National Aeronautics and Space Administration

Human Exploration and Operations Committee Status

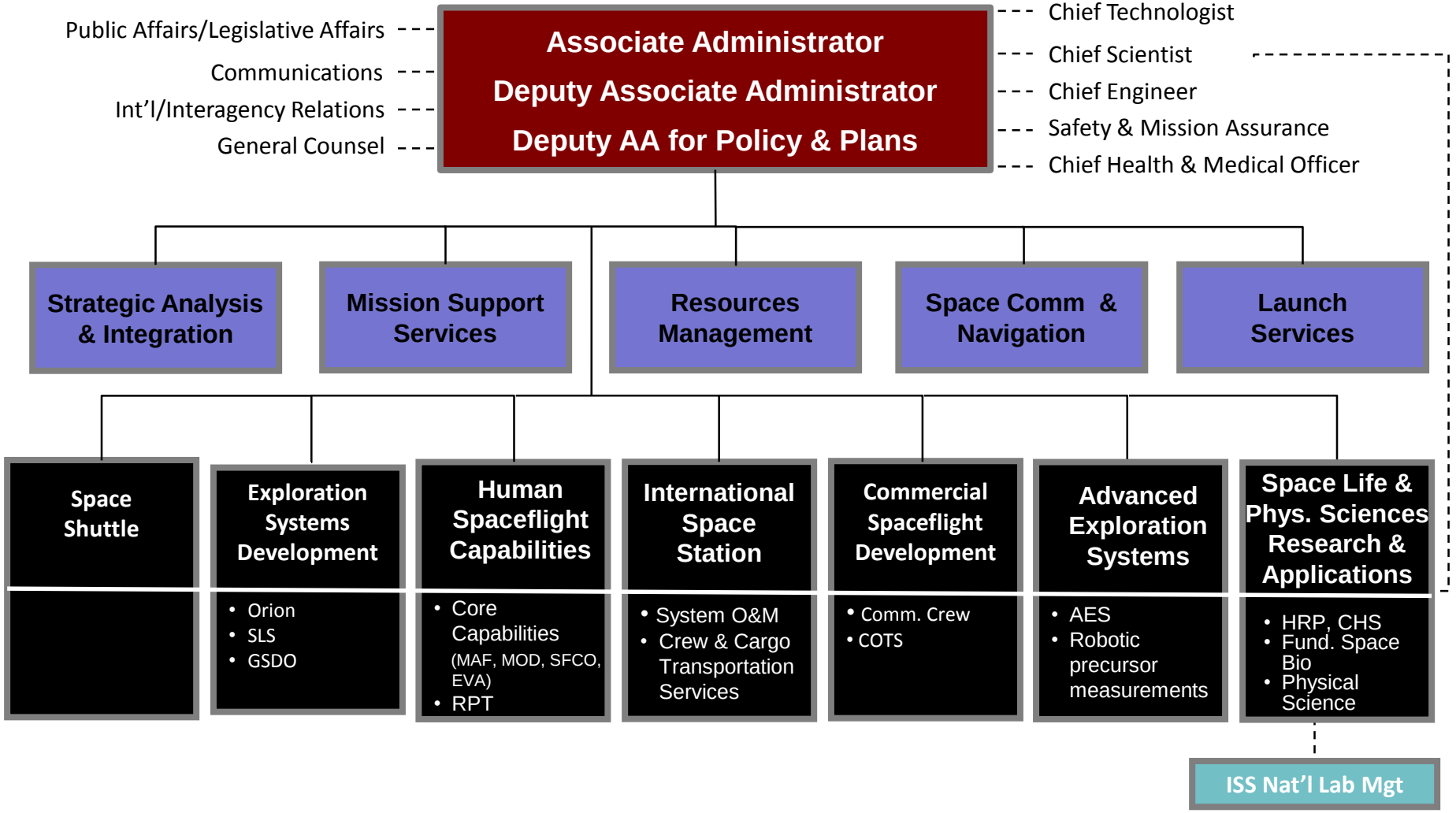
Ken Bowersox
Committee Chair
April 9th, 2015

NAC HEO Committee Members

- Ms. Bartell, Shannon
- Mr. Bowersox, Ken, ***Chair***
- Ms. Budden, Nancy Ann
- Dr. Chiao, Leroy
- Dr Condon, Stephen "Pat"
- Mr. Cuzzupoli, Joseph W.
- Mr. Holloway, Tom
- Mr. Lon Levin
- Dr. Longenecker, David E.
- Mr. Lopez-Alegria, Michael
- Mr. Malow, Richard N.
- Mr. Odom, Jim (James)
- Mr. Sieck, Robert
- Mr. Voss, James

Human Exploration & Operations Mission Directorate

Organizational Structure



Major Events Since Last NAC Meeting

- ISS
  - Soyuz Launch and Landing – Launch of One Year Crew
  - EVAs to prepare for new docking adapter
  - Daily science activity
  - Recovery of SpX 5 Dragon

- Commercial Crew
  - CCtCAP Kickoff

- Orion
  - Continued Review of EFT-1 Data

- Advanced Exploration Activities
  - Selection of Option B for ARM
  - 12 NextStep Awards

NAC HEO Meeting Summary April, 2015

NAC HEO Committee Meeting

Tuesday, April 7th, 2015

Human Exploration and Operations Budget and Status Update

Joint Meeting with NAC Science Committee
Radiation Levels for Mars Exploration

Wednesday, April 8th, 2015

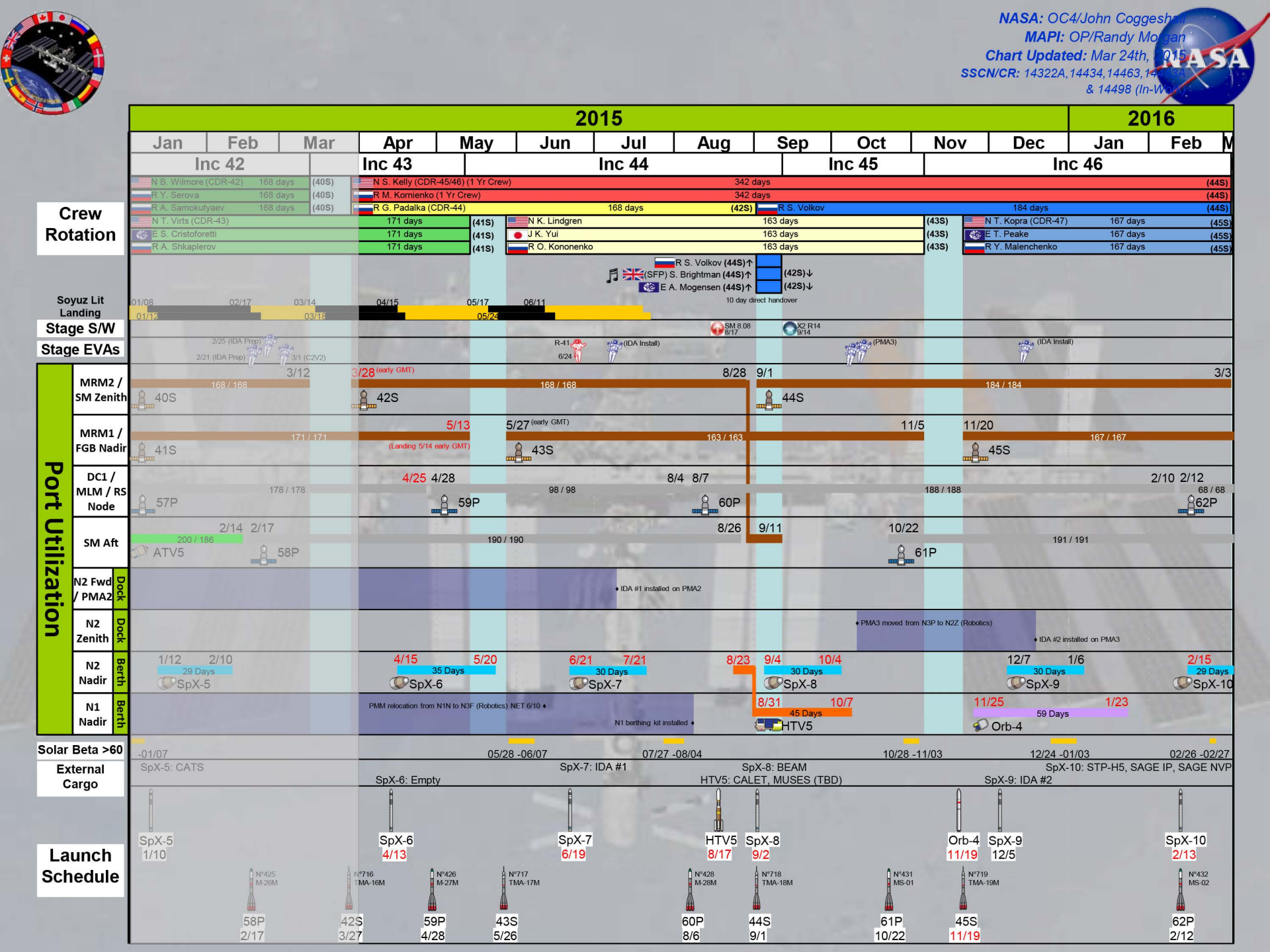
Joint Science and HEO Discussion
Commercial Crew Status
ISS Program Status
Asteroid Redirect Mission
Committee Discussion and Deliberation

