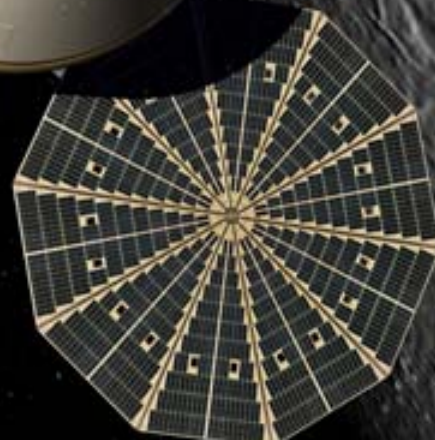




# Project Orion Overview And Prime Contractor Announcement

**Skip Hatfield**  
**Orion CEV Project Manager**

August 31, 2006

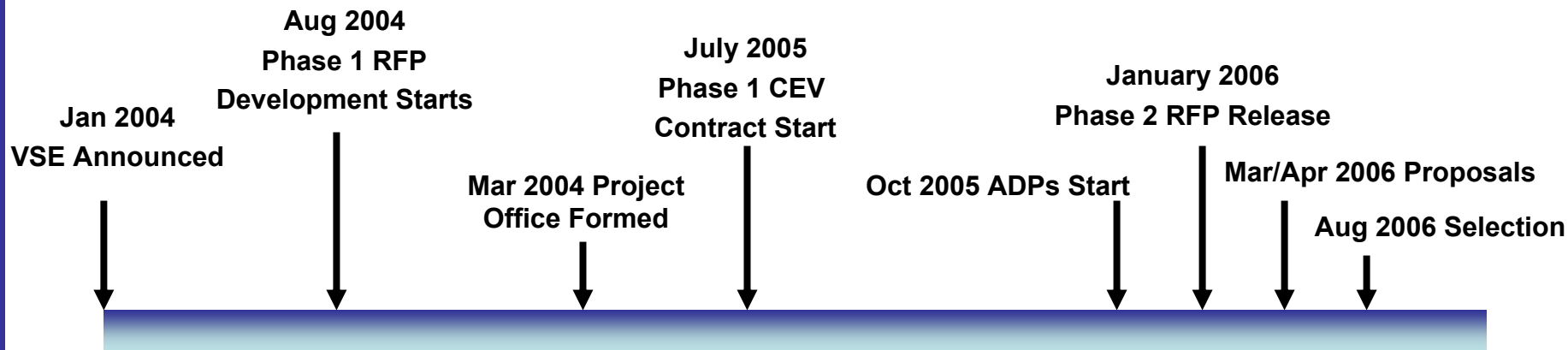




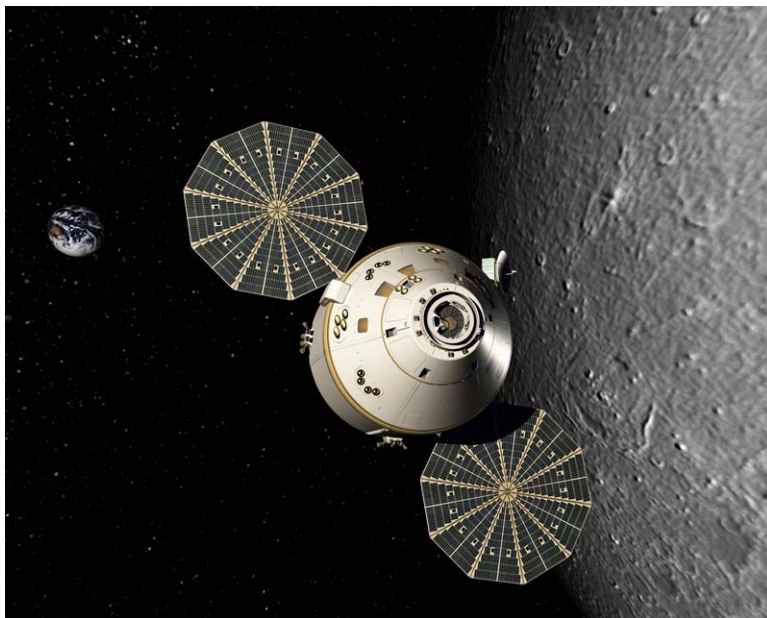
# Contract Selection Continues our Pursuit of the Vision for Space Exploration



