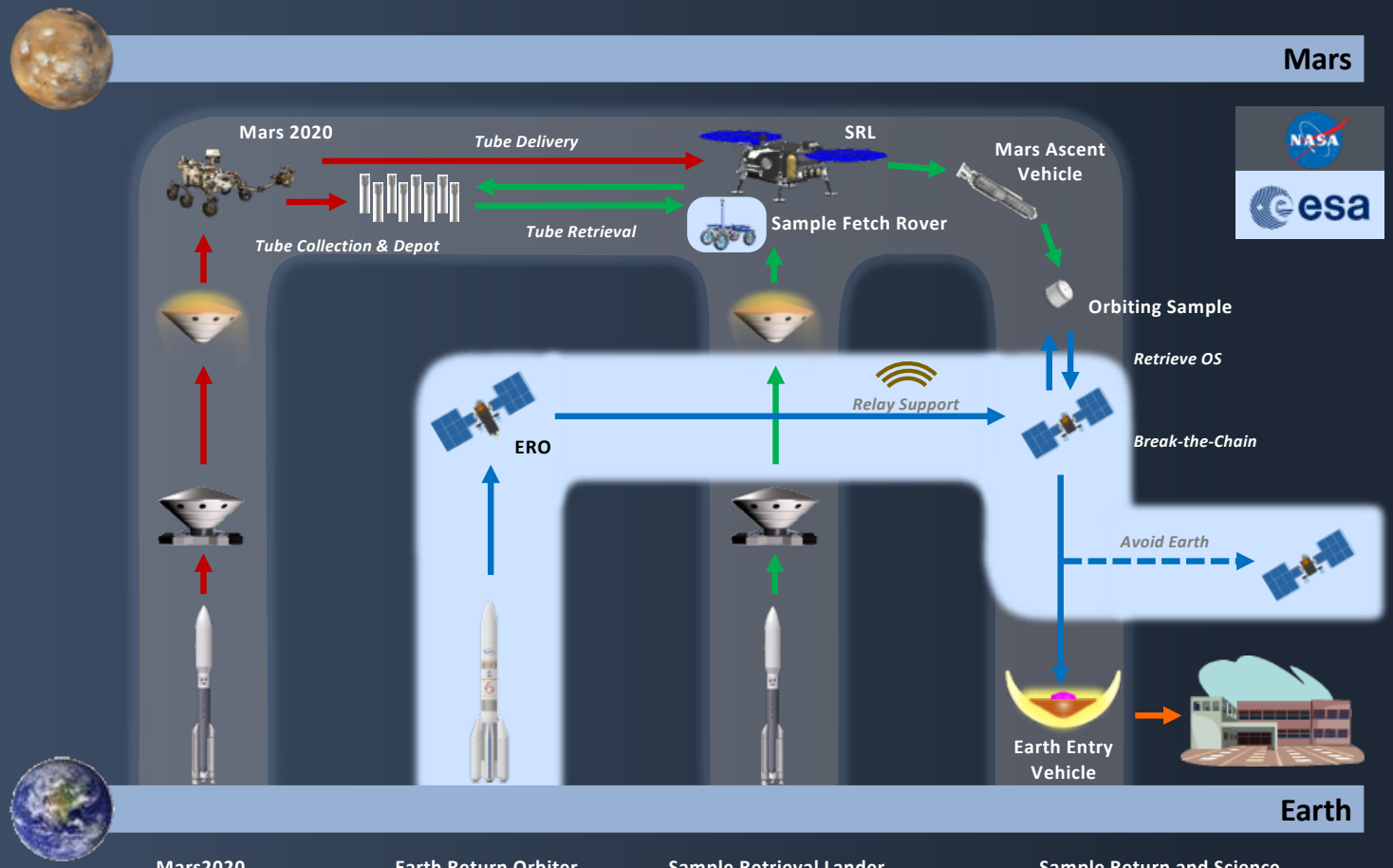
- Mars Sample Return (MSR) has been a priority of the past two National Academy Decadal Surveys
  - First “round-trip” to another planet, paving the way for future human exploration
- Perseverance has landed and is capable of selecting and caching 43 samples.
- The first billion years and life’s beginning in the Solar System- the record is on Mars
  - The oldest known life on Earth existed ~3.5 billion years ago, a time when Mars was habitable
  - Today, <<1% of the Earth’s surface is 3 billion years or older, >50% of the Mars’ surface is 3 billion years or older
- MSR is a complex mission
  - Requires a set of capabilities that were not demonstrated 20, or even 10, years ago.
  - It is only possible today as a result of the $10+B investment made through the formulation, technology and operational projects of the past decades, coupled with a strong international partnership with ESA
- In recognition of the size, complexity, and technological and engineering advances required, MSR employed several processes much earlier in Pre-Phase A
  - Commissioned two Independent Cost/Schedule Estimates
  - Had an Independent Review Board (IRB) conduct a two-month examination of the program
  - Established the program’s Standing Review Board to conduct the MCR as an Agency review