International Space Station Status

Robyn Gatens
Acting Deputy Director, ISS
Tara Ruttley
Associate Program Scientist, ISS Program Office

HEO NAC
April 2015

NASA: OC4/John Coggesh
MAPI: OP/Randy Morgan
Chart Updated: Mar 24th, 2015
SSCN/CR: 14322A, 14434, 14463, 14
& 14498 (In-Work)



42 Soyuz Launch/Increment 43
March - September 2015

Vehicle: 42 Soyuz

Launch: March 27, 2015 (with 4 orbit rendezvous)

Docking: March 28, 2015

Undock/Landing: September 11, 2015

41 Soyuz crew

Anton Shkaplerov, Soyuz Commander
Terry Virts, Increment 43 Commander
Samantha Cristoforetti, (ESA) Flight Engineer

Undock / Landing : May 13, 2015

42 Soyuz Crew

Gennady Pakalka, Soyuz and Increment 44 Commander
Mikhail Kornienko, Flight Engineer
Scott Kelly, Increment 45/46 Commander

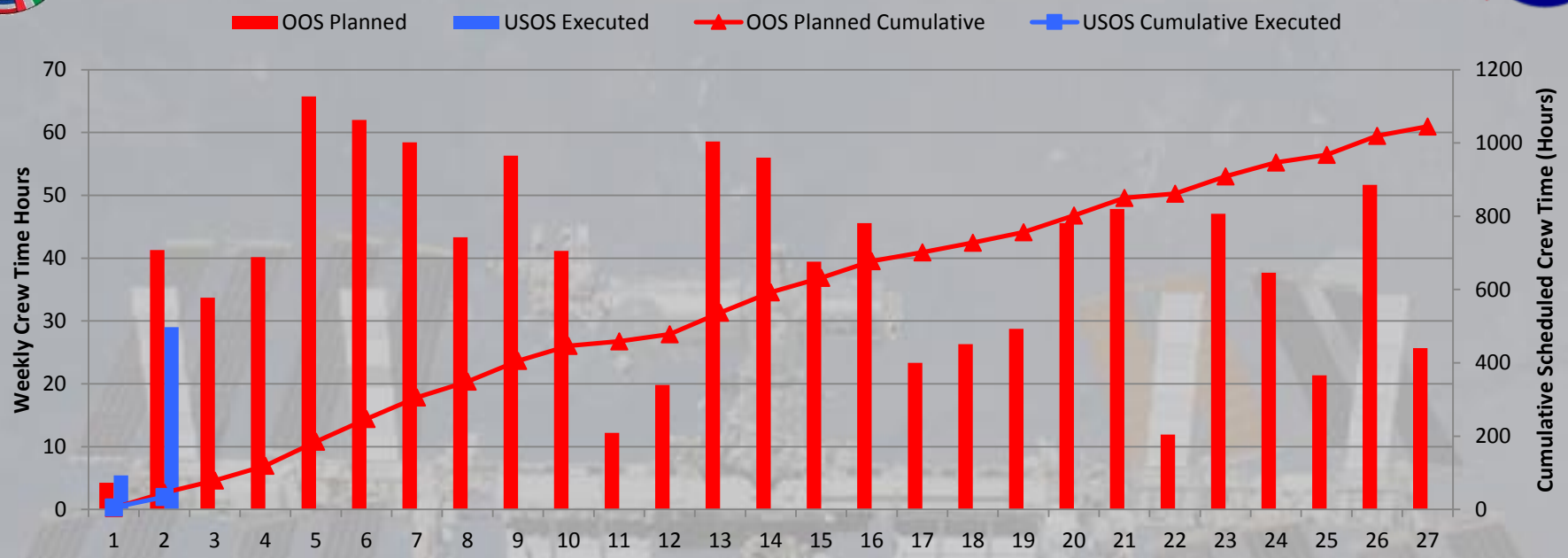
Increment 43 and 44 Highlights

- Beginning of 1-year mission and associated experiments
- Rodent Research-2 is scheduled to start during SpX-6 and continue into Increment 44
- USOS Reconfiguration
  - Delivery and EVA installation of International Docking Adapter (IDA) – 1 (SpX-7)
  - PMM Relocation
  - Node1 Nadir Modifications
- Delivery of first NORS Tank
- HTV-5 use of Node1 Nadir for berthing
- CALorimetric Electron Telescope (CALET) External Payload (HTV-5)
- Arrival of Galley Rack and Multi purpose Small Payload Rack (MSPR-2) Rack (HTV-5)
- Direct Handover Stage 44-9 with 9 crew on ISS

Total ISS Consumables Status

	T1: Current Capability		T2: Current Capability + SpX-6	
Consumable – based on current, ISS system status	**Date to Reserve Level**	**Date to zero supplies**	**Date to Reserve Level**	**Date to zero supplies**
Food – 100%	July 05, 2015	August 18, 2015	July 24, 2015	September 05, 2015
KTO	June 20, 2015	August 04, 2015	July 20, 2015	September 02, 2015
Filter Inserts	April 01, 2016	May 24, 2016	April 01, 2016	May 24, 2016
Toilet (ACY) Inserts	January 03, 2016	February 17, 2016	January 03, 2016	February 17, 2016
EDV + TUBSS (UPA Operable)	December 06, 2015	March 29, 2016	December 06, 2015	March 29, 2016
Pre-Treat Tank	August 20, 2015	September 29, 2015	August 20, 2015	September 29, 2015
Water (Nominal Usage)	September 10, 2015	December 24, 2015	September 10, 2015	December 24, 2015
Consumable - based on system failure				
EDV + TUBSS (UPA Failed)	August 26, 2015	October 14, 2015	August 26, 2015	October 14, 2015
Water, if no WPA (Ag & Iodinated)	July 19, 2015	September 17, 2015	July 19, 2015	September 17, 2015
O_2 if Elektron supporting 3 crew & no OGA	May 10, 2015	September 08, 2015	May 10, 2015	September 08, 2015
O_2 if neither Elektron or OGA	April 14, 2015	June 18, 2015	April 14, 2015	June 18, 2015
LiOH (CDRAs and Vozdukh off)	~0 Days	~14 Days	~0 Days	~14 Days

Inc 43 - 44 Utilization Crew Time



Color Key:
Final OOS
FPIP Plan
Completed

40S Undock 03/11/15

SpX-6
Berth 4/10/15
Berth 4/12/15
Unberth 5/17/15
Unberth 5/21/15

RS EVA 41

SpX-7
Berth 6/15/15
Unberth 7/15/15

US EVA 7/7/15

HTV5
Berth 8/23/15 N2N
Relocate 8/24/15 N1N

Undock 09/11/15
Undock 09/11/15

Soyuz relo 8/28/15

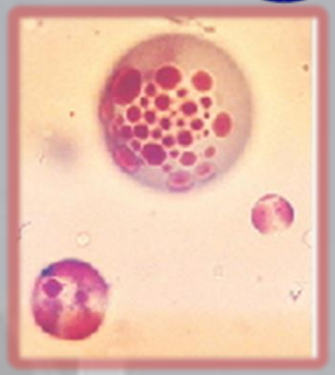
SpX-8
Berth 9/4/15

OP/OZ reconciliation is complete through Week 2.

