National Aeronautics and Space Administration

NAC Human Exploration and Operations Committee

Mr. Richard Kohrs, Chair

April 24th, 2013

Attendees

Present

- Mr. Richard “Dick” Kohrs, Chair
- Mr. Bohdan “Bo” Bejmuk, Vice-Chair
- Ms. Shannon Bartell
- Dr. Stephen “Pat” Condon
- Mr. Joseph “Joe” W. Cuzzupoli
- Dr. David E. Longnecker
- Mr. Richard “Dick” Malow
- Mr. James “Jim” Odom

Telecon

- Dr. Leroy Chiao
- Mr. Tommy Holloway
- Mr. Robert “Bob” Sieck

Agenda

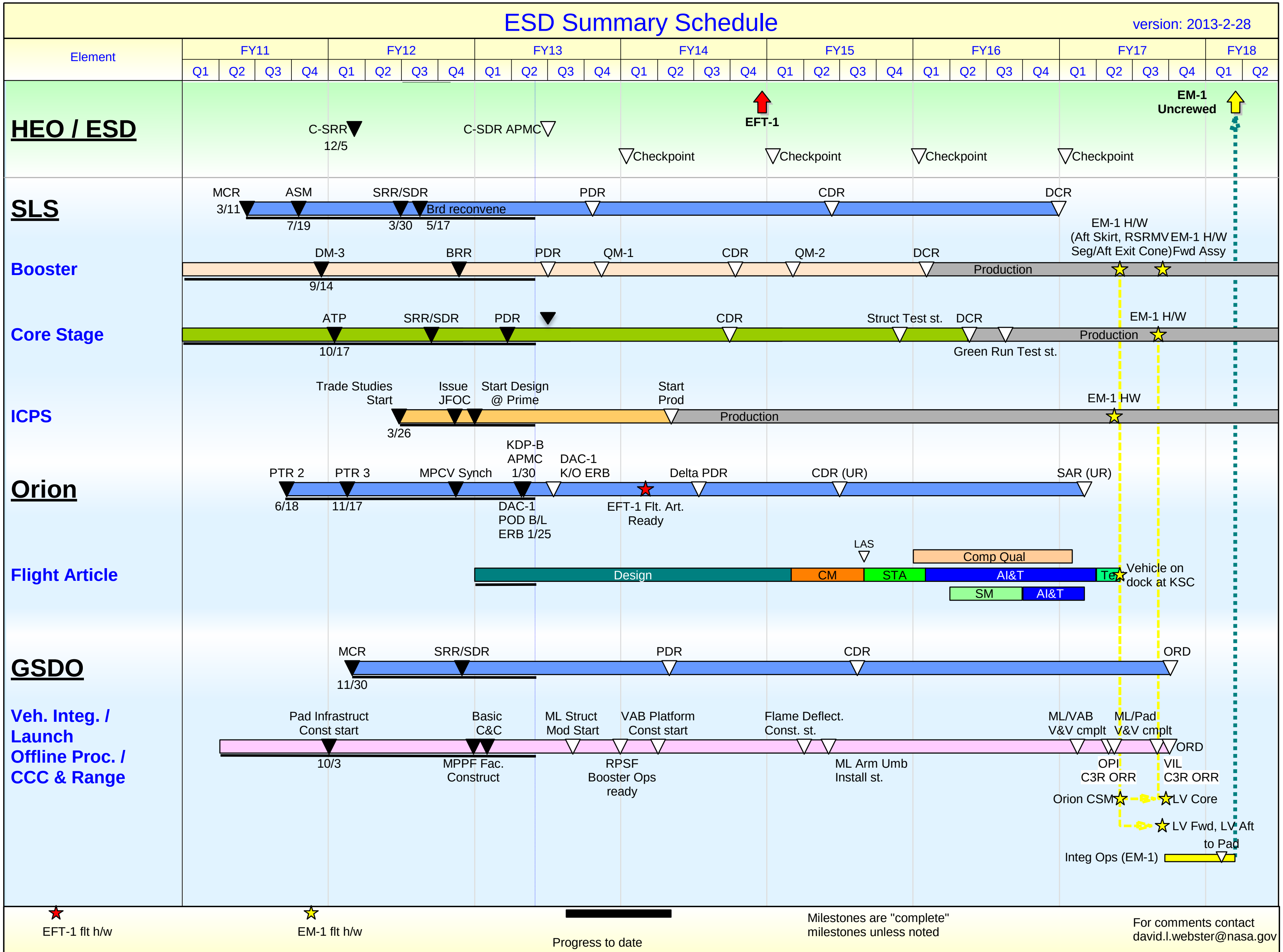
Status of Human Exploration and Operations	**Mr. William Gerstenmaier** Associate Administrator Human Exploration and Operations Mission Directorate, NASA HQ
Status of Exploration Systems Development	**Mr. Daniel Dumbacher** Deputy Associate Administrator, Exploration Systems & Development Division; Human Exploration and Operations Mission Directorate, NASA HQ
Center for the Advancement of Science / Status of Research Subcommittee	**Dr. D. Marshall Porterfield** Director, Space Life & Physical Sciences Research & Applications Division; Human Exploration and Operations Mission Directorate, NASA HQ
Status of International Space Station	**Mr. Kirk Shireman** Deputy Manager, International Space Station Program NASA, Johnson Space Center
Status of Commercial Spaceflight Development	**Mr. Philip McAlister** Director, Commercial Spaceflight Development Division; Human Exploration and Operations Mission Directorate, NASA HQ

