National Aeronautics and Space Administration

NAC Human Exploration and Operations Committee

Mr. Richard Kohrs, Chair

July 30, 2013

Attendees

Present

Mr. Richard (Dick) Kohrs, Chair

Mr. Bohdan (Bo) Bejmuk, Vice Chair

Mr. Joseph Cuzzupoli

Mr. Robert (Bob) Sieck

Dr. Leroy Chiao

Mr. James (Jim) Odom

Dr. David Longnecker

Ms. Nancy Ann Budden

Dr. Stephen (Pat) Condon

Telecon

Mr. Richard (Dick) Malow

Agenda – Public

Status of Human Exploration and Operations	**Mr. William Gerstenmaier** Associate Administrator Human Exploration and Operations Mission Directorate (HEOMD), NASA HQ
Status of Exploration Systems Development	**Mr. Daniel Dumbacher** Deputy Associate Administrator, Exploration Systems & Development Division; HEOMD, NASA HQ
Status of CASIS and Research Subcommittee	**Dr. D. Marshall Porterfield** Director, Space Life & Physical Sciences Research & Applications Division; HEOMD, NASA HQ
Status of International Space Station	**Sam Scimemi** Director, International Space Station Program HEOMD, NASA HQ
Status of Commercial Crew and Cargo	**Mr. Philip McAlister** Director, Commercial Spaceflight Development Division; HEOMD, NASA HQ
Joint Session with NAC Technology and Innovation Committee Technology Briefing	**Dr. James Reuter** Deputy Associate Administrator for Programs, Space Technology Mission Directorate (STMD), NASA HQ