Executed through Increment Wk (WLP Week) 2 =	1	of 25.0 work weeks (4 % through the Increment)
USOS IDRD Allocation:	1045.1	hours (41.8 hrs/week)
OOS USOS Planned Total:	1045.1	hours
USOS Actuals:	34.42	hours
	3.29%	through IDRD Allocation
	3.29%	through OOS Planned Total
Total USOS Average Per Work Week:	34.42	hours/work week
Voluntary Science Totals to Date:	0	hours (Not included in the above totals or graph)
RSA/NASA Joint Utilization to Date:	0	Hours (not included in the above totals or graph)

Pre-Decisional, For Internal Use Only

Advancements Enabled by ISS Research



What was done in space:

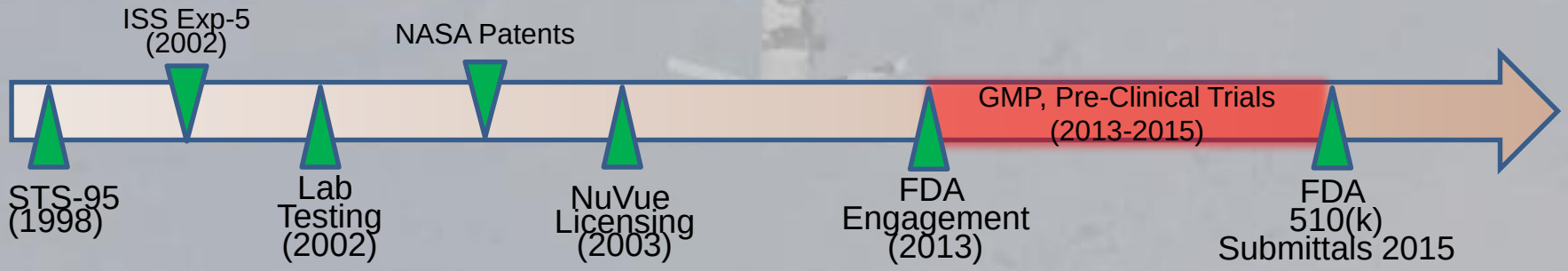
- The NASA Microencapsulation processing system (MEPS) was flown on STS-95 (1998) and ISS Expedition 5 (2002), where the unique behavior of fluids in microgravity led to improvements in microcapsule development.
  - *Microcapsule technology has been tested by many researchers on Earth as a form of cancer treatment by directly injecting microcapsules into tumor sites without the toxic effects of systemic chemotherapy, but several disadvantages have restricted the use of this technology in cancer treatment.*

What spaceflight enabled:

- The space flight results led to the development of a ground-based version of the system (called the Pulse Flow System (PFS)) for Earth-based manufacturing of commercial-scale quantities of the desirable microcapsules that showed significant improvements in treating tumors in laboratory animals.
  - *13 NASA US patents were filed, and are currently licensed to NuVue Therapeutics, Inc.*

What's happening now:

- The MEPS team is currently working closely with the FDA towards three 510(k) applications as visualization markers:
  - Imaging Marker-Microcapsules ("Biopsy Site Marker") for the visualization of tumor tissue sites, (pre and post surgical)
  - Microcapsule Fiducial Imaging Markers for measuring tumor regression
  - Microcapsule Tissue Markers for Magnetic Resonance Imaging compatibility (this was recommended by FDA)
- Results from these studies will also advance development of the chemo markers for future FDA approval



Benefits for Humanity, 2nd Edition

July 2015 Planned Release Date

Human Health

Earth Observation & Disaster Response

Innovative Technology

Global Education

Economic Development of Space

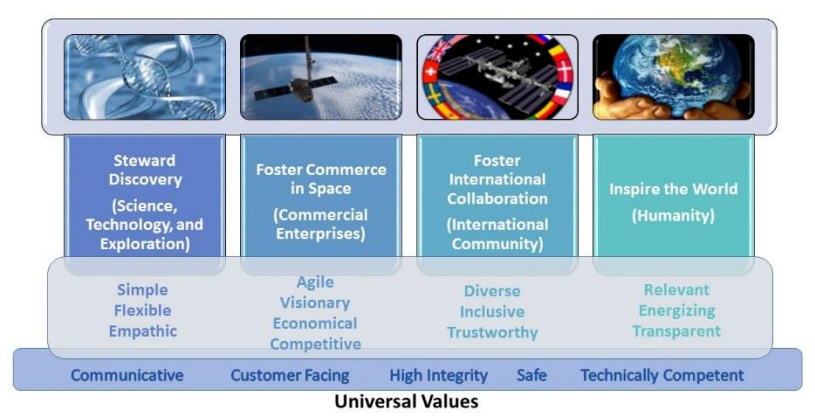
http://www.nasa.gov/stationbenefits

Revolutionize ISS for Science and Exploration

RISE
REVOLUTIONIZE ISS FOR SCIENCE AND EXPLORATION

The Approach

- Dedicated team of ISS and JSC personnel spent 4 months re-engineering ISS Core and Enabling processes.
- Transitioning ISS culture and processes from “assembly” mode to “science discovery/commercialization” mode.
- Design solution marries resolution of current known issues from stakeholder and customer feedback with new process designs.



The Focus	The Customer	The Purpose
	Core Processes	ENSURING SAFETY with DILIGENCE, FLEXIBILITY, TECHNICAL EXCELLENCE and DISCERNMENT
	Core Processes	MANAGE ST&E INTERFACES with EFFICIENCY, FLEXIBILITY, and CONSISTENCY
	Core Processes	PLAN AND PROCESS CARGO with EFFICIENCY, FLEXIBILITY, and RELIABILITY
	Core Processes	PLAN OPERATIONS with EFFICIENCY, FLEXIBILITY, and RESPONSIVENESS
	Core Processes	OPERATE THE VEHICLE with TEAM WORK, EFFICIENCY, and SERVICE

RISE Enabling Process Focus

“Making the right thing to do, the easiest thing to do.”

ISS Core Processes

Highlights

- Utilize specific criteria and rating levels to define support providers need/want to achieve success in the realms of Safety, Requirements, and Operations
- Utilize dashboard concept for data sharing across the program
- Utilize rating and complexity categorization to define safety approval process
- Rewrite of payload interface requirements to reduce duplication and transfer mission success responsibility to the hardware provider).
- Eliminate duplicate data submittal.

National Aeronautics and Space Administration

Commercial Crew Program Status to the NAC

Philip McAlister
NASA HQ, HEOMD
April 2015

We are getting started…

Boeing: CST-100

SpaceX: Dragon

Boeing: CST-100 Interface Test

SpaceX: 39A RP1 System

Boeing: C3PF Logistics Systems

SpaceX: Common Booster Transport to Qualification

Boeing: Water Landing and Rotation Test

Boeing Concept

- Boeing offered its CST-100 crew transportation system featuring a capsule spacecraft, launched using United Launch Alliance's Atlas 5 launch vehicle, and landed using parachute and airbag systems for hard-surface landings, or contingency water landings.
- Boeing plans to launch from SLC-41 (current Atlas 5 launch pad) at the Cape Canaveral Air Force Station.

SpaceX Concept

- SpaceX offered its Crew Dragon crew transportation system featuring a capsule spacecraft, launched using SpaceX's Falcon 9 launch vehicle, and water landings with a planned future upgrade to soft land landing using propulsive systems.
- SpaceX plans to launch from LC-39A (former Space Shuttle launch pad) at the Kennedy Space Center in Florida.

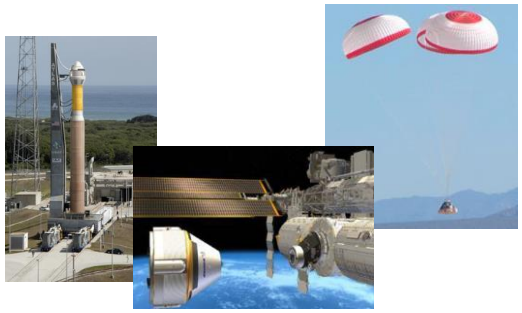
Commercial Crew transportation Capability

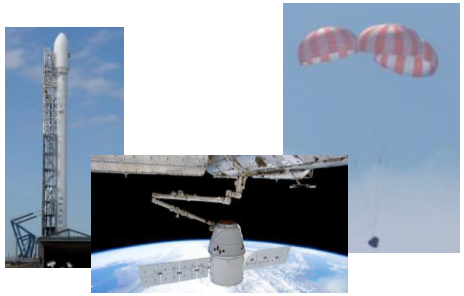
- CCtCap Contract Objectives
  - Complete development and certification of crew transportation systems that meet NASA's safety and performance requirements.
  - Provide for crew rotation capability for 4 NASA or NASA-sponsored crewmembers
  - Provide emergency crew return capability for these crewmembers at any time while the commercial spacecraft is docked to the ISS
  - Transport a limited amount of pressurized cargo to the ISS
  - Return pressurized cargo from the ISS
  - Provide for a crew safe haven capability when the spacecraft is docked to the ISS

Flight Test Programs

- These crew transportation systems are very complex and the development and test activity planned over the next three years will be extremely challenging. Most likely, many things will not go exactly like we and our partners expect.
- Below shows the proposed flight test programs of the partners. The acceptability of these tests in terms of meeting NASA's safety and performance requirements will be determined by NASA.