- Planning for Orion began with the VSE announcement in Jan 2004
- Selection of Lockheed Martin today is informed by
  - NASA architecture and reference configuration studies
  - NASA Advanced Development Project early technology studies
  - Two Contractor teams performing initial designs in Phase 1
- The Orion Team merges today to begin development phase with a strong base of experience



**Orion targets first mission to Space Station no later than 2014 and to the moon no later than 2020**



## Lunar Mission

- **Orion and Lunar Lander boosted to lunar orbit**
  - Up to 4 crew onboard
- **Lander descends to lunar surface for up to 7 day sortie**
- **Orion is uninhabited during lunar surface operations**
- **Lander upper stage returns to Orion in lunar orbit**
- **Orion returns crew to Earth**

## Capable of ISS Missions

- **Transport up to 6 crew members on Orion for crew rotation**
- **210 day stay time**
- **Emergency lifeboat for entire ISS crew**
- **Deliver pressurized cargo for ISS resupply**
- **Orion returns crew to Earth**



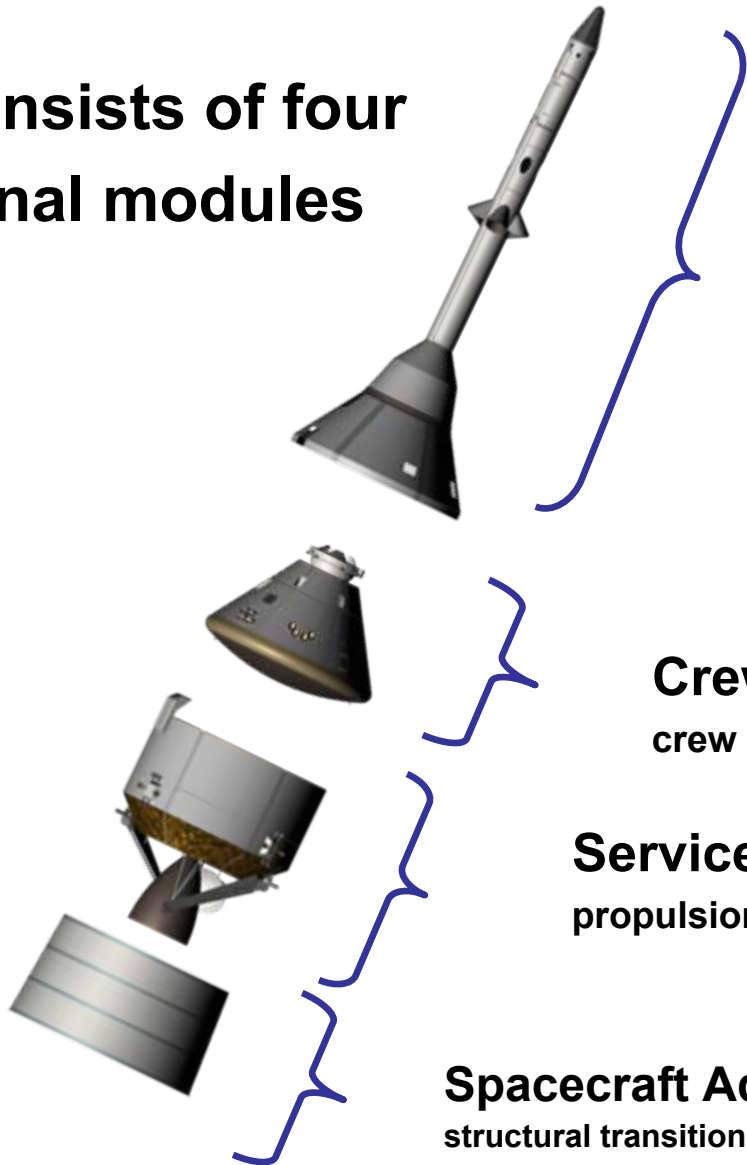