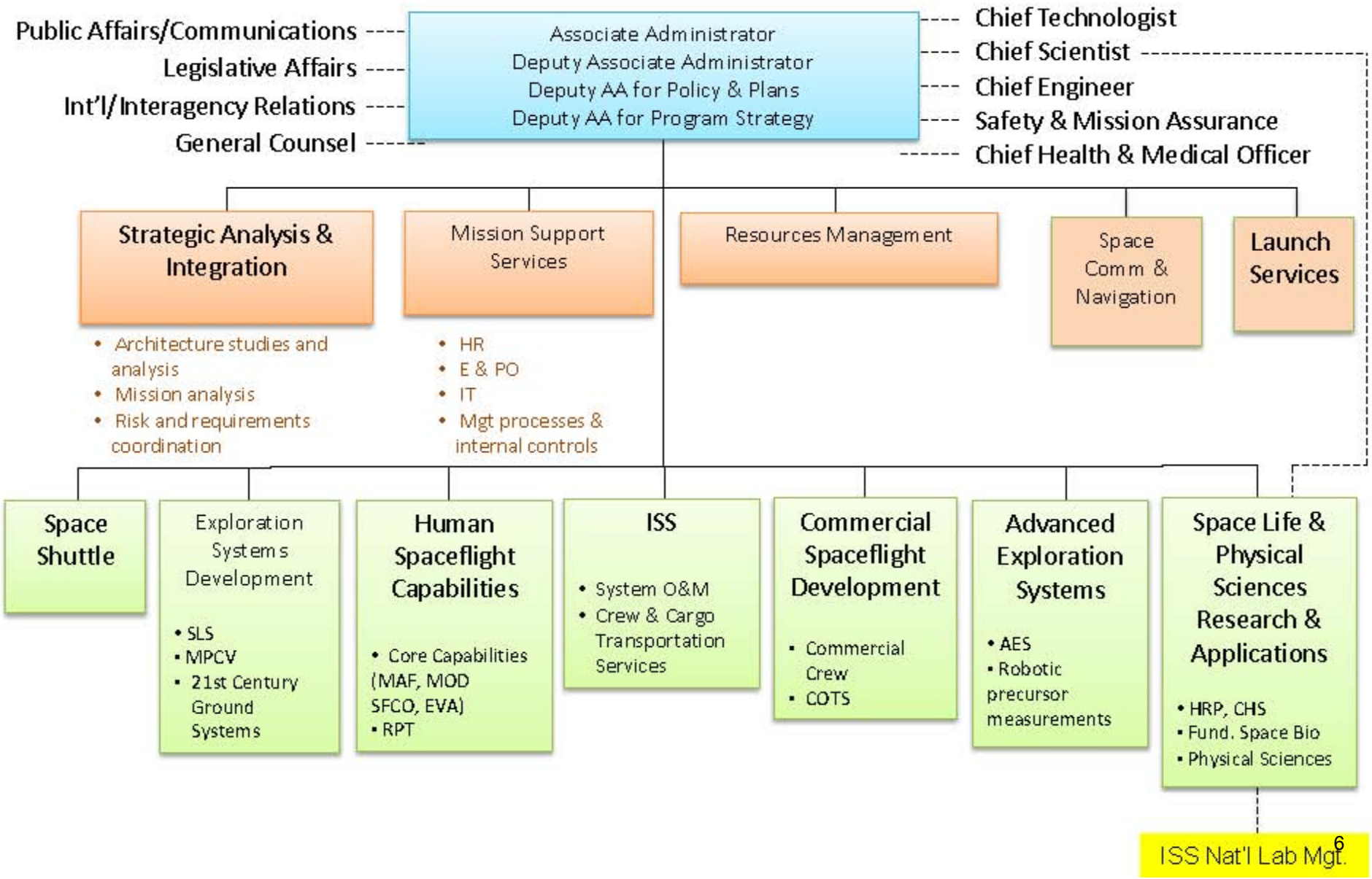
Agenda – Non-FACA

Program Integration within Exploration Systems Development	**Mr. Daniel Dumbacher** Deputy Associate Administrator, Exploration Systems & Development Division; Human Exploration and Operations Mission Directorate, NASA HQ
International Cooperation	**Mr. Nantel Suzuki** Program Executive Human Exploration and Operations Mission Directorate, NASA HQ

Status of Human Exploration and Operations Mission Directorate (HEOMD)

Bill Gerstenmaier | July 29, 2013

Organizational Structure: HEOMD

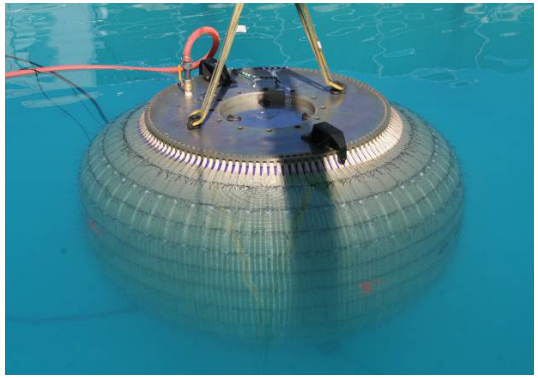


Advanced Exploration Systems

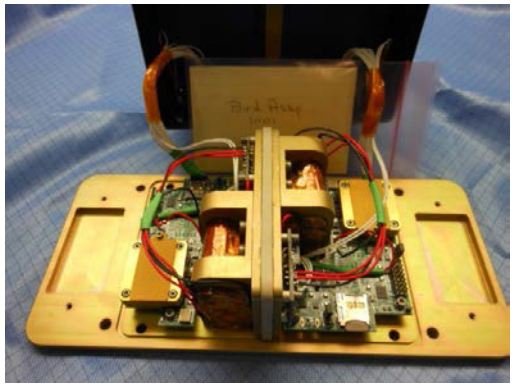
Rapid development and testing of prototype systems and validation of operational concepts to reduce risk and cost of future exploration missions:

- **Crew Mobility Systems**
  - Systems to enable the crew to conduct "hands-on" surface exploration and in-space operations, including crew excursion vehicles, advanced space suits, and crew egress
- **Deep Space Habitation Systems**
  - Systems to enable the crew to live and work safely in deep space, including deep space habitats, reliable life support, radiation protection, and fire safety
- **Vehicle Systems**
  - Systems for in-space propulsion stages and small robotic landers, including nuclear propulsion, modular power systems, lander technology test beds, and autonomous precision landing
- **Operations**
  - Systems to enable more efficient mission and ground operations, including integrated testing, autonomous mission ops, integrated ground ops, and logistics reduction
- **Robotic Precursor Activities**
  - Acquire strategic knowledge on potential destinations for human exploration to inform systems development, including prospecting for lunar ice, characterizing the Mars surface radiation environment, radar imaging of NEAs, instrument development, and research and analysis

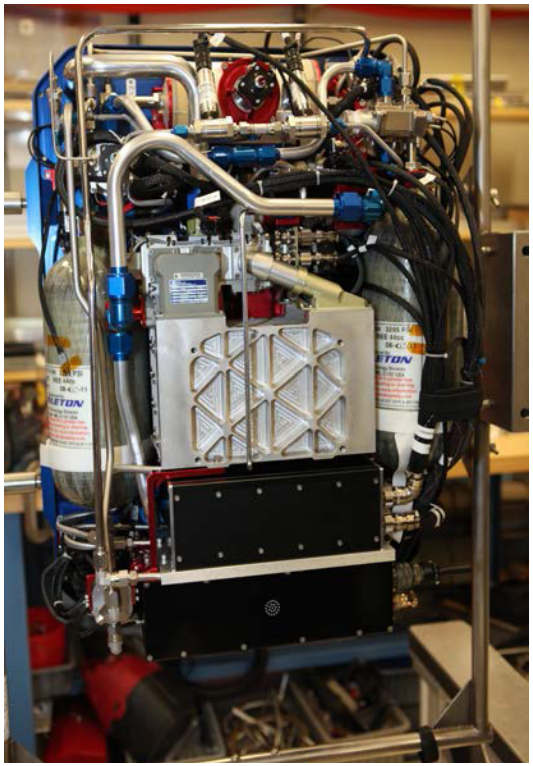
Recent Accomplishments
Advanced Exploration Systems Program



BEAM: Signed $17.8M contract with Bigelow Aerospace to develop inflatable module for demonstration on ISS in 2015. Completed burst test to 8x operating pressure.