National Aeronautics and Space Administration

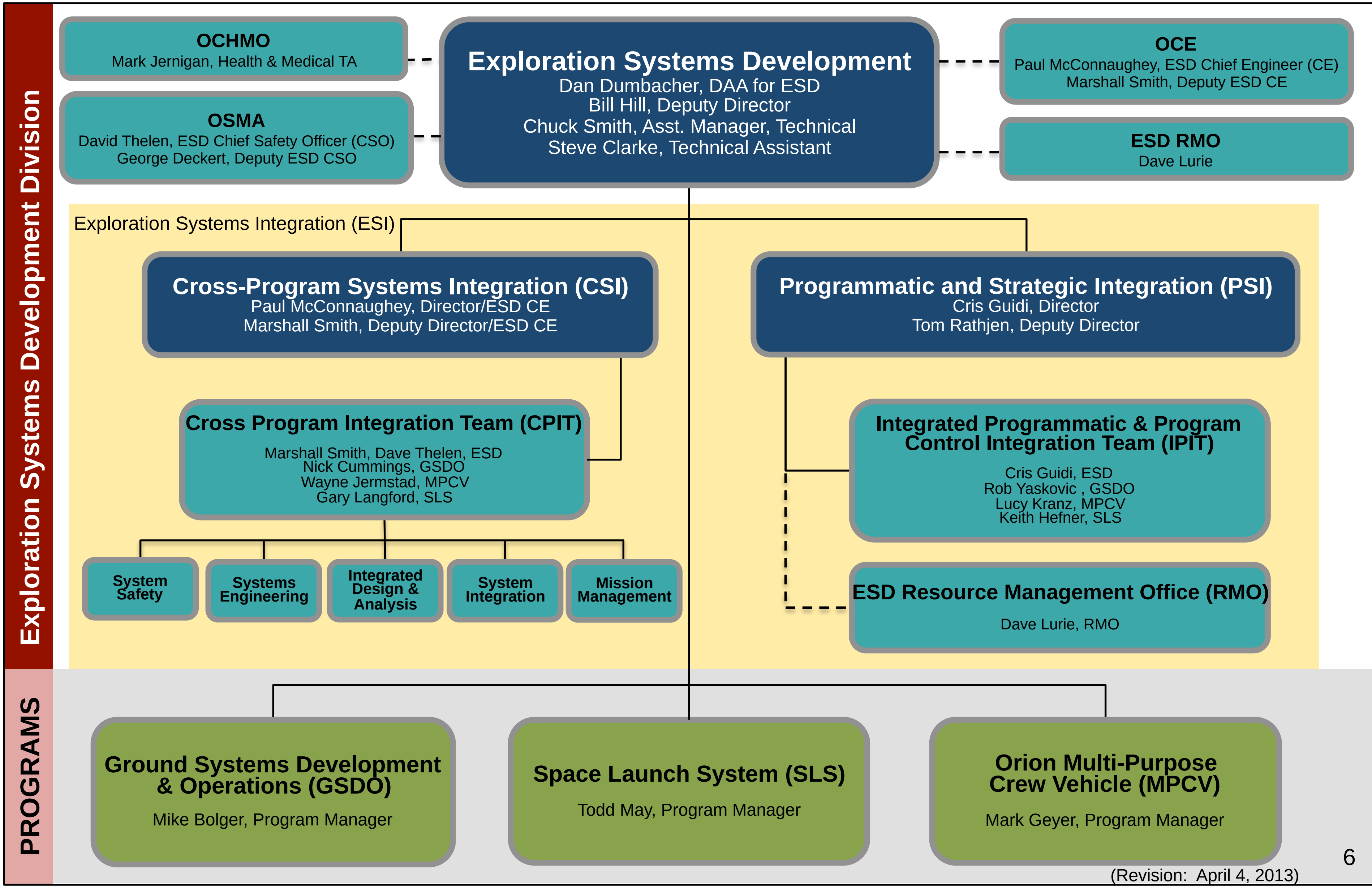
NASA Advisory Council Presentation

Dan Dumbacher

April 2013


ESD Summary Schedule
version: 2013-2-28
Element
FY11 FY12 FY13 FY14 FY15 FY16 FY17 FY18
Q1 Q2 Q3 Q4
HEO / ESD
C-SRR 12/5
C-SDR APMC
EFT-1
EM-1 Uncrewed
Checkpoint
SLS
MCR 3/11
ASM 7/19
SRR/SDR 3/30 5/17
Brd reconvene
PDR
CDR
DCR
Booster
DM-3 9/14
BRR
QM-1
QM-2
Production
EM-1 H/W (Aft Skirt, RSRMV Seg/Aft Exit Cone)
EM-1 H/W Fwd Assy
Core Stage
ATP 10/17
Struct Test st.
Green Run Test st.
EM-1 H/W
ICPS
Trade Studies Start 3/26
Issue JFOC
Start Design @ Prime
Start Prod
EM-1 HW
Orion
PTR 2 6/18
PTR 3 11/17
MPCV Synch
KDP-B APMC 1/30
DAC-1 K/O ERB
DAC-1 POD B/L ERB 1/25
EFT-1 Flt. Art. Ready
Delta PDR
CDR (UR)
SAR (UR)
Flight Article
LAS
Comp Qual
Design
CM
STA
AI&T
Te
Vehicle on dock at KSC
SM
GSDO
MCR 11/30
ORD
Veh. Integ. / Launch Offline Proc. / CCC & Range
Pad Infrastruct Const start 10/3
Basic C&C
MPPF Fac. Construct
ML Struct Mod Start
VAB Platform Const start
RPSF Booster Ops ready
Flame Deflect. Const. st.
ML Arm Umb Install st.
ML/VAB V&V cmplt
ML/Pad V&V cmplt
OPI C3R ORR
VIL C3R ORR
Orion CSM
LV Core
LV Fwd, LV Aft to Pad
Integ Ops (EM-1)
EFT-1 flt h/w
EM-1 flt h/w
Progress to date
Milestones are "complete" milestones unless noted
For comments contact david.l.webster@nasa.gov

ESD Organization



(Revision: April 4, 2013)

Current CSI Organization

(Revision: March 19, 2013)

Cross-Program System Integration (CSI)
Paul McConnaughey
Marshall Smith

Program SE&I Leads
Garry Lyles - SLS
John McCullough - Orion
Phil Weber - GSDO

Steve Bauder - Risk Manager
Arlene Moore – PP&C Manager