# The Lockheed Martin Orion System Elements



Crew Exploration Vehicle Project Office

**Orion consists of four functional modules**



**Launch Abort System --**  
emergency escape during launch

**Crew Module –**  
crew and cargo transport

**Service Module –**  
propulsion, electrical power, fluids storage

**Spacecraft Adapter –**  
structural transition to launch vehicle





# CEV Crew Module



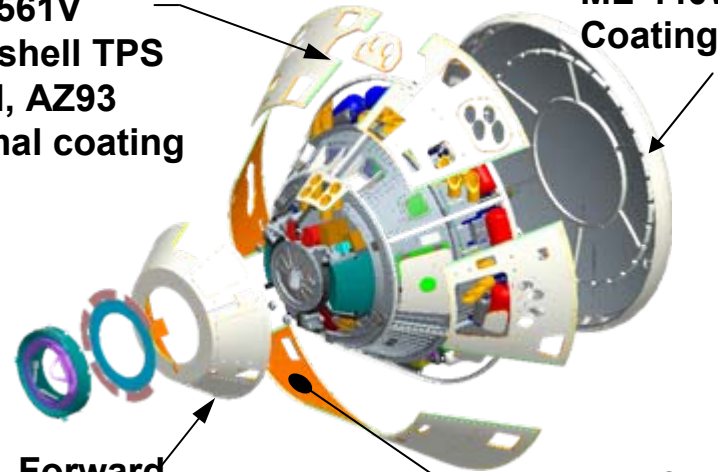
### Configuration Summary

Diameter	16.5 ft
Ref Hypersonic Lift to Drag Ratio	.34 @ 157°α
Pressurized Volume (Total)	691.8 ft <sup>3</sup>
Habitable Volume (Net)	361 ft <sup>3</sup>
Habitable Volume per 4 CM	90.3 ft <sup>3</sup>
CM Propellant	GO <sub>2</sub> /GCH <sub>4</sub>
Total CM Delta V	164 ft/s
RCS Engine Thrust	100 lbf
Lunar Return Payload	220 lbs

### Mass Properties Summary

Dry Mass	17396.8 lbs
Propellant Mass	385.1 lbs
Oxygen / Nitrogen Mass / Water	282.8 lbs
CM Landing Wt.	16174.3 lbs
GLOW	18706.3 lbs

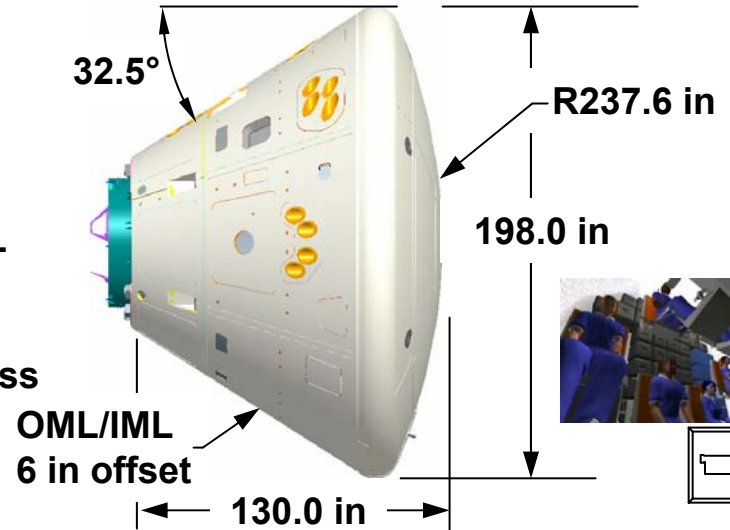
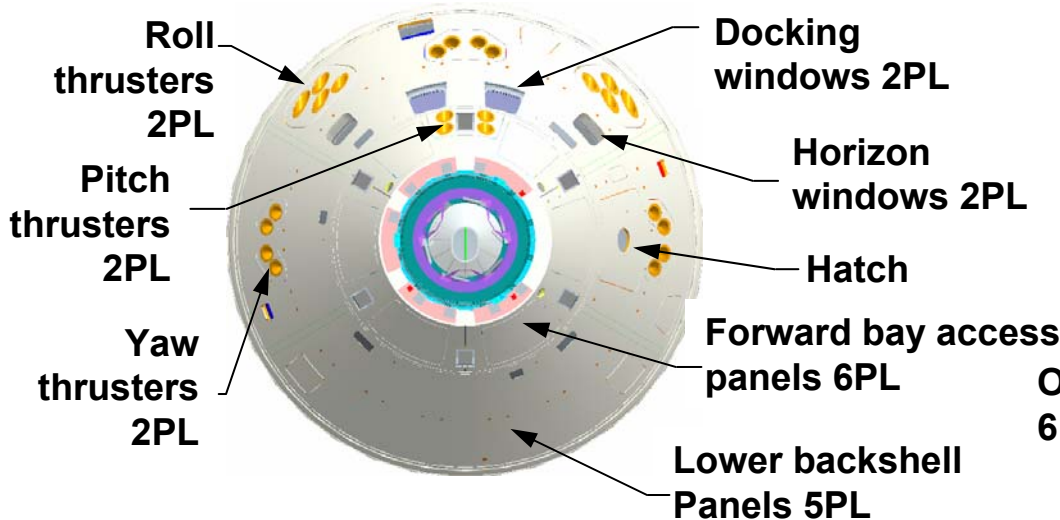
- SLA-561V Backshell TPS panel, AZ93 thermal coating