Radiation Protection: Completed assembly of Radiation Environment Monitor flight unit for EFT-1 mission.

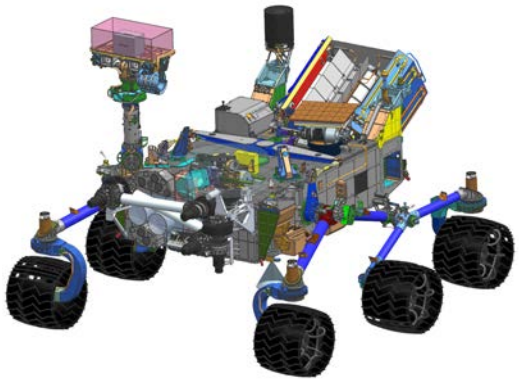


EVA: Completed assembly of the Portable Life Support System (PLSS) 2.0. This is the first new PLSS to be developed since the Shuttle EMU was introduced in 1981. The PLSS 2.0 incorporates new technology components developed by STMD for CO2 removal, suit pressure regulation, thermal control, and energy storage.

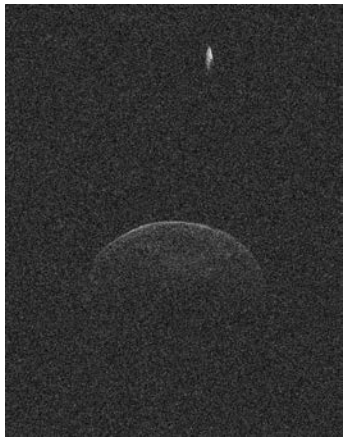
Life Support: Completed integrated chamber tests of ISS-derived Carbon Dioxide Removal Assembly, Trace Contaminant Control System, Sabatier reactor, and Oxygen Generation Assembly.

Recent Accomplishments
Advanced Exploration Systems Program

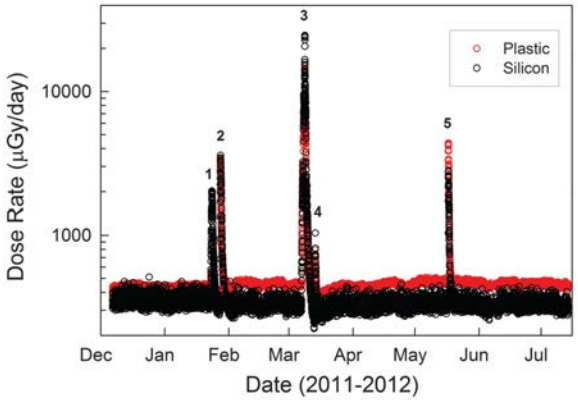
Morpheus: Completed first tether test of new 1.5B vehicle. Demonstrated stable hover and in-flight switching to backup IMU. ALHAT autonomous precision landing system will be demonstrated on Morpheus later this year.



Mars 2020: Partnering with SMD and STMD to develop an in-situ resource utilization payload to demonstrate oxygen production from the Martian atmosphere.