- Boeing
  - Pad Abort Test – 2017
  - Uncrewed Orbital Flight Test to ISS – 2017
  - Crewed Flight Test to ISS – 2017
- SpaceX
  - Pad Abort Test (CCiCap) – 4/2015
  - In-flight Abort Test (CCiCap) – 9/2015
  - ISS Flight w/o Crew – 2016
  - Flight to ISS with Crew – 2017





National Aeronautics and Space Administration

Asteroid Redirect Mission Status

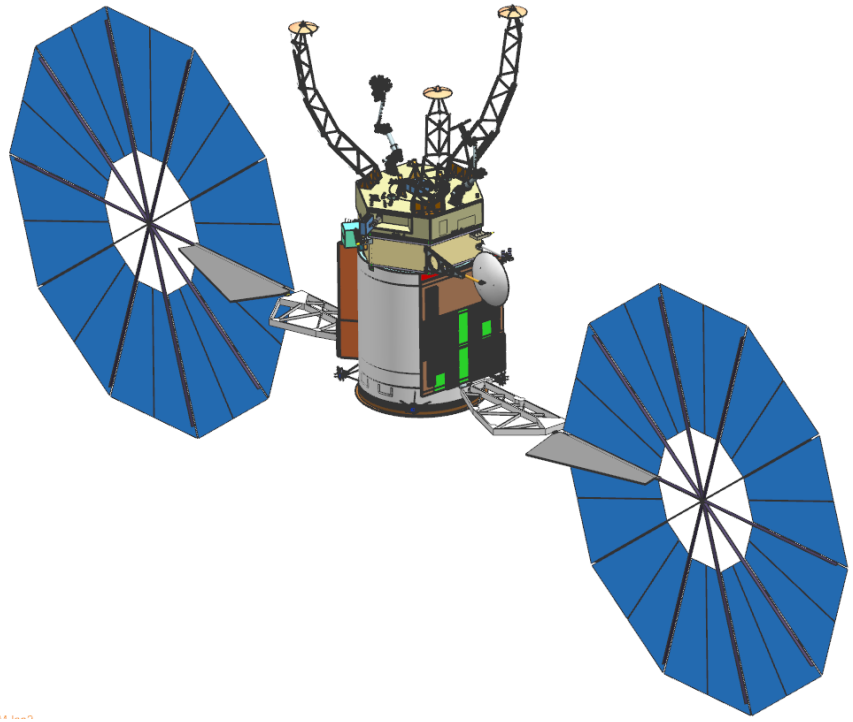
08 April 2015

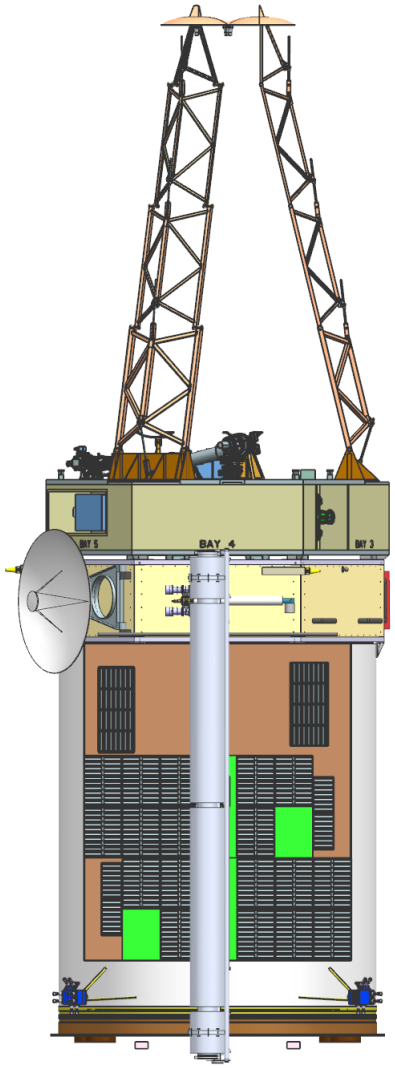
Michele Gates
Asteroid Redirect Mission Program Director

ARM Contributions to Future Deep Space Missions

- **Through ARM, NASA will utilize a number of key capabilities that will be needed for future exploration purposes, as well as providing other broader benefits**
  - Advanced high-power, long-life, high through-put solar electric propulsion
  - Autonomous rendezvous and proximity operations
  - Capture and control of non-cooperative objects
  - Rendezvous and docking systems
  - Deep space trajectory and navigation methods
  - Advanced crew extra-vehicular activity (EVA) technologies and techniques
  - Crewed sample collection and containment
- **Demonstration of basic asteroid deflection techniques that will inform future planetary defense approaches**
- **Opportunities for science and partnership interests, such as for in-situ resource utilization and follow-on use of the SEP based spacecraft**

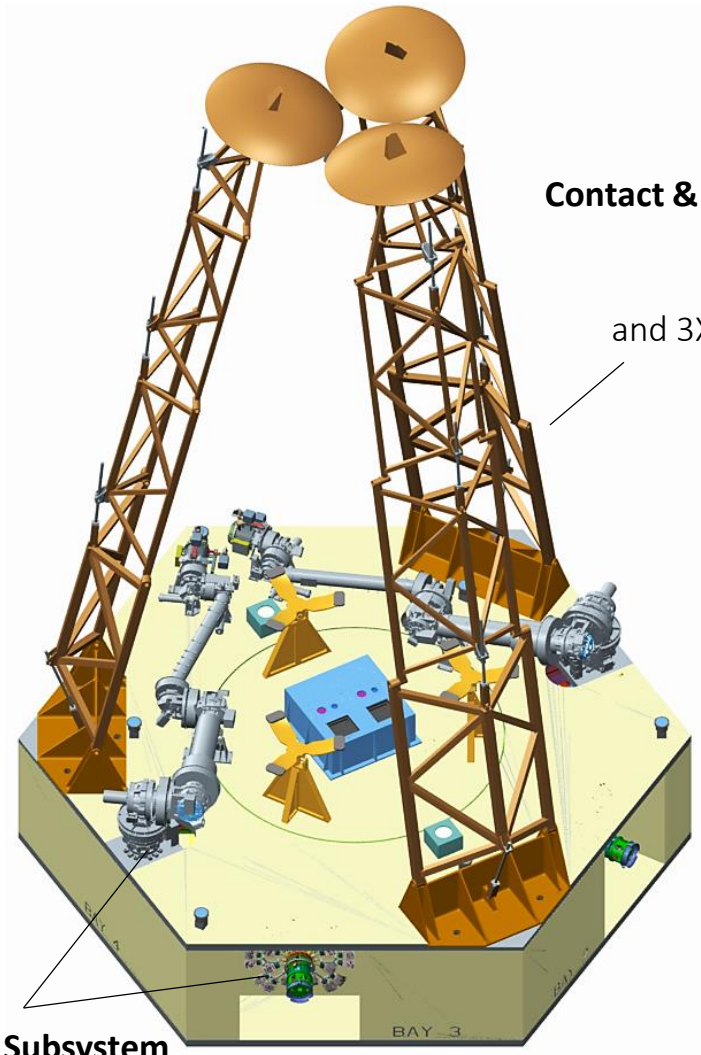
ARRM Baseline Concept Flight System Overview



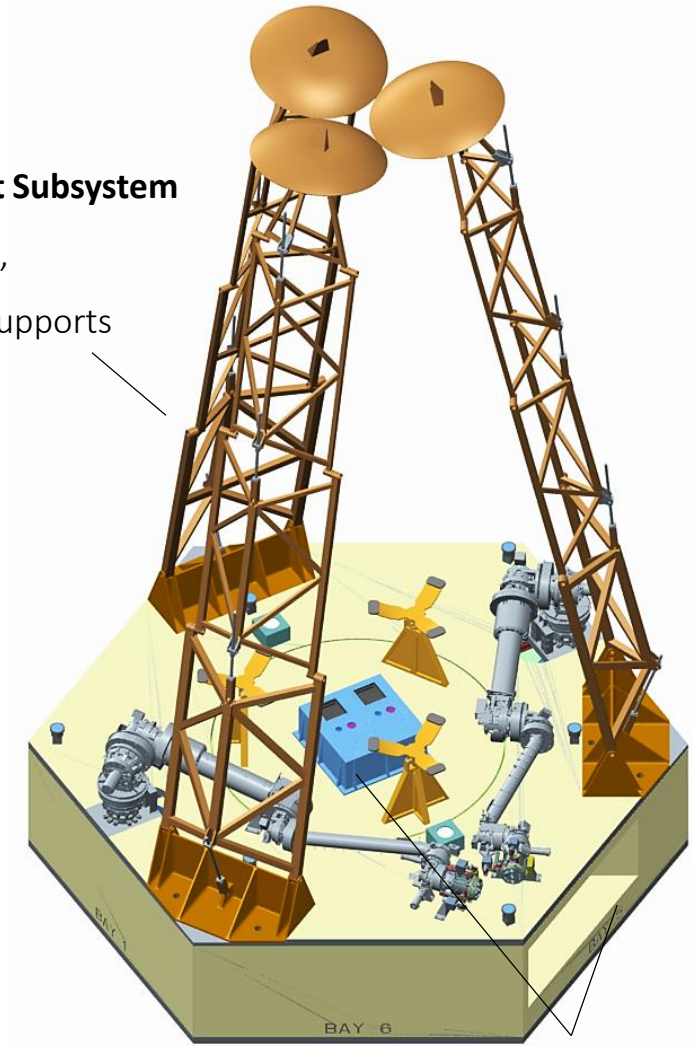


ARRM launch configuration

ARRM Baseline Concept Capture Module



Contact & Restraint Subsystem (CRS)
3X "legs"
and 3X cradle supports



Robot Subsystem
Capture arms (2X)
and tool stowage (2X)