- PICA Heatshield, ML-440WSO Coating

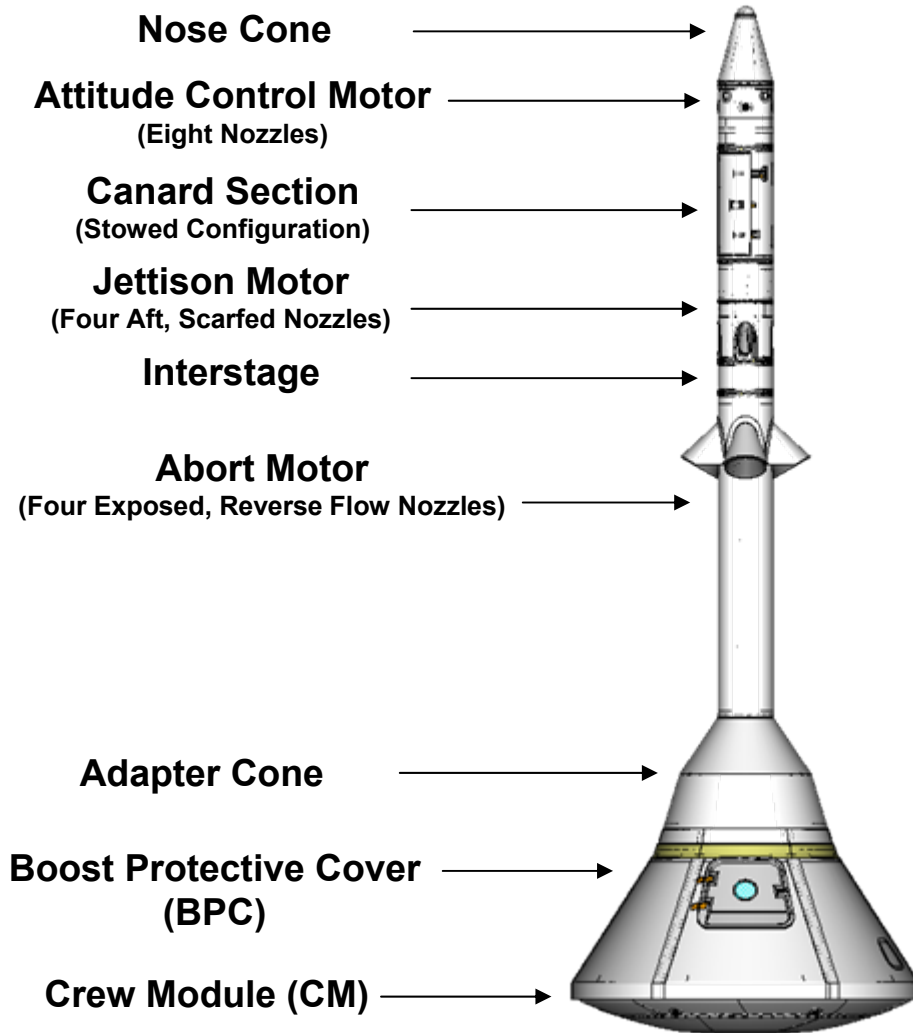
Forward bay cover

Nextel & kevlar MMOD blankets





# Launch Abort System Summary



## Configuration Summary

### Abort Motor

No. of Nozzles:	4
Nozzle Cant Angle (to CL):	30°
Isp (sea level):	250s
Thrust (Total in Vehicle Axis):	506,408 lbs
Burn Time:	2.0s
T/W:	15:1