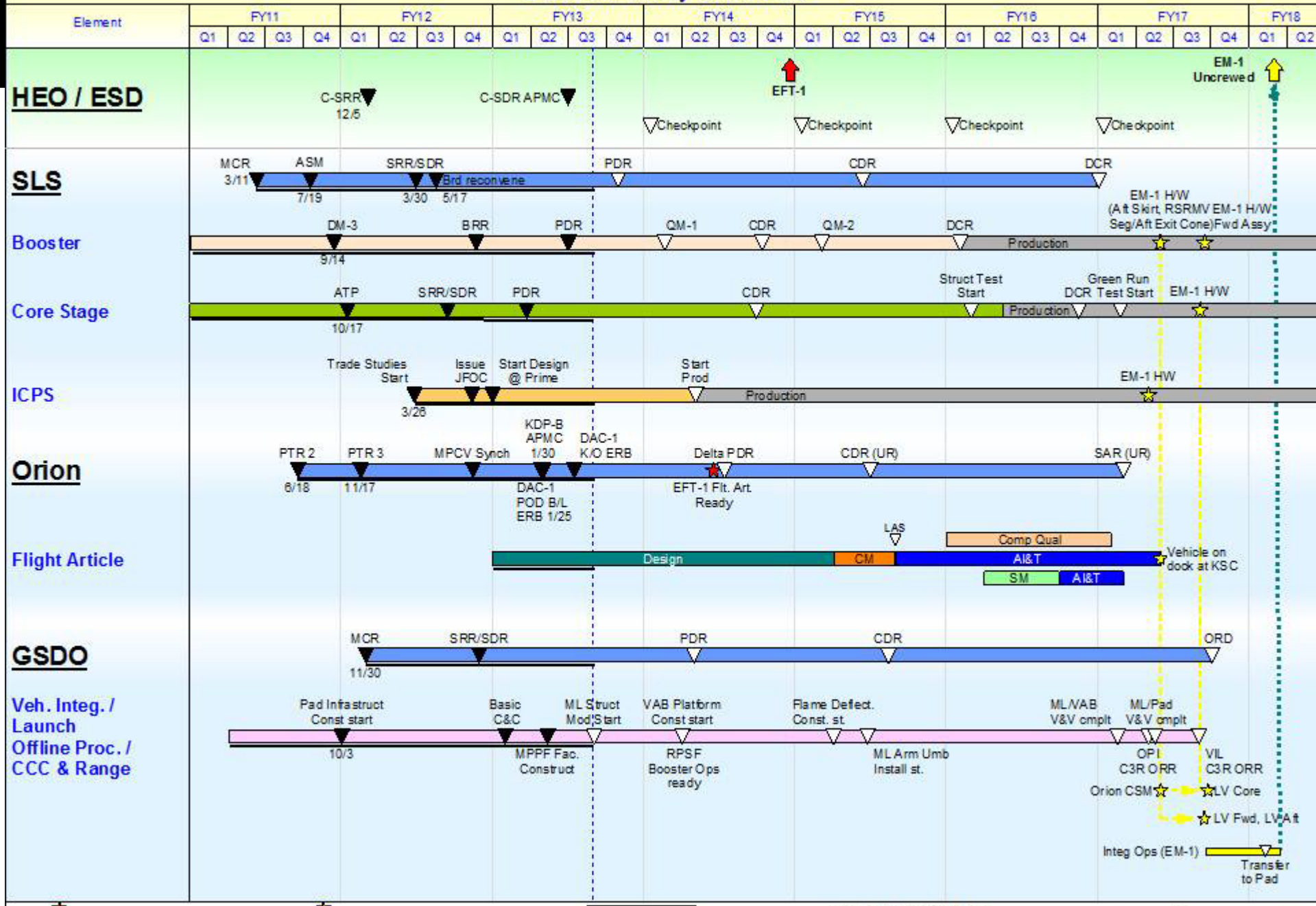
Goldstone Radar: Imaged over 10 candidate targets for human NEA missions. Discovered moon around asteroid 1998 QE2 during its closest approach (0.04 AU) on May 31.



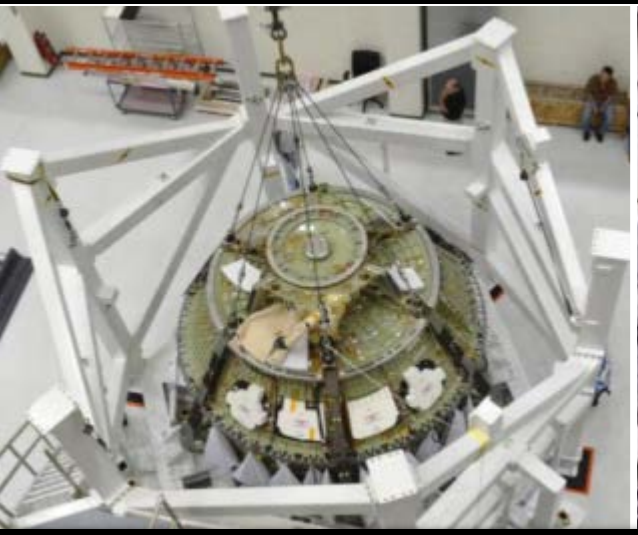
Radiation Assessment Detector: Operating for over 320 sols on Mars. Dose rate data acquired during trip to Mars were published in the May 31 issue of the journal *Science*.