MSR was approved to proceed into Phase A in December following the IBR and the Mission Concept Review

Perseverance landing
2/18/2021



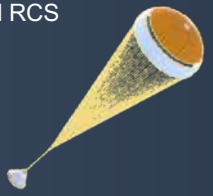
MSR Architecture Overview



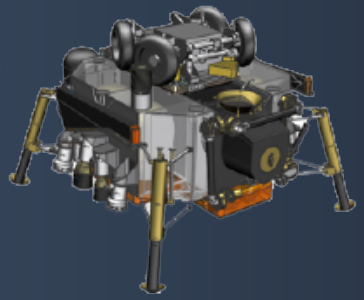
MSR Flight Elements

Cruise Stage (CS)
- Heritage Prop/GNC/FSW
- Redundant X-Band System with LGA and MGA

Entry Vehicle (EV)
- Heritage 4.7m Aeroshell with Backshell Mounted RCS
- Guided Entry
- 23m Parachute
- 4km Divert Capability for Pinpoint Landing
- EDL Communication via UHF System



Propulsive Platform Lander (PPL)
- Throttled-Engine Propulsive 4 Leg Platform
- Solar and Secondary Battery Power System
- Thermal Maintenance of the Mars Ascent Vehicle
- SFR Egress, STS and MAS Launch Execution
- 8 Context/Operational Cameras
- UHF Surface Communications



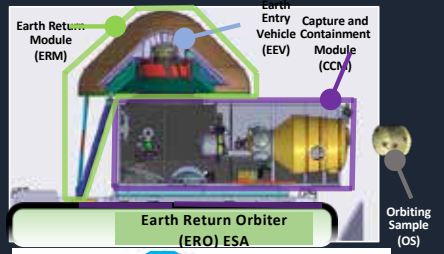
MAV
- Two stage solid rocket
- 380kg maximum mass
- 2.8 m length and 0.5m diameter
- -40 deg C non-op and -20 deg C op

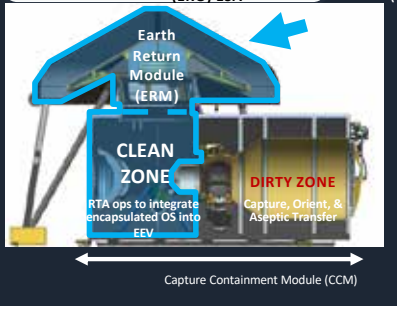
SFR
- 230kg NTE mass with specified volume envelope
- 4 wheels with 55cm diameter
- Umbilical power until power positive on surface

Sample Transfer Assembly (STA)
- 7 DOF arm to insert sample tubes & install OS
- Allow SFR and M2020 operations

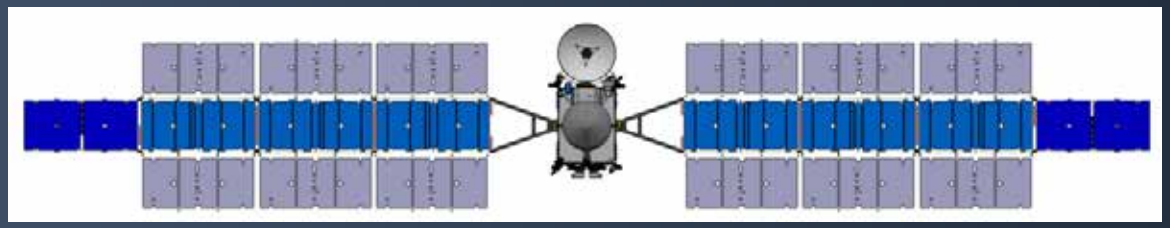
Orbiting Sample (OS)
- Accommodates 30 sample tubes
- OS and MPA each have 8 kg maximum mass (51% and 88% margin, respectively)

CCRS
- Capture the OS
- Break-the-Chain and assure Containment
- Deliver EES to UTTR while meeting BPP requirements

