Exploration Program Status

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• The Congress approved and the President signed the National Aeronautics and Space Administration Authorization Act of 2010
  – Bipartisan support for human exploration beyond Low Earth Orbit

• The law authorizes:
  – Extension of the International Space Station until at least 2020
  – Strong support for a commercial space transportation industry
  – Development of a multi-purpose Crew Vehicle and heavy lift launch capabilities
  – A “flexible path” approach to space exploration opening up vast opportunities including near-Earth asteroids and Mars
  – New space technology investments to increase the capabilities beyond Low Earth Orbit
ESMD Positioned to Respond to Authorization Act

- Currently operating under a Continuing Resolution until March 4, 2011
- Using internal study teams to provide plans in response to NASA Authorization Act of 2010
  - Orion, Heavy Lift, Commercial Crew & Cargo, Technology and Exploration Precursor Robotics all reworking plans in response to the Act’s provisions
- Study Team efforts are informed by Auth Act direction and results of Human Exploration Framework Team (HEFT) ongoing analysis
- HEFT is the architectural planning and analysis function for human exploration, providing decision support to NASA senior leadership on end-to-end HSF needs, which drive near-term priority decisions
  - Not a decision-making body
  - Analyses consider technical, programmatic, and fiscal constraints; their trade studies seek to drive out affordable multi-destination architecture options that meet stakeholder priorities
  - Analyses enable Agency – level strategic and technical decisions
Technology to Enable the Next Explorers
To Go Beyond: Robonaut 2 (R2) ISS Flight Demo

• Experimental Objectives
  – Test dexterous manipulation in 0g
  – Test robot-crew safety in 0g
  – Refine control based on tests

• Experiment Plan
  – R2 Tested IV (IV=intra-vehicle) on fixed stanchion
  – R2 Shipped with IV taskboard
  – Crew will add new experiments

• Future Upgrades
  – Upgrade software with revisions
  – Add mobility with 0g climbing legs
  – Upgrade backpack for mobility
  – Upgrade torso for EVA

http://robonaut.jsc.nasa.gov/
Radiation Assessment Detector Integrated Into Mars Science Laboratory Rover

• **Summary:** The Mars Science Laboratory mission's Radiation Assessment Detector, or RAD, will monitor radiation both during the trip to Mars and on the Martian surface.

• **Description:** The RAD has an upward-pointing, wide-angle telescope that measures and identifies high-energy atomic and subatomic particles. These particles come directly from the sun, distant supernovas and other sources and from secondary radiation in the Martian atmosphere, rocks and soils.

• **Time Frame:** The RAD was installed in October 2010 in preparation for a November 2011 launch.

• **Space Application:** Data from the RAD will help NASA plan human missions beyond Earth orbit by reducing uncertainty about how much radiation protection future astronauts will need.

• **More information:**

The RAD instrument, shown above, was installed in the Mars Science Laboratory Rover.
Images credit: Jet Propulsion Laboratory
SpaceX Status

• Milestones 1-17 and 20 completed for payments to date of $258M out of $278M.
• Falcon 9 maiden flight successfully reached orbit on June 4.
• COTS Milestone 17 - Demo Flight 1 successfully accomplished on December 8.
  – All primary mission objectives successfully demonstrated
    • Falcon 9 launch and Dragon insertion to orbit
    • Dragon separation
    • Safe reentry
  – All other mission objectives successful
• Demo Flight 2 mission planned for June 2011.
  – Rendezvous and proximity operations with ISS
  – ISS communication demonstration
• Demo Flight 3 mission planned for September 2011.
  – Berthing operations with ISS
  – Cargo transfer demonstration
• SpaceX has proposed combining Demo Flight 2 and 3. NASA is considering that proposal.
Commercial Crew Development Round 2

- CCDev 2 Announcement for Proposals was released to industry on October 25, 2010. Proposals were due on December 13, 2010.
- The goals of CCDev 2 investments are to:
  - advance orbital commercial crew transportation system (CTS) concepts
  - and enable significant progress on maturing the design and development of elements of the system, such as launch vehicles and spacecraft, while ensuring crew and passenger safety,
  - with the overall objective of accelerating the availability of U.S. CTS capabilities.
- New competition open to all U.S. commercial providers for NASA Space Act Agreements (SAAs).
- Pay-for-Performance milestones, April 2011 to no later than May 2012.
- CCDev 2 awards are planned to coincide with the FY11 appropriation (estimated for March) which will determine the exact amount available for awards.