Mike Jones – SE&I Schedule
Michele DiGiuseppe – CM/DM

Cross Program Integration Team (CPIT) Leadership
Marshall Smith, Dave Thelen - ESD
Nick Cummings - GSDO
Wayne Jermstad - Orion
Gary Langford - SLS

Ad Hoc Teams
Technical Performance Assessments, D&C, Operability, Tech Planning, Natural Environments, Facilities…

System Safety
Jeff Hamilton

- Integrated Hazards
- Probabilistic Risk Assessment
- Quality Assurance
- FMEA/CIL
- Crew Survivability Assessment

System Engineering
Paul McConnaughey (Acting)

- ConOps & Requirements
- Integrated V&V
- Integrated Drawing Management
- Flight Certification
- Data Integration
- Human Rating
- Human Systems Integration

Integrated Design and Analysis
Joe Brunty

- Aborts
- Ascent Performance/ GNC
- ETE Mission Performance
- Loads
- Induced Environments
  - Shock & Vibe
  - Aero
  - Aerothermal
  - Thermal
  - Acoustics
  - Debris

System Integration
Jessica Parsons

- Integrated Avionics and Software
- Interfaces
- Interface Working Groups
  - Orion to SLS
  - Orion to GSDO
  - SLS to GSDO
  - MS to SLS
  - MS to GSDO
- Integrated Test & Checkout
- OMRS
- Ground H/W Integration
- Logistics Integration

Mission Management
Jon Lenius

- Integrated Launch Criteria
- Mission Integration
- Flight Test Working Group
- Comm/Network
- Range Safety
- Imagery

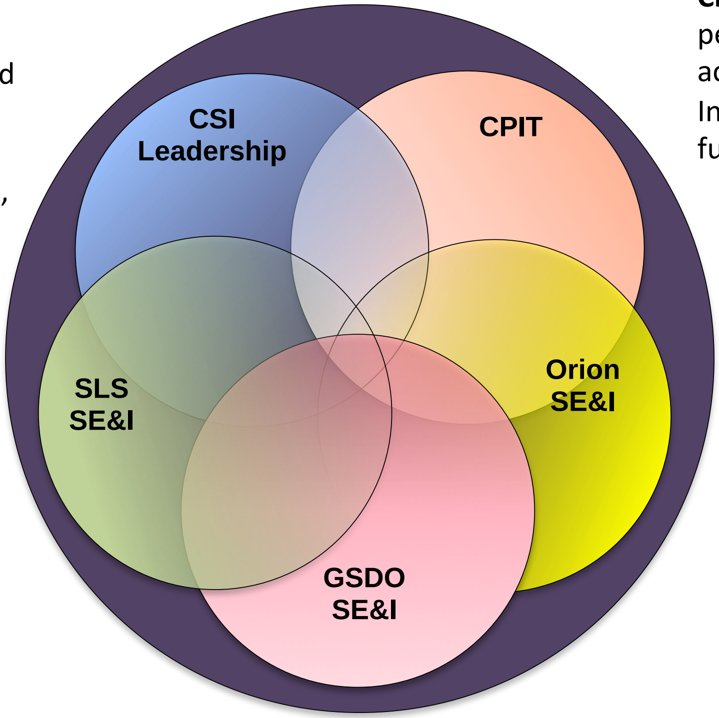
Legend:
- Traditional Level I
- Traditional Level II

Cross Program System Integration (CSI)
Mission and Scope

CSI Mission
CSI provides technical integration across the Exploration Systems Enterprise and assist the ESD DAA with effective, risk-informed decision-making to successfully achieve the EM-1 and EM-2 missions.