ESD Summary Schedule

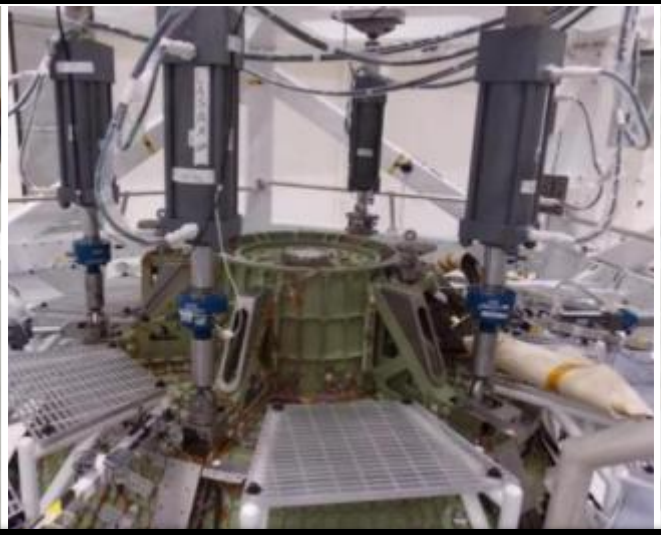
Version: 2013-05-31



Orion Accomplishments

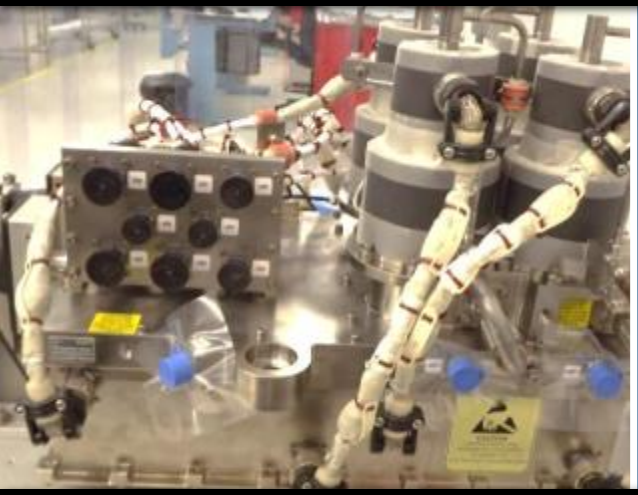


EFT-1 Crew Module being placed in the Static Loads Test Fixture at the Operations and Checkout Facility



Actuators used in the Static Loads Test are attached to the top of the EFT-1 Crew Module

Backshell panel drilling



Environmental Control and Life Support System – Coolant Pump Package 1

Capsule Parachute Assembly System testing at Army Yuma proving ground in AZ

Applying the Avcoat material to Orion heat shield – Textron in MA.

SLS Accomplishments

Vertical Weld Tool Complete at Michoud Assembly Facility

Vertical Assembly Center Construction begins for the Core Stage production

First Trial Barrel Segment Completes Vertical Weld on Core Stage

Completed MSA Shell

Completed Flight Control Test #2,Booster Avionics

Center segment for QM-1 delivered to its test bay at ATK's facility in Utah

GSDO Accomplishments

Installation of flooring in the main firing room started – application of floor sealant

Landing and Recovery EIT participated in shipment of the Crew Module Recovery Cradle to Langley Research Center