- 3 SpaceCube computers, VDSU w/ 128 Gigabytes storage

Relative Navigation Subsystem (RNS)
Deck sensor assembly and
gimbal sensor suite (shown stowed)

National Aeronautics and Space Administration

Pioneering Space – the Evolvable Mars Campaign

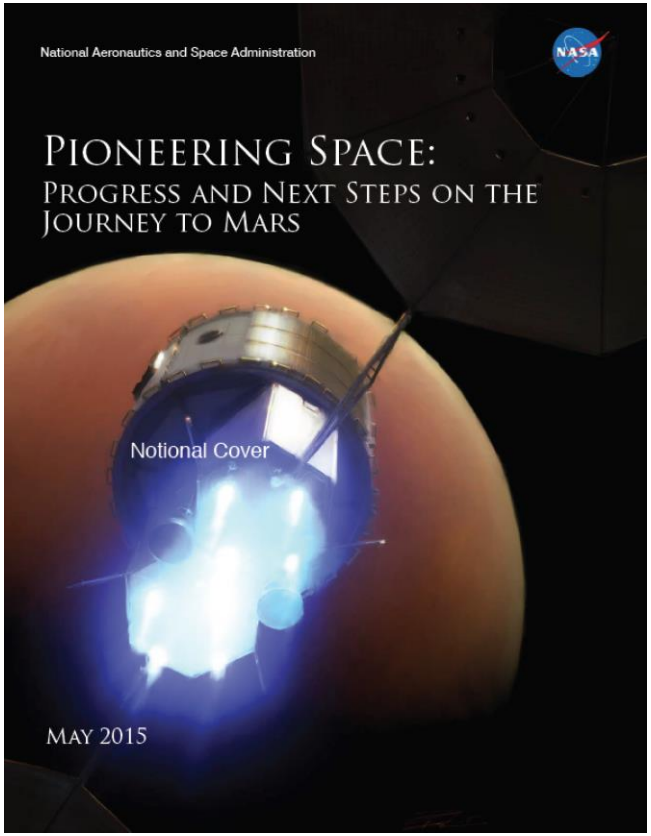
Greg Williams, Jason Crusan

HEOMD

April 2015

Pioneering Space - Outline

- Overall Flow
  - Letter From Administrator
  - Our Goal
  - Our Approach – Pioneering Principles
  - Our Approach – Pioneering Strategy
  - Proving Ground
  - Pioneering Challenges
    - Transportation
    - Working in Space
    - Staying Healthy
    - Strategic Knowledge Gaps
  - Our Progress and Plans
    - Earth-Reliant – ISS, Commercial Crew/Cargo
    - Proving Ground – SLS, Orion, SEP, protoflight habitat systems
    - Earth-Independent – Robotic missions, evolving architectures
  - On the Horizon – Mars
  - Summary



Evolvable Mars Campaign

EMC Goal: Define a pioneering strategy and operational capabilities that can extend and sustain human presence in the solar system including a human journey to explore the Mars system starting in the mid-2030s.

- Identify a plan that:
  - Expands human presence into the solar system to advance exploration, science, innovation, benefits to humanity, and international collaboration.
  - Provides different future scenario options for a range of capability needs to be used as guidelines for near term activities and investments
    - In accordance with key strategic principles
    - Takes advantage of capability advancements
    - Leverages new scientific findings
    - Flexible to policy changes
  - Identifies linkages to and leverage current investments in ISS, SLS, Orion, ARM, EAM, technology development investments, science activities
  - Emphasizes prepositioning and reuse/repurposing of systems when it makes sense
    - Use location(s) in cis-lunar space for aggregation and refurbishment of systems

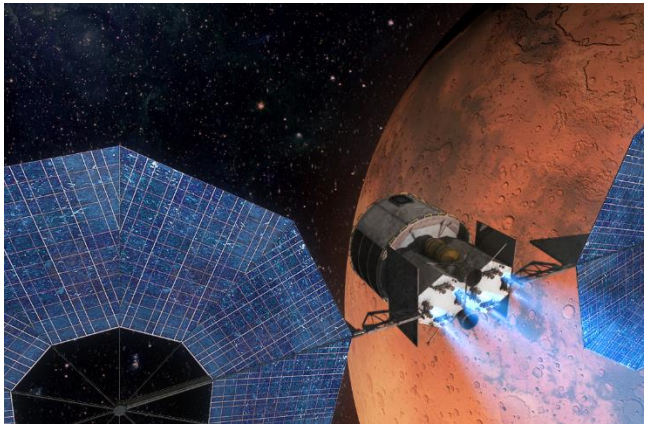
<u>Internal analysis team members:</u>

- ARC, GRC, GSFC, HQ, JPL, JSC, KSC, LaRC and MSFC
- HEOMD, SMD, STMD, OCS and OCT

<u>External inputs from:</u>

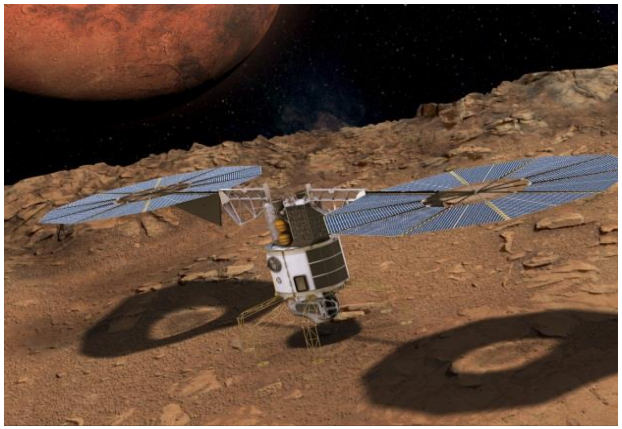
- International partners, industry, academia, SKG analysis groups

Mars Vicinity Missions Provide the "Pull"



Mars Orbit

- Opportunities for integrated human-robotic missions:
  - Real time tele-operation on Martian surface
  - Mars sample return
- Demonstrate sustainable human exploration split-mission Mars concept
- Validate transportation and long-duration human systems
- Validate human stay capability in zero/micro-g