### Attitude Control Motor

No. of Nozzles:	8
Nozzle Cant Angle (to CL):	90°
Isp (vac):	227s
Thrust (per Nozzle):	2500 lbs
Burn Time:	20s

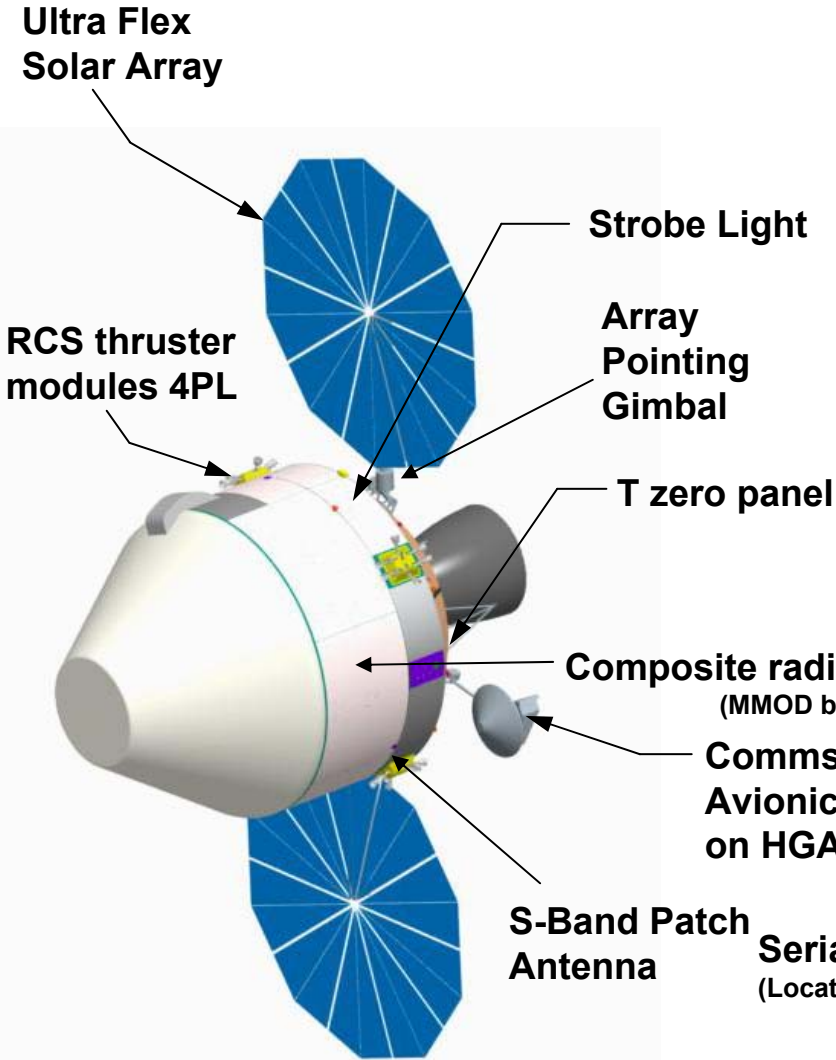
### Jettison Motor

No. of Nozzles:	4
Nozzle Cant Angle (to CL):	35°
Isp (vac.):	221s
Thrust (per Nozzle):	9668 lbs
Burn Time:	1.5 s