Facility modifications in the Multi-Payload Processing Facility

Fabrication of Liquid Oxygen (LO2) Vaporizer that will be installed at Pad B

Pad B Flame Trench and Flame Deflector demolition project

Completed Crew Module Recovery Cradle testing

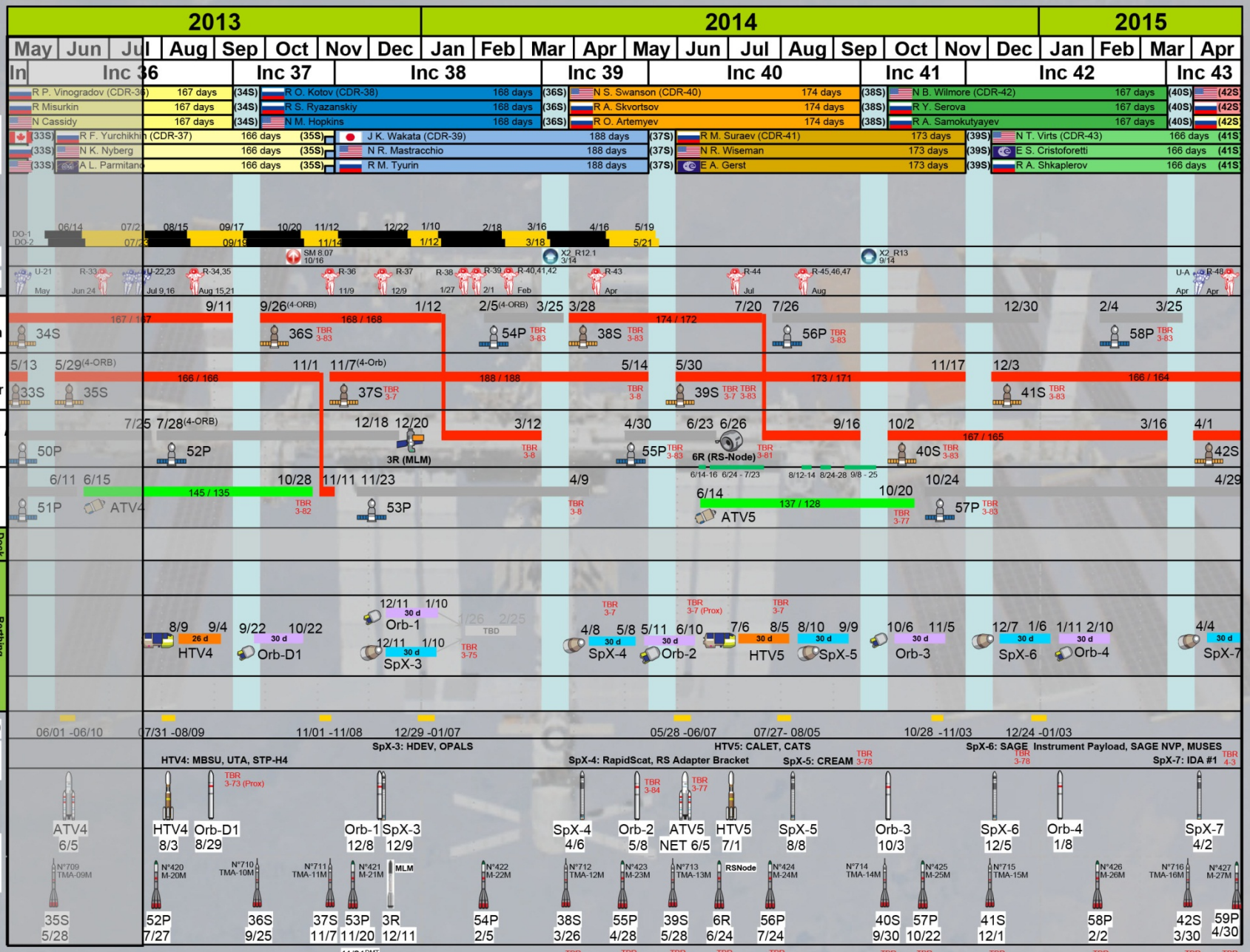
International Space Station Program Status

HEO NAC
July 29, 2013
Sam Scimemi
Director, International Space Station

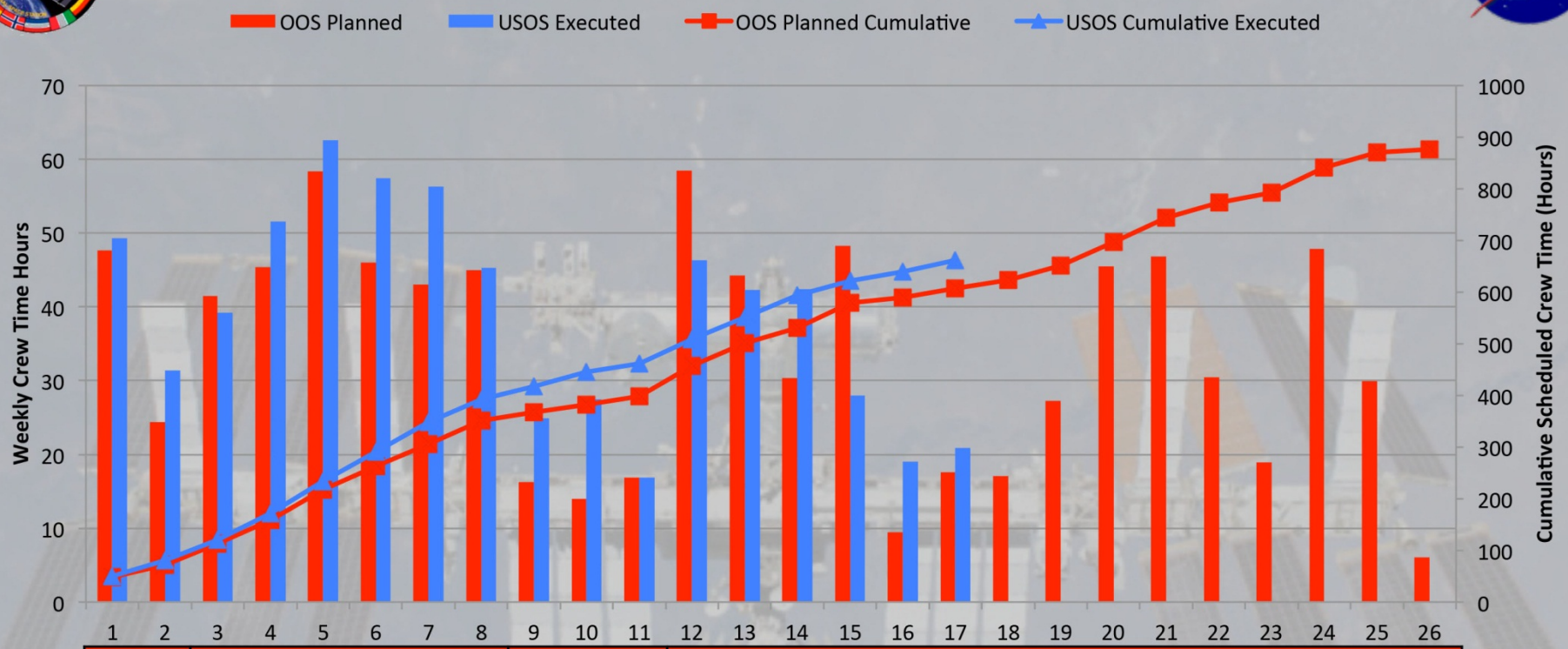
For current baseline refer to SSP 54100 Multi-Increment Planning Document (MIPD)

