Mars 2020 Mission Concept

DEIS Scoping Public Meetings

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Mars 2020 Project

Mars 2020 Concept: Key Features

Seek signs of past life
Collect a returnable cache of samples using a coring system
Use efficient surface operations, one Mars-year lifetime
Prepare for human exploration

Explore a geologically diverse landing site
Confirm ancient habitability of site
Make coordinated scientific measurements, down to microscopic level
Benefit from design heritage of Curiosity rover
Improve Entry, Descent, Landing technology for precise landing
Mars 2020 Mission Concept Summary

Proven Design Elements from MSL

- **Cruise Stage**: Build to print
- **Backshell/Parachute**: Build to print
- **Descent Stage Vehicle**: Build to print
- **Rover**: High heritage, some subsystem changes, new instruments
- **Heatshield**: Build to print
Proposed Launch in 2020

- Twenty-day launch period during daytime from July 16 to August 4, 2020
- Launch vehicle will be competitively selected under the NASA Launch Services Program
- Until selection by NASA, project checks mission design scenarios using the MSL launch vehicle as a model
- No significant changes to launch site operations are expected

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<thead>
<tr>
<th>Requirement/Spec</th>
<th>MSL</th>
<th>Mars 2020</th>
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<tbody>
<tr>
<td>Launch Vehicle</td>
<td>Atlas V 541</td>
<td>Intermediate/Heavy Class</td>
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<tr>
<td>Launch Mass Allocation</td>
<td>4050 kg</td>
<td>4050 kg</td>
</tr>
<tr>
<td>Launch Mass Actual</td>
<td>3840 kg</td>
<td>To be determined</td>
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Proposed Cruise/Approach Phase

- Fundamentally the same cruise phase as Curiosity
- Seven months travel time
- Same navigation accuracy requirements
- No changes required to cruise flight system design
- No changes to cruise operations

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<tr>
<th>Trajectory Characteristics</th>
<th>MSL</th>
<th>Mars 2020</th>
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<tr>
<td>Cruise Duration</td>
<td>8.5 months</td>
<td>~7 months</td>
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<tr>
<td>Max Earth Range</td>
<td>1.75 AU</td>
<td>1.60 AU</td>
</tr>
<tr>
<td>Max Sun Range</td>
<td>1.54 AU</td>
<td>1.58 AU</td>
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Entry-Descent-Landing (EDL)

Proposed landing between February 15-21, 2021

New Rover Elements for Science

- Rover would carry a suite of newly selected/competed science instruments and technology experiments to support mission goals.
- NASA Announcement of Opportunity released September 24, with selection expected in Spring 2014
Surface Sampling System Concept

Notional Sample Collection & Caching Steps
1. Arm would move coring drill to bit box and loads bit
2. Arm would dock new bit at sample caching system, swing arm would load empty sample tube into drill bit
3. Arm would move coring drill to target rock
4. Coring drill would be activated, rock core collected into sample tube
5. Arm would dock filled sample tube to caching system
6. Swing arm would seal sample tube with plug at sealing station and loads into cache canister
7. Process would repeat until cache is filled...
8. Cache would be removed through rover top deck by robotic arm (either Mars 2020 mission or possible future mission) or potentially ejected directly to surface through bottom of sample caching system.

Technology Payload Concepts

• Entry Aeroshell Instrumentation
  – Gathers data upon entering atmosphere
• Terrain Relative Navigation (TRN)
  – Avoids hazards at landing
• Ringsail Parachute for Planetary Entry
  – More time to accomplish landing
Preparing for Human Exploration

- The Mars 2020 mission may carry an experiment that would use the Martian environment to produce useful resources
  - Would demonstrate CO₂ collection and dust characterization.
  - These data would feed forward to larger technology validation and systems necessary for potential future human missions to Mars.

Landing Site Selection Process

Key Science Definition Team Finding: Consider a wide range of sites across the equatorial region (± 30° latitude)
Power Source and Thermal Control

- Baseline power system would use the excess heat from a single Multi-mission Radioisotope Thermoelectric Generator (MMRTG) for electricity and keeping key rover engineering and scientific equipment at proper operating temperatures
  - Mars is very challenging thermal environment: the daily temperature can range from -198°F to +122°F
  - Thermal control of hardware internal to the rover chassis would be maintained via a pumped fluid system, utilizing both MMRTG waste heat and external radiators.
- An MMRTG would enable full Mar 2020 operations capability across the desired science landing site latitude band.
- Solar power design concepts are under study as alternatives.

Solar Power Alternatives: Initial Findings

- A solar power-only version of the M2020 mission architecture, landed at the equator, would last about ½ Martian year
- Dust accumulation on solar arrays would need to be removed for the mission to last longer
- Possible combination of solar arrays and Radioisotope Heater Units could enable missions around the equator
- The Mars 2020 Draft EIS will address Mars 2020 mission alternatives using the latest available information.
Mars 2020 Mission Concept Summary
A crucial element in executing NASA's strategic plan for space science

LAUNCH
- Intermediate/Heavy Class Rocket
- Launch Period: July/Aug 2020

CRUISE/APPROACH
- Seven-month cruise
- Arrive Feb 2021

ENTRY, DESCENT & LANDING
- MSL EDL system: guided entry and powered descent/Sky Crane
- 25x20 km landing ellipse
- Access to landing sites ±30° latitude, ≤0.5 km elevation
- ~950 kg rover

SURFACE MISSION
- Prime mission of one Mars year
- 20-km traverse distance capability
- Seeking signs of past life
- Future returnable cache of samples
- Prepare for human exploration of Mars