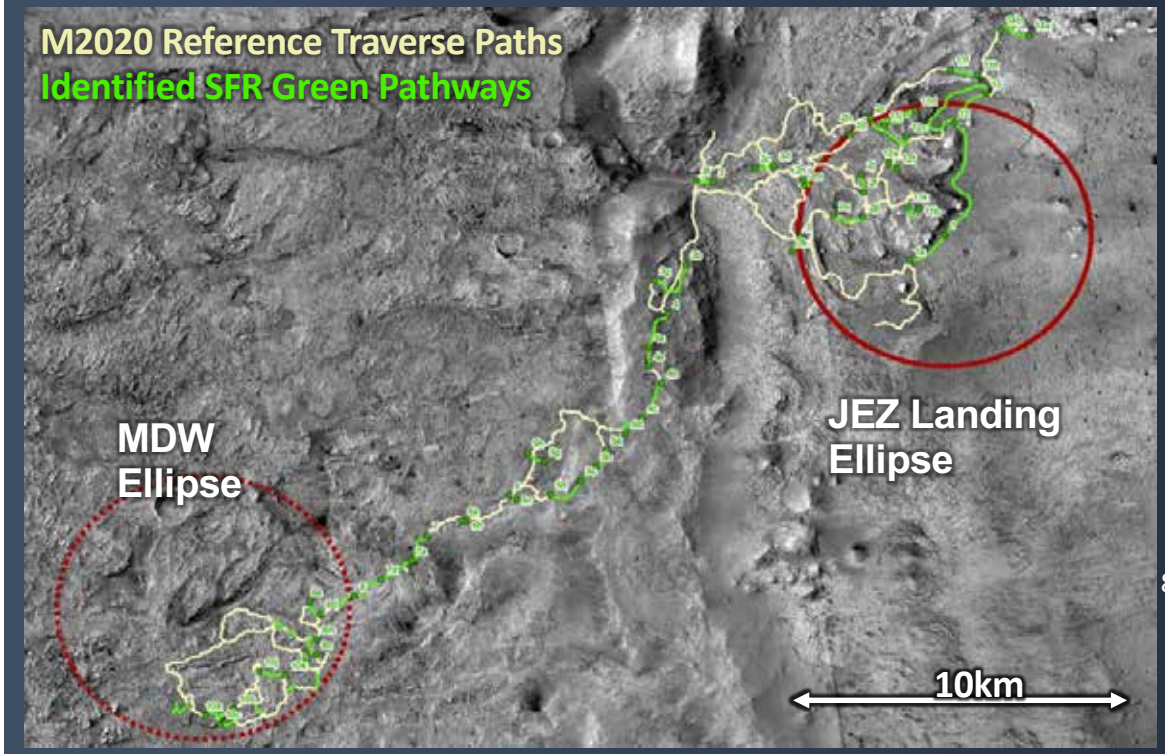




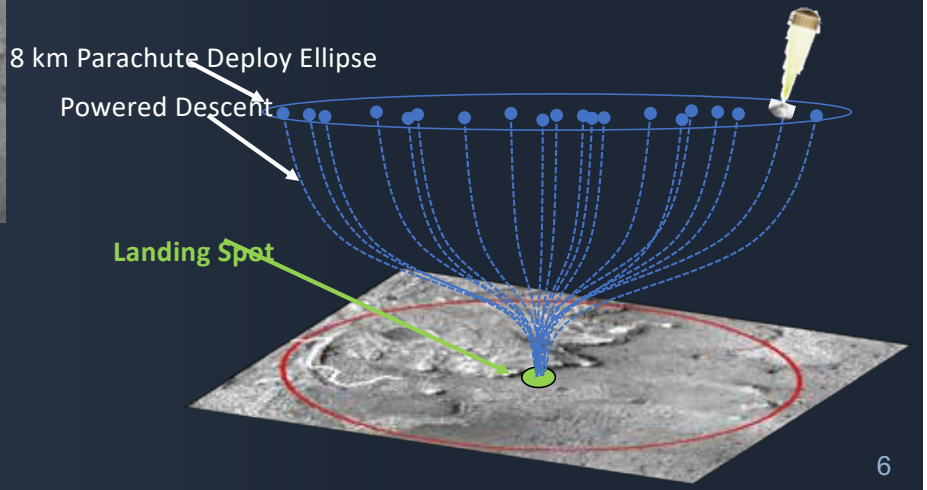
- **ERO**



Overview of Green Pathways Across Jezero-Midway Region



- SRL will carry enough propellant to fly out the backshell separation ellipse (8 x 8 km) and land at a specific spot (~±20m accuracy)
- Enables new capability of landing at a specific site pre-scouted from the Mars surface



Summary

- With launch and successful landing of Perseverance, the MSR Campaign is underway
- This is the most important planetary science undertaking in a generation
- Organizational responsibilities are defined and team is moving out
  - MOU signed; full partnership with ESA
- Through the pre-phase A effort, the team developed a feasible baseline and broad set of options
  - Mission is technically constrained to launch in the 2026-2028 timeframe
  - M2020 has agreed to place surface samples in green zones enabling our surface operations strategy
- The time is now to leverage investments and technology advances
- Team is working to mature architecture in Phase A
  - Close trades
  - Demonstrate viability on technology and engineering developments
  - Refine cost and schedule estimates with institutional commitments and updated FY22 budget profile
  - Continue refinement of backup Launch Readiness Date planning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