ISS Flight Plan

NASA: OC4/John Coggeshall
MAPI: OP/Randy Morgan
Chart Updated: July 17th, 2013
SSCN/CR: 13681B (Baseline)



Inc 35-36 Utilization Crew Time



Date Color Key:
Completed
35-36 Final OOS
FPIP Plan

SpX-2
(Unberth on 3/24/13) (Dock on 5/1/13)
(Unberth on 3/26/13)

ATV4

US EVA 21

Orb-D1

(Berth on 5/8/13)
Below the line

(Dock on 6/15/13)

US EVA

US EVA

HTV4
(7/20/13 – 8/19/13)

(8/9/13 – 9/4/13)

(Berth on 9/22/13)

WLP 2 contains 35 minutes of ESA Utilization that has not been agreed upon.

OC/OZ reconciliation is not completed as of Week 17.

Executed through Increment Wk (WLP Week) 17 =	16.0	of 24.2 work weeks (66.12% though the Increment)
USOS IDRD Allocation:	875	hours
OOS USOS Planned Total:	876.49	hours
USOS Actuals:	661	hours
	75.54%	through IDRD Allocation
	75.41%	through OOS Planned Total
Total USOS Average Per Work Week:	41.31	hours/work week

Pre-Decisional, For Internal Use Only

EVA 23 EMU 3011 Internal Water Leakage

- On 7/16/13, EV2/Luca Parmitano reported feeling water in his helmet at about 45 minutes into US EVA 23. Later in the EVA, EV1/Chris Cassidy confirmed a large amount of water inside the helmet. The crew were able to get EV2's helmet off and he was found to be in good health.

- Initial troubleshooting was executed on 7/17/13. It was determined that an estimated 1.8 lbs. of re-supplied feedwater was unaccounted for beyond nominal EVA usage, which is consistent with the crew reports of approximately 1.0-1.5 liters in the helmet by the end of the EVA. The Disposable In Suit Drink Bag (DIDB) was filled, folded and squeezed with no leaks. There were no leaks reported in the Liquid Cooling and Ventilation Garment (LCVG) and other water lines inside the Hard Upper Torso (HUT).
- .

EVA 23 EMU 3011 Internal Water Leakage

- As a result of the troubleshooting, the most likely path of the water leak is through the helmet vent port. The remaining credible failure sources are located in the EMU Portable Life Support System (PLSS).
- The technical, operational and safety community have revised the fault tree based on a thorough review of safety documentation, an understanding of the design of the suit and through observed operational behavior. A formal fault tree closure process is being defined.
- Additional troubleshooting is planned for 7/26/13. The goal of this troubleshooting is to gather data that will be used to close out legs of the fault tree. Additional team meetings will convene to discuss further troubleshooting and recovery options, as required.
- The community is reassessing the safety documentation and operational procedures to insure that sufficient controls exist to mitigate the internal water leakage should an event such as that seen during EVA 23 recur.

EVA 23 EMU 3011 Internal Water Leakage

- The HEOMD AA initiated a Mishap Investigation Board to investigate the root cause and will recommend remediation/correction activities.
- The MIB begins its work the week of July 29 and will report out within 75 days.

National Aeronautics and Space Administration

Commercial Cargo and Crew Update

NAC HEO Meeting

July 30, 2013
Philip McAlister
NASA HQ

CCP Risks

- Prematurely eliminating competition is one of the primary risks to NASA satisfying the goals and objectives of the Program.