CSI Leadership
- Provides strategic objectives and guidance for technical integration and integrated risk mitigation across the Enterprise.
- Engages Programs, NASA Institutions, and Technical Authorities to perform effective integration across the Enterprise.

SLS SE&I leads technical integration and risk mitigation which are focused on the launch and propulsion systems



Cross-Program Integrat ion Team (CPIT) performs the backbone technical integration across the Enterprise, using product-oriented Integration Task Teams (ITTs) across five key functional areas:
- System Safety
- System Engineering
- Integrated Design & Analysis
- System Integration
- Mission Management.

Orion SE&I leads technical integration and risk mitigation which are focused on the crew vehicle, flight systems, and crew systems.

GSDO SE&I leads technical integration and risk mitigation which are focused on the vehicle assembly, launch readiness, and post-mission vehicle recovery and de-servicing.

Exploration Systems Development
Integrated Manifest

EFT-1

September 2014
Test Article – Orion MPCV
Commercial Launch Vehicle

BEO Uncrewed

December 2017
Uncrewed Orion MPCV
SLS - 70 mt

AA-2

December 2018
LAS Test Article - Orion MPCV

BEO Crewed

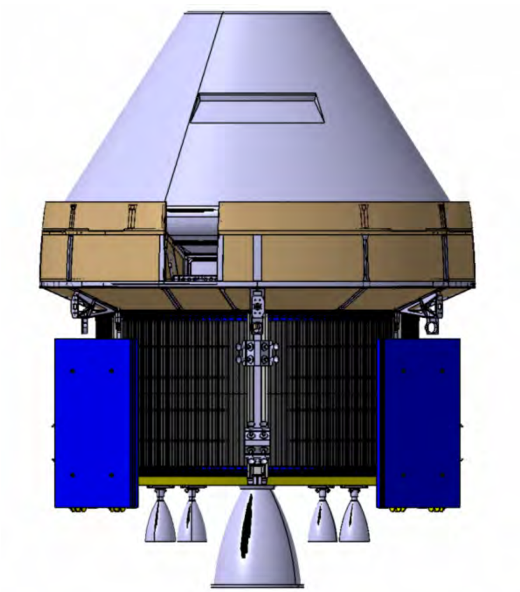
August 2021
Crewed Orion MPCV
SLS- 70 mt

BEO Crewed

August 2023
Crewed Orion MPCV
SLS- 105 mt
1st flt – competed boosters

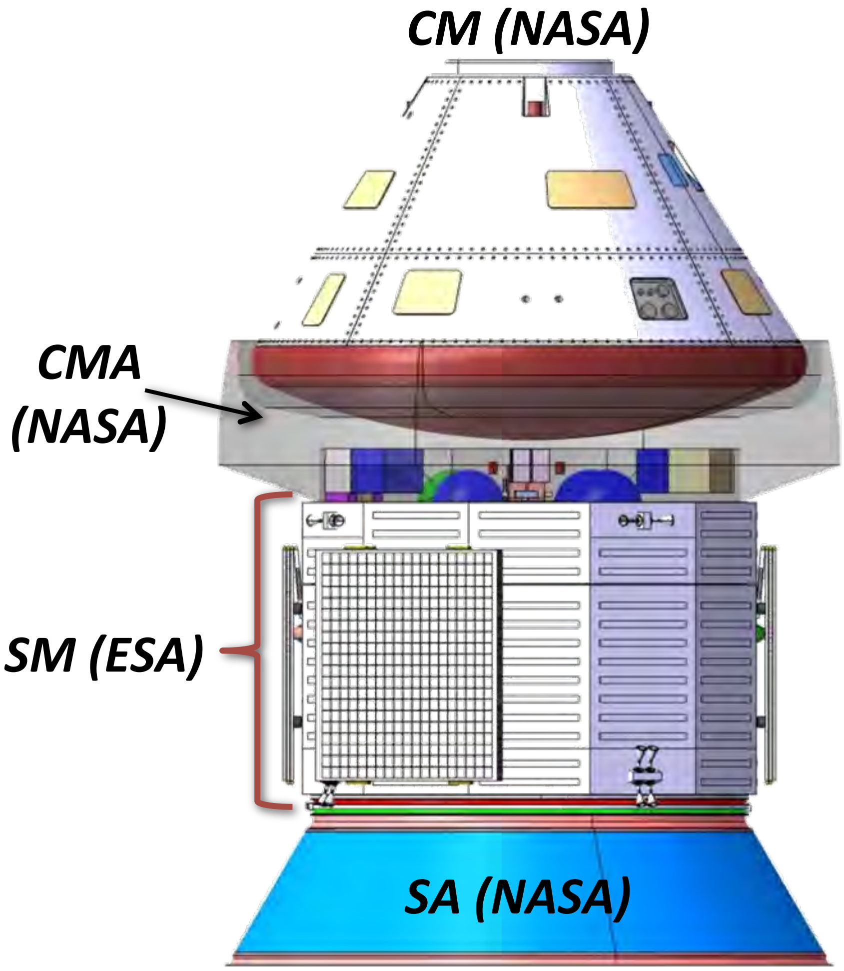
Orion Service Module/ESA Partnership

- NASA signed an agreement in December 2012 for the European Space Agency (ESA) to provide a service module for the Orion spacecraft's Exploration Mission-1 in 2017.
- The agreement primarily maps out a plan for ESA to fulfill its share of operational costs and additional supporting services for the International Space Station by providing the Orion service module and necessary elements of its design for NASA's Exploration Mission-1 in 2017.
- The service module will:
  - house power, thermal and propulsion systems
  - contain in-space propulsion capability for orbital transfer, attitude control and high-altitude ascent aborts
  - generate and store power and provide thermal control, water and air for the astronauts
  - remain connected to the crew module until just before the capsule returns to Earth