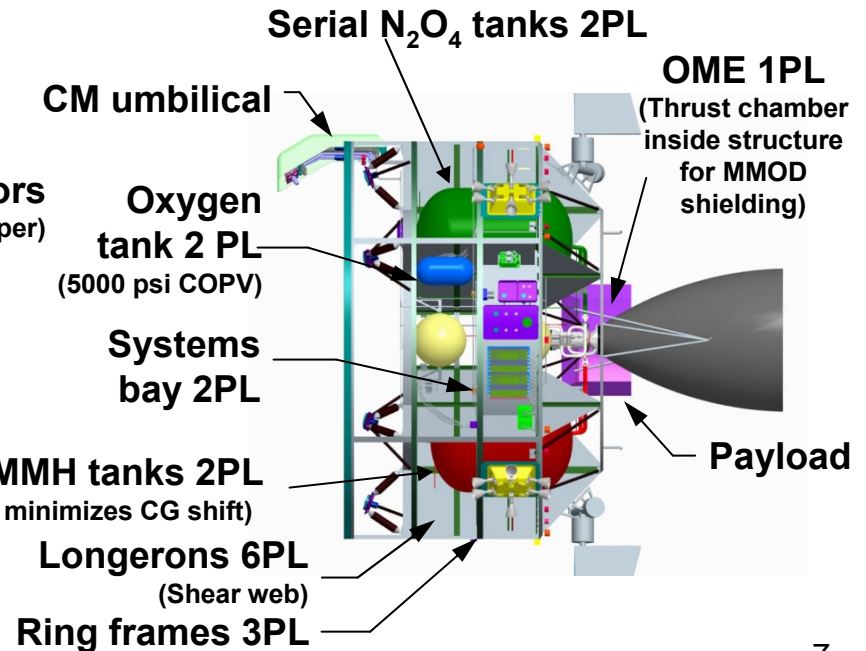
## Mass Properties Summary

Dry Mass	8148 lbs
Propellant	5468 lbs
GLOW	13616
lbs	

Launch Abort Vehicle (LAV): Crew Module + LAS



Configuration Summary	
Structural Configuration	3 Rings / 6 Longerons
Propulsion Configuration	2x2 Serial Feed
SM Propellant	MMH/N <sub>2</sub> O <sub>4</sub>
Total SM ΔV	6086 ft/s
Main Engine Thrust	7500 lbf
RCS Thruster Thrust	100 lbf
Solar Array Area	388 ft <sup>2</sup>
Solar Array Power	9.15 Kw
Radiator Area	334 ft <sup>2</sup>
Thermal Dissipation	6.3 Kw