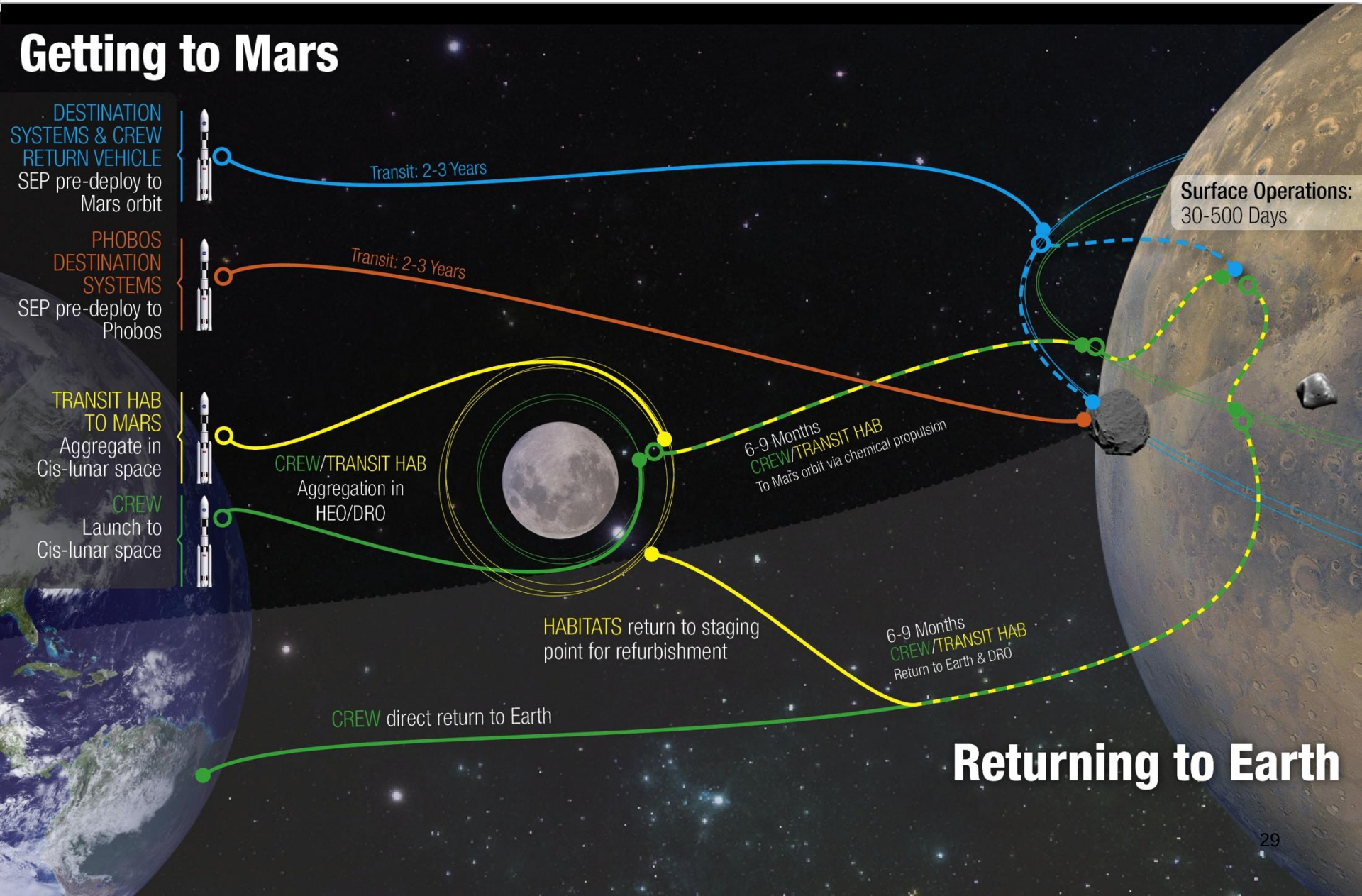
Mars Moons

- Opportunities for integrated human-robotic missions:
  - Real time tele-operation on Martian surface
  - Mars & moons sample return
- Demonstrate sustainable human exploration split-mission Mars concept
- Moons provides additional radiation protection
- In-situ resource utilization
- Validate human stay capability in low-g

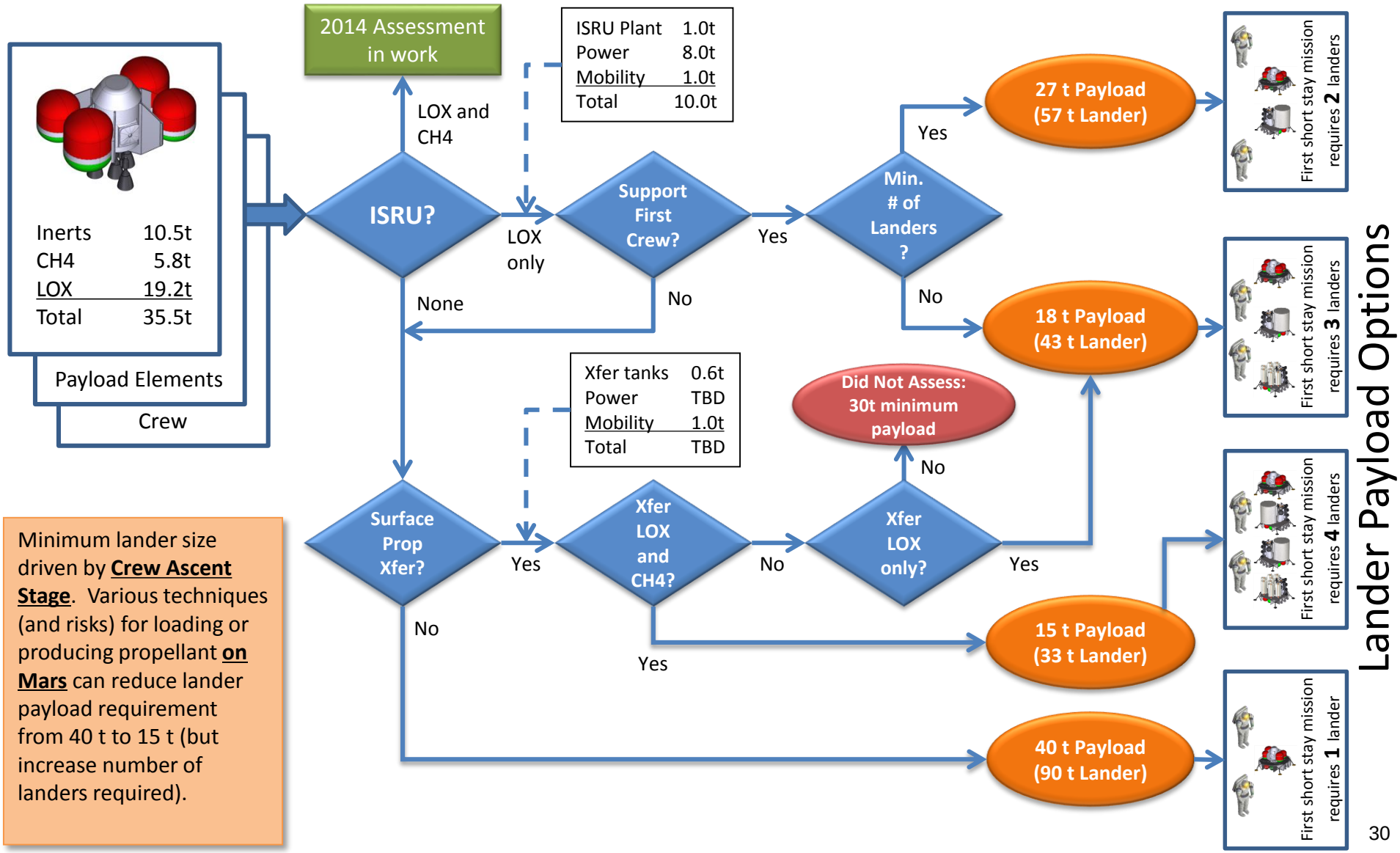
Mars Surface

- Opportunities for integrated human-robotic missions:
  - Search for signs of life
  - Comparative planetology
  - Understanding Mars climate changes
  - Geology/geophysics
- Planet provides radiation protection
- Entry, descent, landing
- EVA surface suits
- In-situ resource utilization
- Validate human stay capability in partial-g