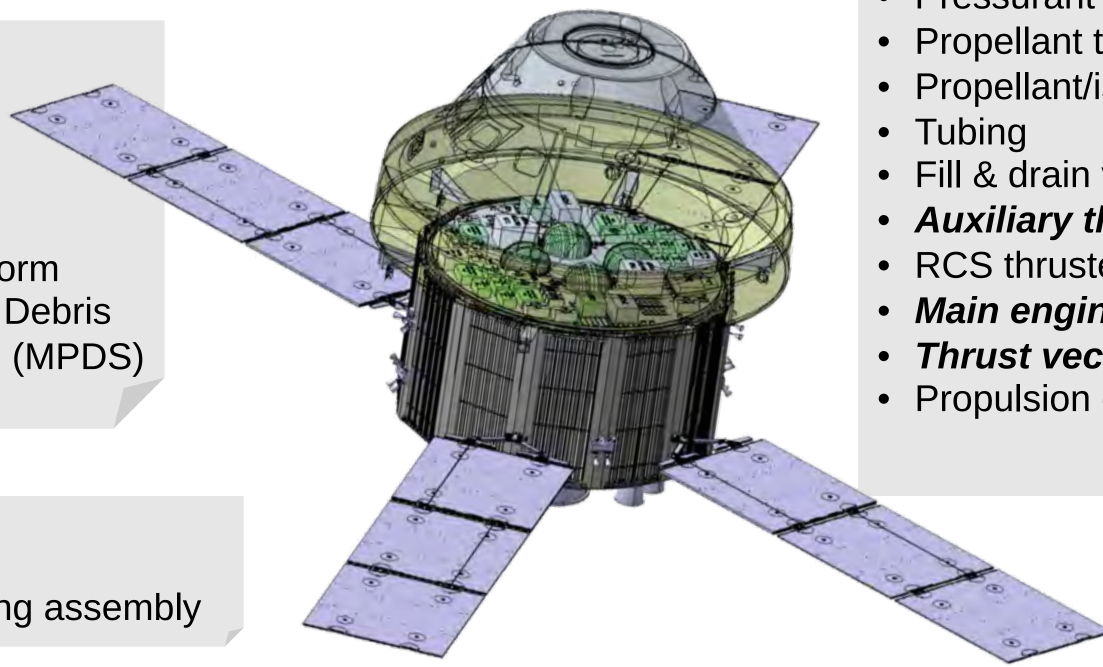
ESA Service Module Overview

- The Crew Module (CM) and SM will physically interface via an interface ring called the Crew Module Adapter (CMA).
- The SM and CMA is attached to the CM from launch until just prior to the entry interface.
- NASA will be responsible for the CM, CMA, Spacecraft Adapter & Separation Mechanism (SA), SAJ (jettisonable fairings), and the Launch Abort System.
- ESA will be responsible for the SM consisting of:
  - Load bearing primary structure
  - Gas and water consumable storage tanks
  - 2 coolant loop 24 m2 fluid radiators
  - 4 Solar Arrays
  - Propulsion subsystem based on:
    - Orbital Maneuvering System Engine (OMS-E), 8 Auxiliary thrusters, 24 Reaction Control Systems thrusters
    - 4 propellant tanks + 2 Helium pressurization tanks



MPCV roles

ESA SM Reference Configuration



Structure
- Upper cylinder
- Tank platform
- Main cylinder
- Lower platform
- Equipment platform
- Micrometeoroid Debris Protection System (MPDS)

Propulsion
- Pressure control assembly
- Pressurant tanks
- Propellant tanks
- Propellant/isolation system
- Tubing
- Fill & drain valves
- ***Auxiliary thrusters***
- RCS thrusters
- ***Main engine***
- ***Thrust vector control***
- Propulsion drive electronics

Solar Generator
- ***Solar cells***
- Solar array wing assembly

Solar array drive assembly
- Solar array drive mechanism
- Solar array drive electronics