# CEV Spacecraft Adapter

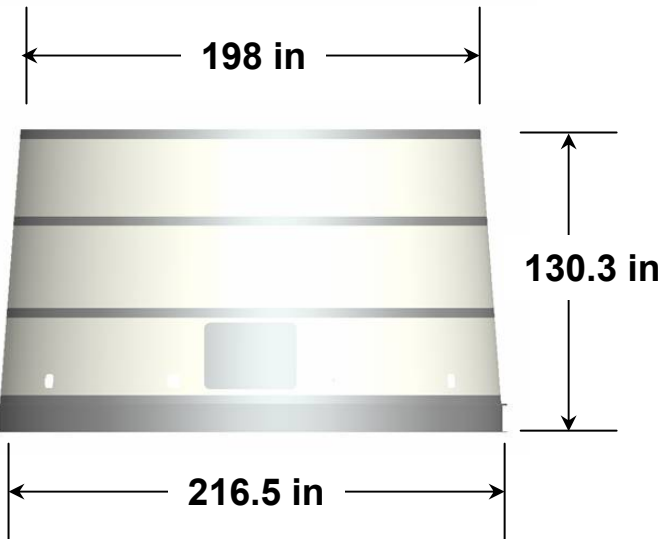
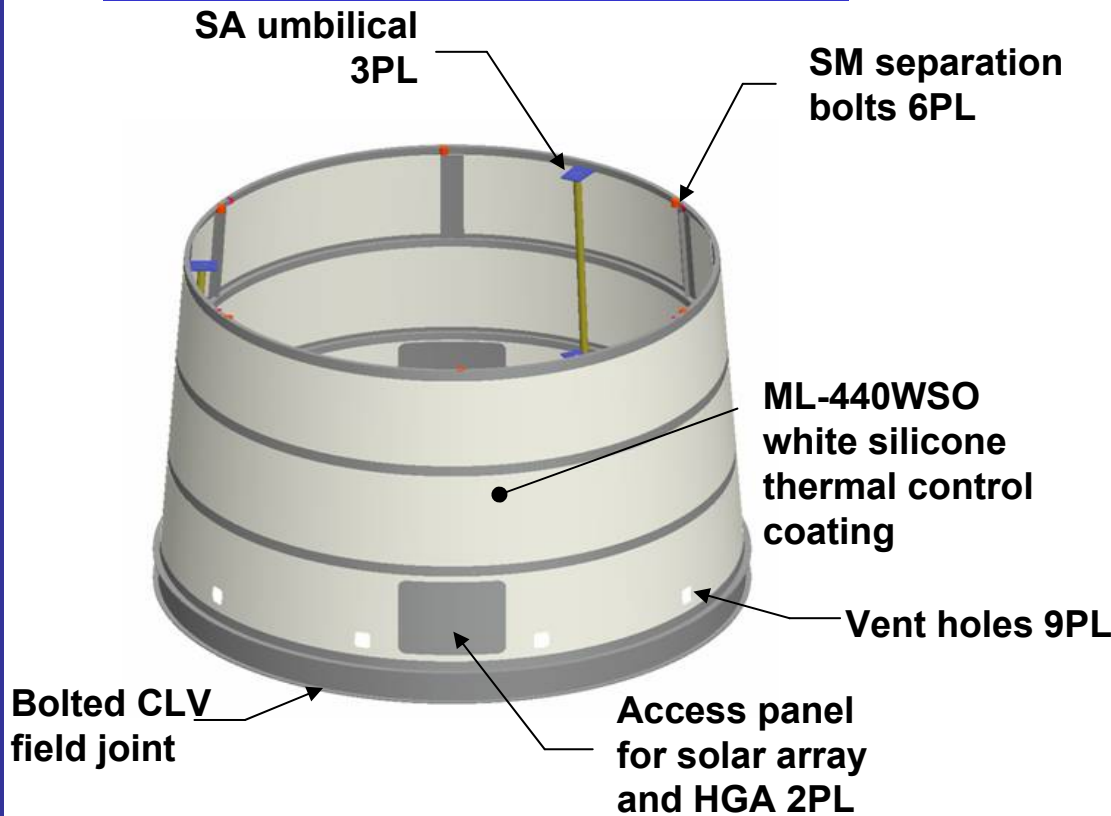


## Configuration Summary

Panel Material	IM7/977-3 sandwich
Longeron Material	7075 aluminum
Ring Frame Material	2024 aluminum

## Mass Properties Summary

GLOW	1281.4 lbs
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# Orion Lockheed Martin Industry Team



Crew Exploration Vehicle Project Office

**LOCKHEED MARTIN**

- Systems & Design Engineering Support



**Hamilton Sundstrand**

A United Technologies Company

- Environmental Control & Life Support
- Active Thermal Control
- System Power Management

**AEROJET**

- Propulsion

**LM GRC**

- SM Liaison Office



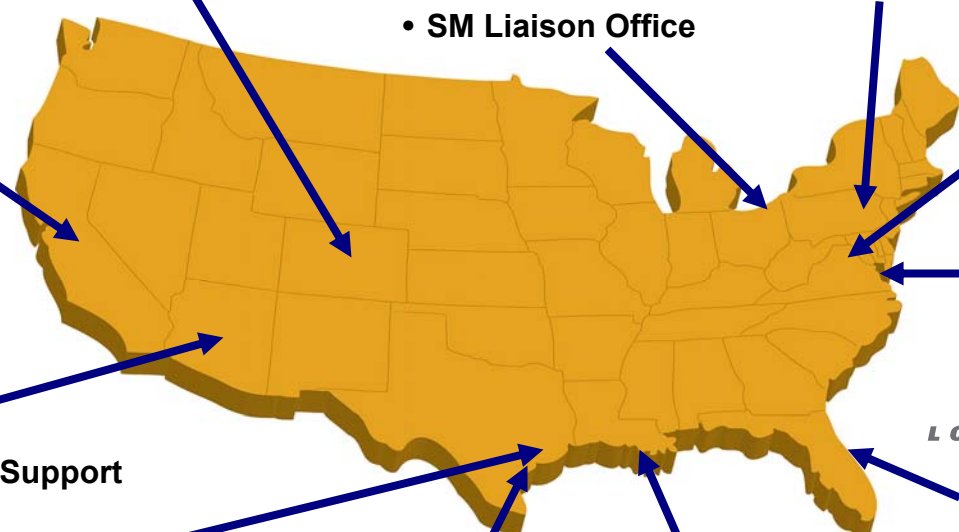
- Launch Abort System
- Safety & Mission Assurance