- Competition among more than one industry partner during the development phase is important to safety and cost effectiveness.
  - A competitive environment provides strong incentive for companies to meet and exceed NASA's safety certification requirements
  - Competition prevents NASA from becoming dependent on a sole provider regardless of safety or cost implications
  - Competition supports cost-sharing by industry which augments government funds and encourages industry partners to "stay in the game" when encountering difficulties

Recommendation 1

NASA should add commercial expertise to the already impressive membership of the Research Subcommittee of the HEO Committee. Specifically, the committee should receive input from research, development and commercialization leadership in one or more of the relevant industries (e.g., pharmaceutical, biologicals, materials science, etc.) that have experience in applied research.

Major Reasons for Proposing the Recommendation: The current committee is populated by an impressive cadre of research leaders from academia but the commercial opportunities for research in microgravity are equally important, as evidenced by several projects that have been achieved to date. Further, such input would provide a valuable link to the activities of CASIS (the Center for the Advancement of Science in Space), which has relationships with the SLPS (Space Life and Physical Sciences) program.

Consequences of No Action to the Proposed Recommendation: Committee deliberations will reflect only the viewpoints and perspectives of academia, and thus will not provide NASA with the broadest possible guidance from an important contributor to the research community.

Recommendation 2

Elevate Priority of the Commercial Crew Development

NASA elevate priority of the Commercial Crew development and vigorously protect its funding, and establish a schedule with traceable milestones and target date for first crewed mission in 2017. These NASA actions are needed to avoid undesired growth in Commercial Crew development time and risky increased reliance on a single provider, Soyuz.

Major Reason for Recommendation: Rapid establishment of US domestic crew transportation to ISS is critically important to the sustainability of the US Human Space Program. NAC HEO Committee observed a very significant shortfall in Commercial Crew Program funding over past three years, typically on the order of 40% less than requested. During this funding shortfall period NASA has been funding three potential providers and maintaining 2017 schedule. NAC HEO committee's opinion is that continued reduction in Commercial Crew budget, funding the three providers, and maintaining 2017 schedule is not possible. If required funding is not provided the recommended action is to protect the 2017 schedule.

Consequences of no action: Increased risk to ISS due to dependency on single source provider for crew transport to and from station.

NAC HEO Committee Finding

NAC HEO committee was briefed on the Exploration Systems Directorate status and schedule. We commend the Systems Engineering and Integration Management team's progress in the schedule, cost and management of the Integrated Task. Future reviews on this subject by the NAC HEO Committee should continue. Major program issues that are currently being evaluated by the Integration Team should be updated and reviewed by the HEO Committee.

Demonstrate and Articulate the Justification and Strategy for NASA's New Asteroid Initiative

2013-01-01 (HEOC-01)

Recommendation: During the last NAC meeting, the HEOC recommended that NASA clearly demonstrate and articulate a strategy for the Agency's new Asteroid Initiative and highlight associated benefits to the public. NASA responded by sending HEOC a summary of the Asteroid Initiative. The HEOC acknowledges and appreciates the HQ response to our recommendation. We want to extend the recommendation to add that NASA work to reflect current priorities and planning for the Asteroid Initiative, among other waypoint steps, to the ultimate Mars Mission via internal and external communications.

NASA should immediately update the NASA Website to reflect current planning (including the necessary steps to progress from current capabilities to those needed for successful human Mars exploration), priorities, and technical plans and accomplishments such as those summarized by the Space Technology Mission Directorate.

Demonstrate and Articulate the Justification and Strategy for NASA's New Asteroid Initiative

(continued)

Major Reasons for Proposing the Recommendation: The current NASA website lacks definition of an articulated step-by-step plan and lacks a summary of plans, recent successes, and accomplishments that demonstrate how NASA is moving forward towards future human exploration of space.

Lack of information for NASA employees and the public, on NASA websites and other communications, leads to the perception that NASA lacks a well-developed, agency-wide and focused plan for future missions.

Consequence of No Action on the Proposed Recommendation: As we stated before, in the absence of a clearly demonstrated and articulated justification, the new Asteroid Initiative might miss external interest and support, leading to loss of public and Congressional support. NASA risks losing U.S and international confidence in its place as the leader in human space exploration.

NASA Response:

BACKUP

HEO NAC Subcommittee on Life and Physical Sciences

NASA Advisory Council recommended formation of a research subcommittee of the HEO Committee in March, 2012

Research Subcommittee is chaired by Dr. David Longnecker, MD, of the American Association of Medical Colleges. Members are:

Robert Altenkirch, University of Alabama in Huntsville
Kathy Banks, Texas A&M University
Jeff Hof fman, Massachusetts Institute of Technology
Terri Lomax, North Carolina State University
Stein Sture, University of Colorado
Kathy Thornton, University of Virginia

First meet ing of the Research Subcommittee was held in April, 2013, in conjunction with the Spring meeting of the HEO Committee.

Next meeting will be held on July 31, 2013. The subcommittee will review the relationships between research and technology and between human research and space biology in HEO. Main focus now on implementation of the new science management strategies based on an “open source science” approach.