Data Management
- Command & management unit
- ***Network Interface Cards***

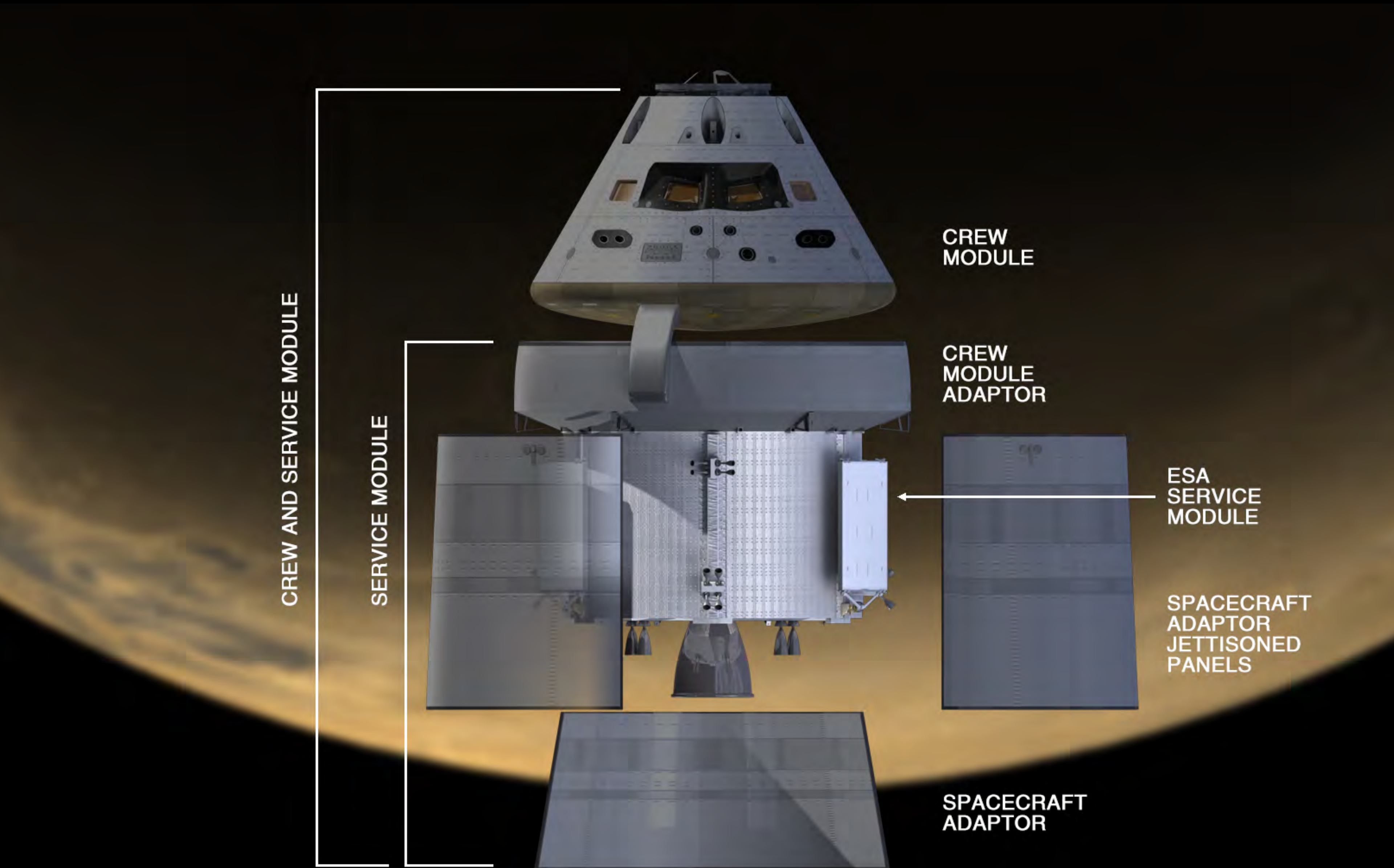
SM Harness

Thermal Control
- Passive thermal control
- Active thermal control
- Thermal control unit

Electrical Power
- Power control & distribution unit

Consumable Storage
- Water delivery system
- Gas delivery system

Note: Items in bold italic are the agreed to NASA contributions to the ESA SM


CREW MODULE
CREW MODULE ADAPTOR
ESA SERVICE MODULE
SPACECRAFT ADAPTOR JETTISONED PANELS
SPACECRAFT ADAPTOR
CREW AND SERVICE MODULE
SERVICE MODULE

National Aeronautics and Space Administration

NASA Advisory Council
Human Exploration and Operations Committee

D. Marshall Porterfield PhD.
Director, Space Life and Physical Sciences
Human Exploration & Operations Mission Directorate

Status Report:
SLPS NAC Subcommittee
CASIS

Space Life and Physical Sciences

- **NASA's Space Life and Physical Sciences Research and Aplications Division (SLPS) has been formulated to execute high quality, high value research and application activities in the areas of:**
  - Space Biology
  - Physical Sciences
  - Human Research
- **These programs conduct fundamental and applied research to advance basic knowledge and to support human exploration in the environment of space.**
- **Division serves as the agency liaison with the ISS National Laboratory management organization (CASIS)**

Executive Branch and Congressional Direction for a Nonprofit Management Entity

The President's FY-11 Budget request included specific direction to NASA to establish an independent research management organization for the U.S. share of ISS utilization capacity. This direction was consistent with findings and recommendations contained in the November 2009 GAO report on "ISS: Significant Challenges May Limit Onboard Research." Many studies have been conducted over the past decade by NASA and others regarding approaches to managing U.S. utilization of the ISS.

Section 504 of the NASA Authorization Act of 2010 extended ISS operations to 2020 and directed NASA to maximize the value of the investment of the U.S. government has made in the ISS and demonstrate the scientific and technological productivity of the ISS over the next decade. It directed NASA to enter into a Cooperative Agreement with an independent nonprofit organization with 501(c)(3) status to support research and development and to manage the activities of the ISS National Laboratory.