1: Mars Split Mission Concept



Largest Indivisible Payload Element and Options for Size of the Lander

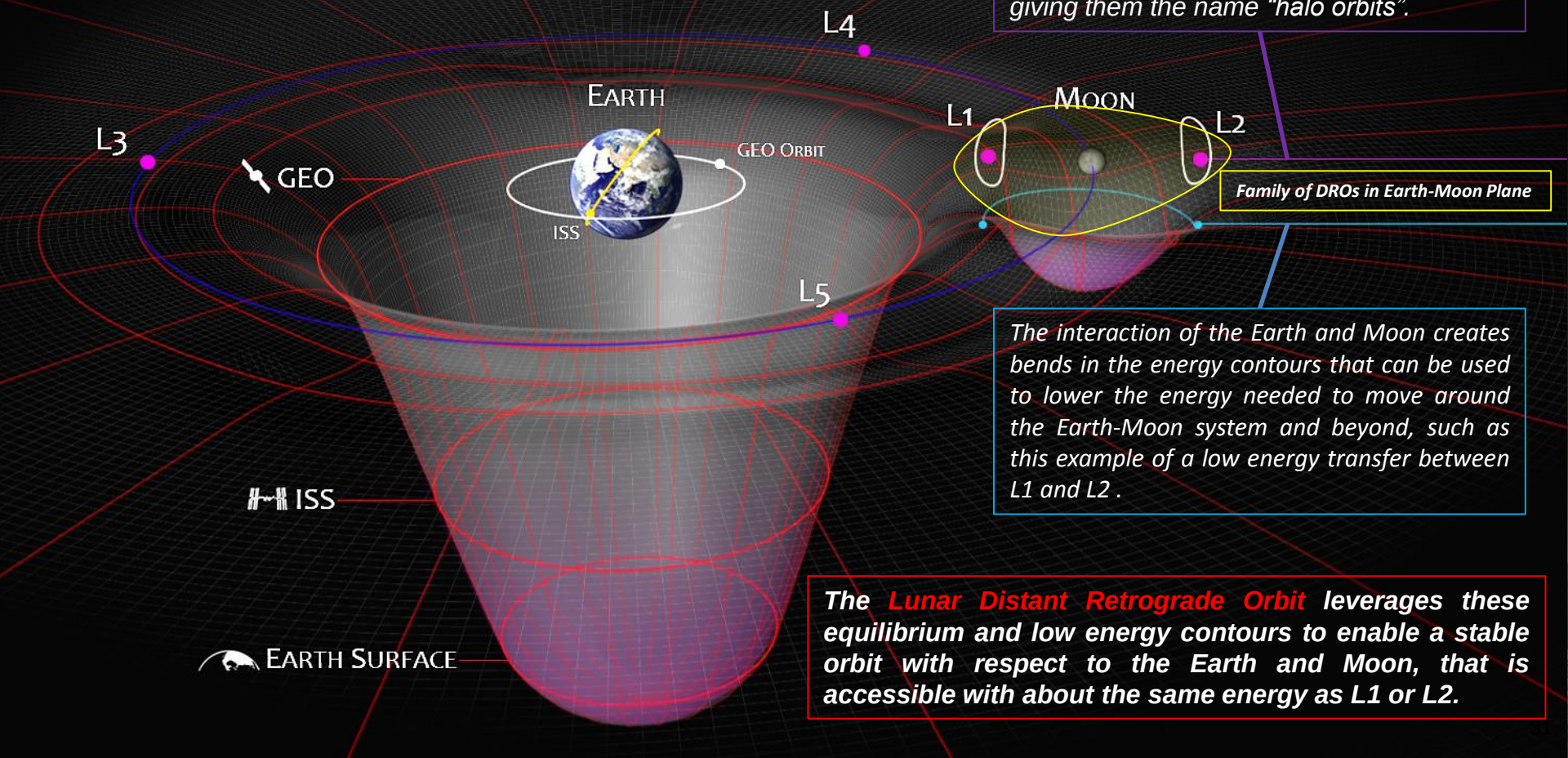


Minimum lander size driven by **Crew Ascent Stage**. Various techniques (and risks) for loading or producing propellant **on Mars** can reduce lander payload requirement from 40 t to 15 t (but increase number of landers required).

Cis-Lunar Space:
How the Earth and the Moon Interact

The contours on the plot depict energy states in the Earth-Moon System and the relative difficulty of moving from one place to another.

A spacecraft at L2 is actually orbiting Earth at a distance just past the Moon, however if you look at it from the Moon, the orbit will look like an ellipse around a point in space giving them the name "halo orbits".

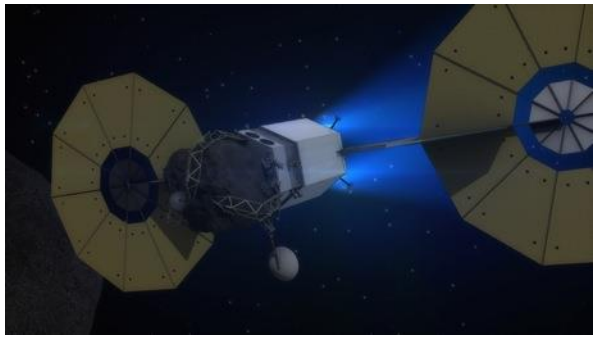


Family of DROs in Earth-Moon Plane

The interaction of the Earth and Moon creates bends in the energy contours that can be used to lower the energy needed to move around the Earth-Moon system and beyond, such as this example of a low energy transfer between L1 and L2 .

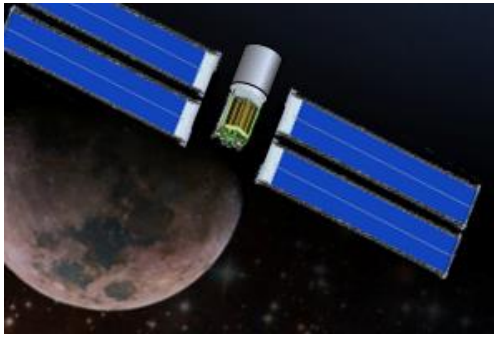
The Lunar Distant Retrograde Orbit leverages these equilibrium and low energy contours to enable a stable orbit with respect to the Earth and Moon, that is accessible with about the same energy as L1 or L2.

SEP Module Extensibility for Mars



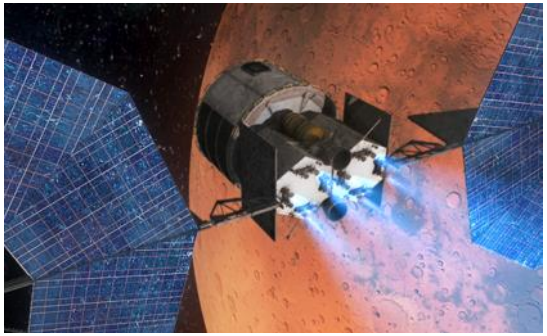
Block 1

- 50-kW Solar Array
- 40-kW EP System
- 10-t Xenon Capacity



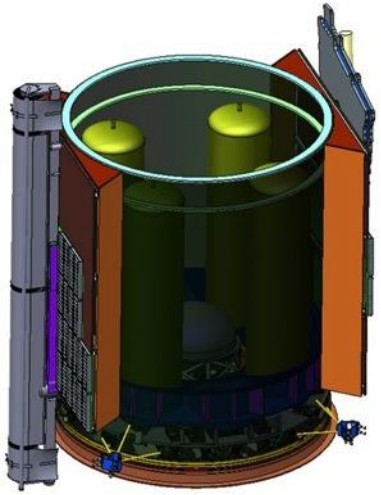
Block 1a (SEP/Chem)

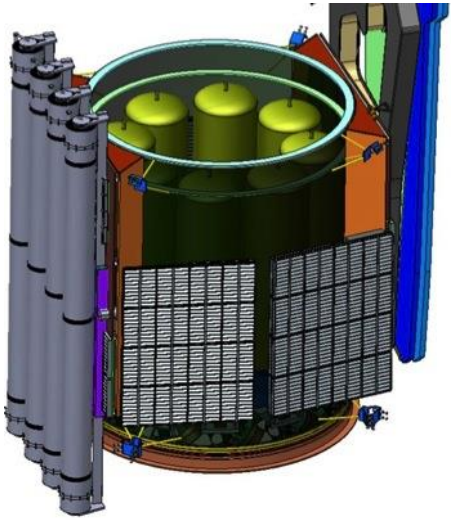
- 190-kW Solar Array
- 150-kW EP System
- 16-t Xenon Capacity

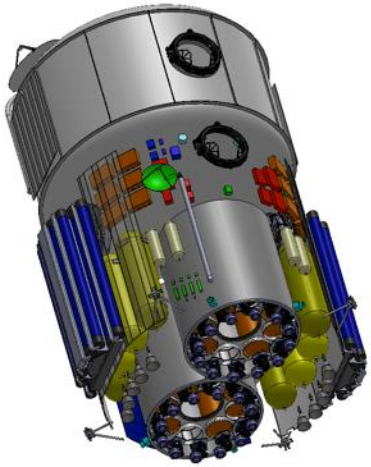


Hybrid

- 250 to 400-kW Solar Array
- 150 to 200-kW EP System
- 16-t Xenon Capacity With Xe Refueling Capability







National Aeronautics and Space Administration

Mars Mission and Space Radiation Risks Overview

Briefing to
NAC HEOMD/SMD Joint Committee

April 7, 2015

Steve Davison • HEOMD • NASA Headquarters

Space Radiation Presentations

Overview

- Mars Mission and Space Radiation Risks — *Steve Davison, NASA-HQ, 30 min*
- Health Standards Decision Framework — *David Liskowsky, NASA-HQ, 10 min*

Space Radiation Environment

- Introduction — *Chris St. Cyr, NASA-GSFC, 5 min*
- Solar Energetic Particles — *Allan Tylka, NASA-GSFC, 30 min*
- Comparison and Validation of GCR Models — *Tony Slaba, NASA-LaRC, 30 min*
- GCR Radiation Environment Predictions — *Nathan Schwadron, Univ. of NH, 30 min*
- Emerging GCR Data from AMS-2 — *Veronica Bindi, Univ. of Hawaii, 30 min*

