Secondary Payloads, EM-1 and Beyond

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Secondary Payload Integration Manager
SLS Family

- **Core Stage**: 322 ft.
  - Interstage Advanced Boosters
- **SLS Block 2 Cargo**: 130t
- **SLS Block 1B Crew**: 105t
- **SLS Block 1B Cargo**: 105t
- **Orion** Launch Abort System
- **Interim Cryogenic Propulsion Stage**
- **Launch Vehicle Stage Adapter**
- **Universal Stage Adapter**
- **Solid Rocket Boosters**
- **Cargo Fairing**
- **Exploration Upper Stage**
- **Interstage**
- **RS-25 Engines**
- **Advanced Boosters**
EM-1, SLS Block 1 (70-Metric-Ton)
LVSA Structural Test Article
EM-1 Mission Profile

Total Payload Deployment System
Mission Duration: 10 days

1) LAUNCH
2) Perigee Raise Maneuver (PRM)
   ICPS - 100x975 nmi
   (185x1806 km)
3) TRANS-LUNAR INJECTION (TLI)
   ICPS
4) MPCV/ICPS Separation
   10 min. after TLI

2nd Payload Deployment Conditions
- Ground launch window up to 2 Hrs long (depends on launch day in weekly window).
- DRO Mission Scenario— Weekly Launch Window with Lunar Arrival ~3.5 to 8.5 days, early in window is longest trip time.
- End of the disposal maneuver, the ICPS is at 26,750 km Earth Radius, inertial velocity of 5.279 km/s.
5) Trajectory Correction Maneuvers (TCMs)
   Orion
   Outbound: 3 - 8 days
6a) Mission & Return to Earth
    Orion

5b) Trajectory Disposal Maneuvers (TDMs)
    ICPS w/2nd Payloads 45 - 60 min.
6b) 2nd Payload Deployment - Start
    Deployment window 10 days
    Outbound: 3 - 8 days
7) ICPS to Helio Orbit

2nd Payload Option(s)
- Orbit Moon
- Impact into Moon
- Fly out past moon
Movie of EM-1 Secondary Payload Deployment

(removed embedded video so charts can be emailed)
**The Moon**

- **Lunar Flashlight**
  LEAD PARTNER: JPL
  SPONSOR: NASA HEO AES
  Using a laser, search for ice deposits and locations with valuable resources on the moon.

- **Lunar IceCube**
  LEAD PARTNER: Morehead State University of Morehead, Kentucky
  SPONSOR: NASA HEO Next Step
  Using an Infrared Spectrometer, search for water in all forms and other volatiles on the moon.

- **LunaH-Map**
  LEAD PARTNER: Arizona State University, Tempe, Arizona
  SPONSOR: NASA SMD Planetary Science
  Using neutron spectrometers, create maps of near-surface hydrogen in craters and other permanently shadowed regions of the moon’s south pole.

- **OMOTENASHI**
  LEAD PARTNER: JAXA
  INTERNATIONAL PARTNER: University of Tokyo
  Observe the radiation environment and soil mechanics of the moon.

**The Earth**

- **EQUULEUS**
  LEAD PARTNER: NASA JAXA
  INTERNATIONAL PARTNER: University of Tokyo
  Image the earth’s plasmasphere for a better understanding of earth’s radiation environment.

- **Skyfire**
  LEAD PARTNER: Lockheed Martin
  SPONSOR: NASA HEO Next Step
  Perform environmental sensor analysis as passing the Moon and in final position in geosynchronous orbit around Earth.

**An Asteroid**

- **NEA Scout**
  LEAD PARTNER: Marshall Space Flight Center
  SPONSOR: NASA HEO AES
  Travel by solar sail to a near-earth asteroid and take pictures and other characterizations of its surface.

**Avionics Unit**

- **Avionics Unit Development Managed By Marshall Space Flight Center**
  The avionics unit deploys the payloads with an electrical pulse to individual dispensers, activating a spring-loaded deployment mechanism.

**Other Missions**

- **BioSentinel**
  LEAD PARTNER: Ames Research Center
  SPONSOR: NASA HEO AES
  Use single-celled yeast to detect, measure, and compare the impact of deep-space radiation on living organisms over a long period of time.

- **ArgoMoon**
  LEAD PARTNER: European Space Agency/ASI, International Partner
  Observe the Interim Cryogenic Propulsion Stage as it follows its disposal stage.

**Centennial Challenge’s Cube Quest Winners**

As winners of the Ground Tournament, three CubeQuest payloads will ride on EM-1. Once in deep space, the next phase of the Cube Quest Challenge begins with the Deep Space Derby and the Lunar Derby. Each payload will demonstrate various communications, navigation and longevity achievements. Competitors have a shot at $5 million in prize money, marking the agency’s largest-ever prize competition.

Team Miles (Fluid & Reason, LLC)
Cislunar Explorers (Cornell University)
SEDS Triteia (University of California at San Diego)
Heimdallr (Ragnarok Industries)
CU-E3 (University of Colorado)

**SLS EM-1 Secondary Payloads**
<table>
<thead>
<tr>
<th>Bus Stops</th>
<th>Distance (approx.)</th>
<th>Flight Time (approx.)</th>
<th>Approx. Temp.</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>26,700 km</td>
<td>3 Hrs. &amp; 34 Min.</td>
<td>13°C (55°F)</td>
</tr>
<tr>
<td>2</td>
<td>64,500 km</td>
<td>7 Hrs. &amp; 51 Min.</td>
<td>-7°C (20°F)</td>
</tr>
<tr>
<td>3</td>
<td>192,300 km</td>
<td>3 Days, 6 Hrs. &amp; 12 Min.</td>
<td>-29°C (-20°F)</td>
</tr>
<tr>
<td>4</td>
<td>384,500 km</td>
<td>6 Days, 11 Hrs. &amp; 57 Min.</td>
<td>-26°C (-15°F)</td>
</tr>
<tr>
<td>5</td>
<td>411,900 km</td>
<td>7 Days, 0 Hrs. &amp; 16 Min.</td>
<td>-29°C (-20°F)</td>
</tr>
</tbody>
</table>

**Description**
- **1** First opportunity for deployment, cleared 1st radiation belt
- **2** Clear both radiation belts plus ~1 hour
- **3** Half way to the moon
- **4** At the moon, closest proximity (~250 km from surface)
- **5** Past the moon plus ~12 hours (lunar gravitational assist)

Note: All info based on a 6.5 day trip to the moon.
B1B SecPay Config Concept

Payload Adapter Fitting Panels

Co-Manifested Payload

Deployed Before Secondary Payload Deployment

USA Wall

Connector Panel

USA

22 – 6U
2 – 12U
2 – 27U

(USA & Payload Adapter Fitting for Secondary Payload mounting locations)