Selection of CASIS to manage the ISS National Laboratory

NASA released a Cooperative Agreement Notice (CAN) on February 14, 2011 for a non-profit entity "to develop the capability to implement research and development projects utilizing the ISS National Laboratory." The objectives stated in the CAN included:

Identify the unique capabilities of the ISS that provide breakthrough opportunities for non-NASA uses

Identify and prioritize the most promising research pathways

Increase the utilization of the ISS and facilitate matching of research pathways with funding sources

In April, 2011, four proposals were received in response to the CAN. CASIS was awarded a Cooperative Agreement on August 31, 2011. The Agreement has a planned value of $15M/year, with a period of performance ending in September, 2020.

CASIS Startup Activities

CASIS began with an interim Board of Directors comprised of the executive management of Space Florida, the sponsoring organization for the CASIS proposal

Frank DiBello (chair)
Howard Haug
Denise Swanson

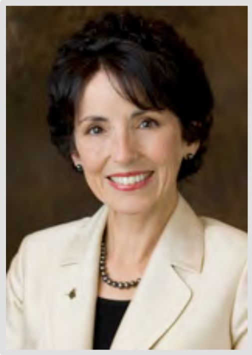
The original Executive Director was Dr. Jeanne Becker, who also served as an acting Chief Scientist. She resigned on March 5, 2012, citing differences with the Board. Jim Royston, originally Director of Strategy, Planning, and Operations, was named as the acting Executive Director

In 2012, the Chief Scientist, Timothy Yeatman, MD, working with an interim Science Advisory Board, reviewed published results from life sciences research on the ISS and identified initial CASIS research priorities in protein crystal growth and non-embryonic stem cell culture. Three proposals were selected for protein crystal growth research, through an open solicitation and peer review.

ISS National Lab – Current CASIS Board of Directors

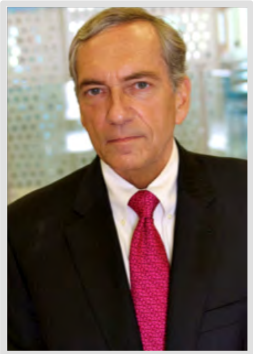
The current CASIS Board was appointed in November, 2012. Under Florida state law, it is self-perpetuating – the board is responsible for selecting its successors.

Dr. France Córdova
Chair of the CASIS Board;
President Emerita of Purdue University.
Previously, Chancellor of UC Riverside and NASA Chief Scientist.



Dr. Bess Dawson-Hughes, M.D.
Professor of Medicine at Tufts University;
Director of the Bone Metabolism Laboratory at Tufts.

Dr. Lewis Duncan
President of Rollins College. Previously, Dean of the Thayer School of Engineering at Dartmouth University; Head of Earth and Space Sciences at Los Alamos National Laboratory



Dr. Leroy M. Hood, MD
A pioneer in the systems approach to biology and medicine.
He has played a role in founding over 14 companies, including Amgen and Applied Biosystems.

Dr. Andrei Ruckenstein
Vice President and Associate Provost for Research at Boston University.

Dr. Gordana Vunjak-Novakovic
Mikati Foundation Professor of Biomedical Engineering and Medical Sciences at Columbia University;
director of the Laboratory for Stem Cells and Tissue Engineering at Columbia.

Dr. Howard Zucker,
Professor of Clinical Anesthesiology at Albert Einstein College of Medicine;
Adjunct Professor of Law at Georgetown University; senior advisor in the Division of Global Health and Human Rights at Massachusetts General Hospital.

ISS National Lab

Current Board top priority is hiring a new permanent Executive Director. The Board is also developing its strategy and mission concept for CASIS.

CASIS has completed two solicitations, selecting proposals in protein crystal growth and materials science.

The CASIS Science Advisory Board is currently examining the potential for Earth Observation and non-embryonic stem cell culture aboard the International Space Station.

Research Subcommittee of the HEO Committee

NASA Advisory Council Recommendation in March, 2012 to create a subcommittee that "…advises NASA on the research and educational needs that are required to support a plan for the long-range human exploration of space. The subcommittee should include a breadth of perspectives that encompass research and higher educational needs, not representation of specific disciplines."

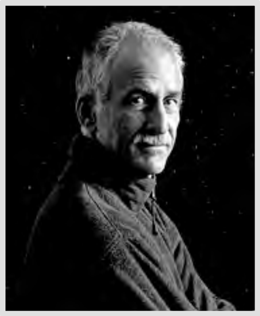
Space Life and Physical Sciences – HEOC Research Subcommittee

Dr. David Longnecker, M.D.
Chair of the subcommittee; member of the Human Exploration and Operations Committee; Director of the Association of American Medical Colleges; Robert D. Dripps Professor Emeritus of Anesthesiology and Critical Care at the University of Pennsylvania.

Dr. Robert A. Altenkirch
President of The University of Alabama in Huntsville. Previously, president of New Jersey Institute of Technology; vice president for research at Mississippi State University and dean of the College of Engineering and Architecture at Washington State University.

Dr. M. Katherine Banks
Dean of Engineering at Texas A&M University. Previously, head of the School of Civil Engineering at Purdue University where she also served as director of the EPA Hazardous Substance Research Center.