**Honeywell**

- Avionics
- Integrated System Health Management
- Crew Interface
- Mission Ground Ops Support

**LM LaRC**

- LAS Liaison Office



**LOCKHEED MARTIN**

- Program Management
- Systems Integration
- Crew Module Development
- Service Module Development
- Qualification Test
- Software Development



**LOCKHEED MARTIN**

**KSC**

- Final Assembly
- Checkout
- Acceptance Test
- Sustaining Engineering
- Spacecraft Refurbishment

- Operator Interfaces
- Ground Processing
- Mission Flight Planning
- Software Development

**LOCKHEED MARTIN**

**Michoud**

- CM and SM Structures



# Project Orion is Leveraging Unique Skills Throughout NASA



Crew Exploration Vehicle Project Office

## Ames

- Lead Thermal Protection System ADP
- Aero-Aerothermal database
- Software and GN&C support

## Glenn

- Lead Service Module and Spacecraft Adapter integration
- Flight Test Article "Pathfinder" fabrication
- SE&I Support

## Dryden

- Lead Abort Flight Test Integ/Ops
- Abort Test Booster procurement
- Flight Test Article Devt/Integ

## Goddard

- Communications Support

## Orion Project Management



## JPL

- Thermal Protection System support

## Langley

- Lead Launch Abort System integration
- Lead landing system ADP
- SE&I Support

## Johnson

- Lead Crew Module integration
- Orion Spacecraft Integration
- GFE projects management
- Flight Test Program

## Kennedy

- Ground processing
- Launch operations
- Recovery operations

## Marshall

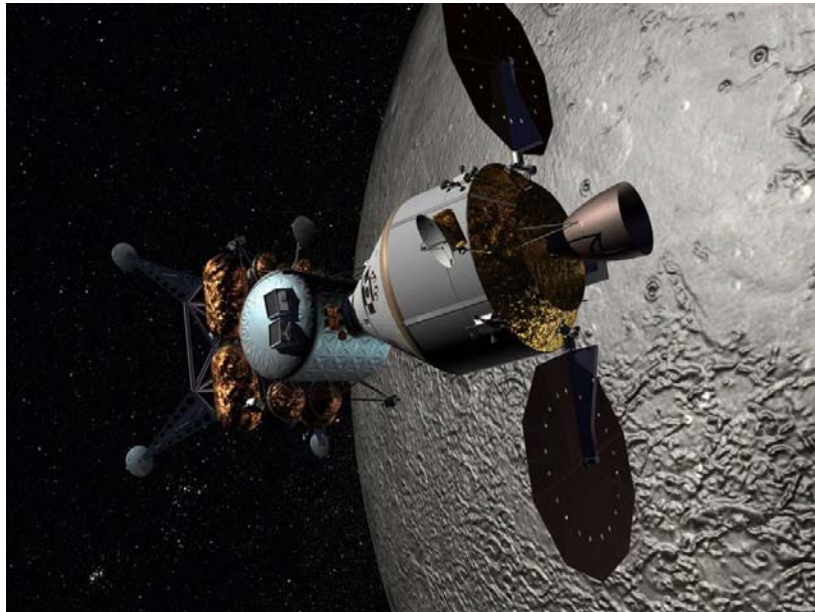
- LAS and SM SE&I Support



# Orion Advances the Human Exploration Vision



- **Orion is the next generation crew piloted spacecraft**
  - Human access to Low Earth Orbit ...
  - ... and to the Moon and Mars
- **Orion has a talented management team and workforce which utilizes unique personnel and facility strengths from across NASA and industry**



- **We have an exciting path to bring Orion to meet the mission**
  - Finalize requirements
  - Mature the technology
  - Design the Systems
  - Test the Systems
  - Prepare for first flight operations
- **We are committed to meeting the national priorities for Orion!**