Radiation Health Risk Projections — *Eddie Semones, NASA-JSC, 45 min*

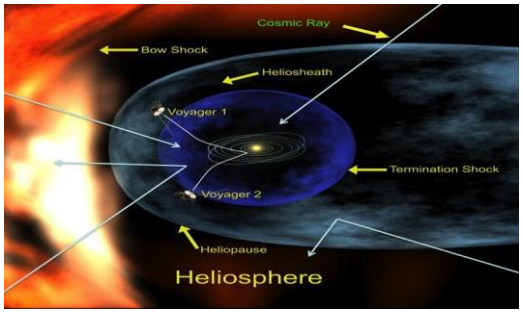
- NCRP Recommendations, Permissible Exposure Limits, Space Radiation Cancer Risk Model, Operations and In-Flight Solar Particle Event Mitigations

Space Radiation R&T for Risk Mitigation — *Lisa Simonsen, NASA-LaRC, 45 min*

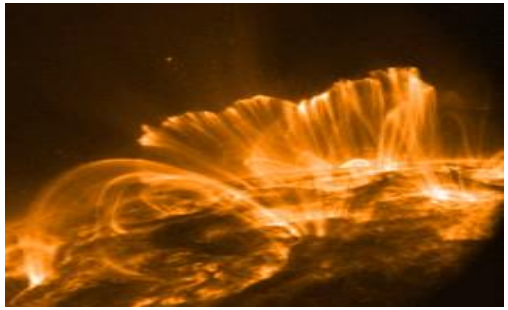
- Radiobiology Research Portfolio (Cancer, CNS, Cardio) and Spacecraft Shielding Design, Analysis, and Optimization

Space Radiation Challenge

Galactic cosmic rays (GCR) – penetrating protons and heavy nuclei



Solar Particle Events (SPE) – low to medium energy protons



What are the levels of radiation in deep space and how does it change with time? → **How much radiation is inside the spacecraft, on Mars surface, and in the human body?** → **What are the health risks associated with radiation exposure?** → **How do we mitigate these health risks?**

SMD R&D

Helio- & Astrophysics Characterization/measurement

Modeling/Prediction & Real-time Monitoring

HEOMD R&D

Radiation Transport Code Development

Transport of radiation into body

Tissue/Organ doses

Cancer risks

Acute radiation

Non-cancer risks

NSRL research

Spacecraft Shielding

Bio-Countermeasures

Medical Standards

Mars Mission Human Health Risks

Based On The On-going Human System Risk Board (HSRB) Assessment, The Following Risks Are The Most Significant For A Mars Mission:

- Adverse affect on health
  - ✧ space radiation exposure (long-term cancer risk)
  - ✧ spaceflight-induced vision alterations
  - ✧ renal stone formation
  - ✧ compromised health due to inadequate nutrition
  - ✧ bone fracture due to spaceflight induced bone changes
  - ✧ acute and chronic elevated carbon dioxide exposure
- Inability to provide in mission treatment/care
  - ✧ lack of medical capabilities
  - ✧ ineffective medications due to long term storage
- Adverse impact on performance
  - ✧ decrements in performance due to adverse behavioral conditions and training deficiencies
  - ✧ impaired performance due to reduced muscle and aerobic capacity, and sensorimotor adaptation

Post Mission Risks

In-Mission Risks

Current Space Flight Health Standards

- **NASA Should Be Able To Meet All Fitness for Duty (FFD) And Permissible Outcome Limits (POL) Standards For A Mars Mission**
  - Based on long-duration ISS flight experience and mitigation plans
- **Meeting The Current Low Earth Orbit (LEO) Space Radiation Permissible Exposure Limit (PEL) Standard Will Be Challenging For A Mars Mission**
  - NASA exposure limit is the most conservative of all space agencies

Area	Type	Standard
Bone	POL	Maintain bone mass at ≥-2SD
Cardiovascular	FFD	Maintain ≥75% of baseline VO2 max
Neurosensory	FFD	Control motion sickness, spatial disorientation, & sensorimotor deficits to allow operational tasks
Behavioral	FFD	Maintain nominal behaviors, cognitive test scores, adequate sleep
Immunology	POL	WBC > 5000/ul; CD4 + T > 2000/ul
Nutrition	POL	90% of spaceflight-modified/USDA nutrient requirements
Muscle	FFD	Maintain 80% of baseline muscle strength
Radiation	PEL	≤ 3% REID (Risk of Exposure Induced Death, 95% C.I.

Post Mission Cancer Risk For A 900-day Mars Mission

Mars Mission Timing	Mission Shielding Configuration	Calculated REID, 95% C.I. (Age=45, Male-Female)	Amount Above 3% Standard
Solar Max	Good shielding like ISS (20 g/cm2) w/no exposure from SPEs	4% - 6%	1% - 3%
Solar Max	Good shielding like ISS (20 g/cm2) w/large SPE	5% - 7%	2% - 4%
Solar Min	Good shielding like ISS (20 g/cm2)	7% - 10%	4% - 7%

NASA Standards Limit The Additional Risk Of Cancer Death By Radiation Exposure, Not The Total Lifetime Risk Of Dying From Cancer

- Baseline lifetime risk of death from cancer (non-smokers)
  - 16% males, 12% females
- After Mars Mission (solar max), Astronauts lifetime risk of death from cancer ~20%

Mars Space Radiation Risk For Solar Max Can Be Explained As Follows

- If 100 astronauts were exposed to the Mars mission space radiation, in a worst case (95% confidence) 5 to 7 would die of cancer, later in life, attributable to their radiation exposure and their life expectancy would be reduced by an average on the order of 15 years
- Challenging to use a population-based risk model to estimate individual risk for the few individuals that would undertake a Mars Mission

Reducing Mars Mission Radiation Risks

NASA Is Working Across All Phases Of The Mars Mission To Minimize The Space Radiation Health Risk

Pre - Mission

Radiation Factors
*Individual Sensitivity – Biomarkers**
Selection – age, gender
Model Projection of Risk
Space Radiation Envir. Model

In - Mission

Radiation Factors
Shielding
Mission Duration
Solar Min vs. Max
Operational Planning
Dosimetry
*Countermeasures**
- Pharmaceutical & Nutritional

Post - Mission

Radiation Factors
*Occupational Health Care for Astronauts**
- Personalized Cancer Screening, Biomarkers
- Cancer Treatment

Reduction in Total Risk Posture

**long-term development*

Areas of Discussion

- Joint Science and HEO Committee Discussion
  - HEOMD and SMD Cooperative Efforts
  - Radiation exposure on a Mars mission.
- Communication of program goals and achievements
- Program affordability/sustainability
- Human Exploration Plans

- Topics for future Meetings

Program Affordability and Sustainability

- Originally started tracking this topic after the December, 2013 NAC meeting.
- Received a briefing on NASA's management instruction NPR 7120.5E in April 2014
- Conducted short data gathering sessions with program management teams at Marshall, Johnson, and Kennedy in the summer and fall of 2014.
- Received a lessons learned briefing from the COTS program manager on January of 2015.

Summary From 7120 Fact Finding

- Users understand the need for a guidance document on program management.
- The Document is comprehensive and especially useful for training purposes.
- Users realize that some requirements are meant to meet requirements of stakeholders outside of NASA.

- Tailoring of requirements is difficult
- No central advocate for focusing requirements levied by numerous stakeholders
- While the requirements section of 7120.5E has been reduced, the guidelines portion has grown and guidelines are treated as requirements by stakeholders.
- Often easier to satisfy a requirement that adds little value in order to avoid the effort of tailoring.
- Multiple layers of independent assessment with a larger number of reviews and review bodies than is necessary interferes with the management team's ability to efficiently run their program.
- Reserve/confidence level guidelines are unrealistic for large programs – reserves too big of a target.

Proposed NAC Recommendation January, 2015

TITLE: Focus on Affordable Program Management

Recommendation: The NAC recommends that NASA take action to make programs and projects more affordable by:

1. Examining the current approach for tailoring mandatory NASA management requirements and making changes to expedite the resolution of tailoring requests.
2. Working with groups that are currently conducting separate reviews of programs to minimize the number and maximize the benefit of reviews and reviewing groups.

MAJOR REASONS FOR PROPOSING THE RECOMMENDATION:

The affordability of NASA's programs is a potential barrier to the achievement of NASA's strategic goals. Some program costs, are within NASA's purview to control, such as internal program management requirements and various program or project reviews which are mandated by various NASA groups. During data gathering efforts by the Human Exploration and Operations Committee on his topic, two specific areas were consistently mentioned by program managers who were interviewed – difficulty of tailoring management requirements, and the overhead of supporting numerous external and internal program reviews.

CONSEQUENCES OF NO ACTION ON THE PROPOSED RECOMMENDATION:

Difficulty or delay in achieving NASA's strategic goals due to program costs which are higher than necessary.

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