- NASA is currently in a BLACK-OUT period with industry regarding CCDev 2. All information above is public and has been previously disclosed.
• In May 2010, NASA released to industry the first version of our commercial human rating requirements in a document titled, Commercial Human Rating Plan (CHRP).

• NASA received extensive input from industry on the CHRP and began revising it.

• NASA developed and adopted a concept known as “crew transportation system certification”, as opposed to “human rating”.


• On December 9, NASA baselined and released the Commercial Crew Transportation System Certification Requirements for NASA Low Earth Orbit Missions document (see right).
Key Auth Act Direction
- The Administrator shall, to the extent practicable, extend or modify existing vehicle development and associated contracts
- The initial capability of the core elements, without an upper stage, of lifting payloads weighing between 70 tons and 100 tons into low-Earth orbit
- The capability to lift the multipurpose crew vehicle
- The capability to serve as a backup system for supplying and supporting ISS cargo requirements or crew delivery requirements not otherwise met by available commercial or partner-supplied vehicles

SLS Reference Vehicle Design
- 27.5’ Diameter LOX/LH₂ Core Stage
- Five RS25 based engines using Shuttle assets then RS25E expendable derivative
- Two 5-Segment Ares derived SRBs
- Delivers 108.6t to 30x130 nmi

Evolved System to 130mT
- Upper stage with one or two J-2X upper stage engines (trades pending)
- Draft FY11 CR language dictates concurrent development of upper stage with core vehicle
Space Launch Systems (SLS) Approach

• NASA Reference Vehicle Design for SLS is an Ares/Shuttle-derived LOX/LH2 solution
  – This vehicle comes closest to meeting schedule FOM with opportunities for affordability that could bring costs down to acceptable levels
• NASA will use recently-awarded BAA study contracts and Government Requirements Analysis Cycle to validate decisions through rigorous technical and acquisition process
  – Work with industry on multiple affordability options for heavy lift
  – Validate that Ares/Shuttle derived solution is truly most cost effective
  – Provide alternative acquisition plan in event Reference Vehicle Design is unaffordable
• In parallel with SLS acquisition activities, the Constellation Ares contracts will continue through FY11 to minimize workforce disruptions
• Final decisions on NASA’s plans for the SLS will be made during the Acquisition Strategy review process in early 2011.
SLS Near-term Activities

Ares Constellation Contracts- Under CR continue at reduced rates

BAA Objective: Identify contractor ideas to inform arch/acquisition
- Affordability: minimize $, schedule, simplify DDT&E process, etc.
- Capture Unique/new thoughts, options, technologies, concepts
- Possible incorporation into Government models/analyses

RAC Objective: “SRR-lite” of Vehicle Architectures:
- 4 Teams: 1) LOX/LH2; 2) LOX/RP; 3) Modular.(4) Affordability
- Utilizes HLV BAA data as applicable
- New look at Government Oversight/Insight
- Provides critical & matured products for Acq (RFP, JOFOC, rqmts)

SLS Acquisition Planning
- 90-Day Congressional Report
  - Preliminary Report January 2011
  - Final Report April 2011

SLS Procurement Actions
- RFP Release 30April2011
- Proposals Due 7July2011
- Award by End of CY11
Multi-Purpose Crew Vehicle (MPCV)

• NASA Authorization Act of 2010 calls for an MPCV which:
  – Continues to advance development of the human safety features, designs, and systems in the Orion Project.
  – Serves as primary crew vehicle for missions beyond LEO
  – Conducts regular in-space operations in conjunction with payloads delivered by the Space Launch System or other vehicles in cis-lunar space (rendezvous, docking, EVA)
  – Provides means of delivering crew and cargo to the ISS as a back-up to commercial crew and international partners

• Based on these requirements, NASA has selected the beyond-LEO version of the Orion design ("block 2") as the MPCV Reference Vehicle Design

  • Provides crew launch, return, and operation in deep space
  • Crew size: 2 to 4
  • Crewed mission duration: 21.1 days
  • Delta V capability: 5233 ft/s
  • Main engine thrust: 7,500 pounds
  • Pressurized volume: 690.6 cubic feet
  • Net habitable volume: 316 cubic feet
  • Skip entries up to 4,800 nmi from lunar return trajectories
  • Water landing off California coast
  • 5.4 nmi landing accuracy

• Final decisions on NASA’s plans for the MPCV will be made during the Acquisition Strategy review process in early 2011.