Dr. Jeffrey A. Hoffman *Professor of the Practice in the Department of Aeronautics and Astronautics at the Massachusetts Institute of Technology; director at MIT of the Massachusetts Space Grant Consortium. He served as the NASA Europe Representative, and flew on five Shuttle missions as a NASA astronaut.*



Dr. Terri L. Lomax
Vice Chancellor for Research, Innovation and Economic Development at North Carolina State University. Previously, Deputy Associate Administrator for Research in the Exploration Systems Mission Directorate, and Director of the NASA Fundamental Space Biology Division.

Dr. Stein Sture
Vice Chancellor for Research at the University of Colorado, Boulder; Huber and Helen Croft Endowed Professor in the Department of Civil, Environmental, and Architectural Engineering in the College of Engineering and Applied Science.

Dr. Kathryn C. Thornton
Professor at the University of Virginia in the School of Engineering and Applied Science in the Department of Mechanical and Aerospace Engineering. Previously, Assistant Dean and later Associate Dean for Graduate Programs. Selected as an astronaut candidate by NASA in May 1984, Thornton is a veteran of four space flights.

NAC:
International Space Station Program Status

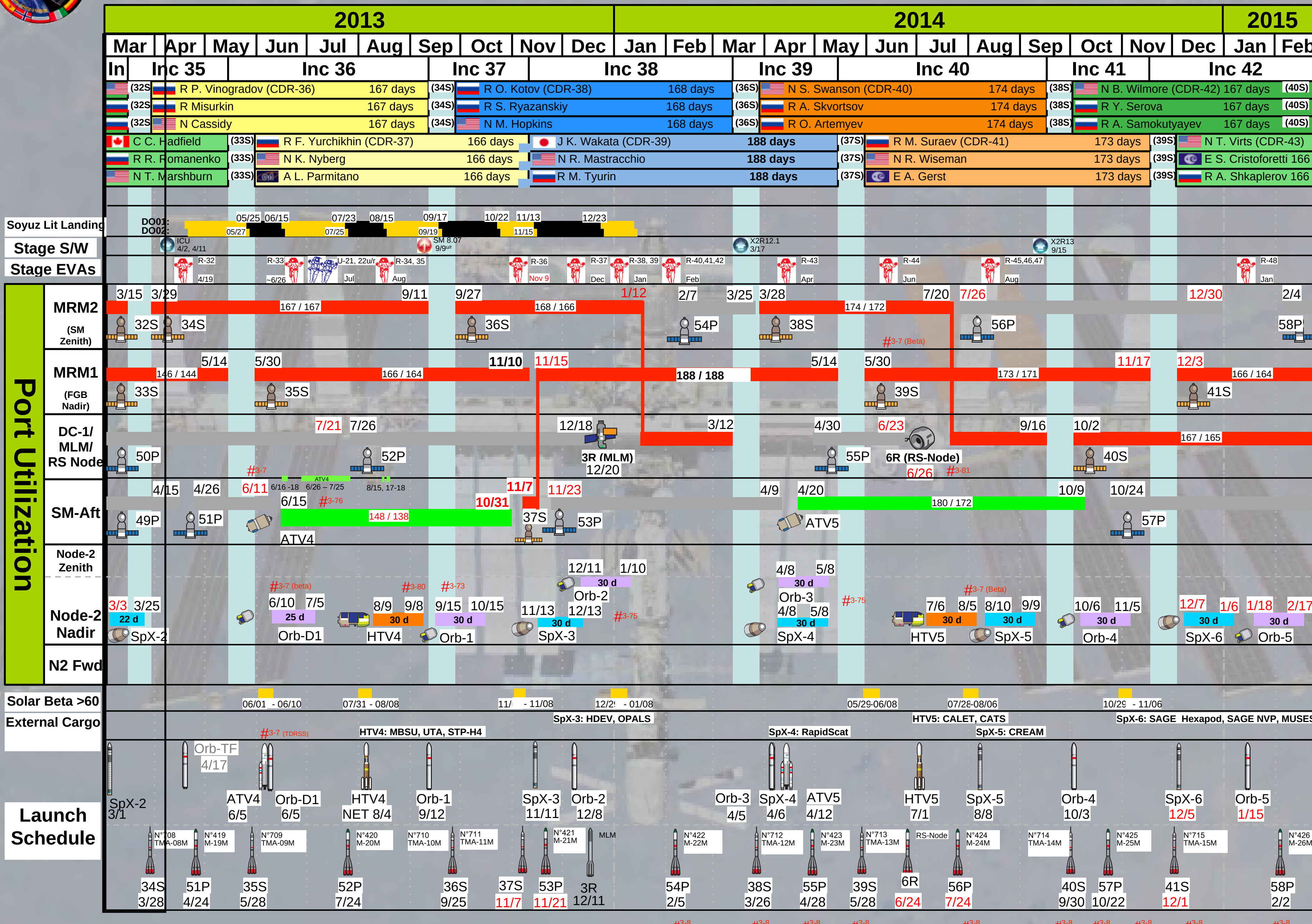
April 2013

Kirk Shireman
Deputy Manager, ISS Program

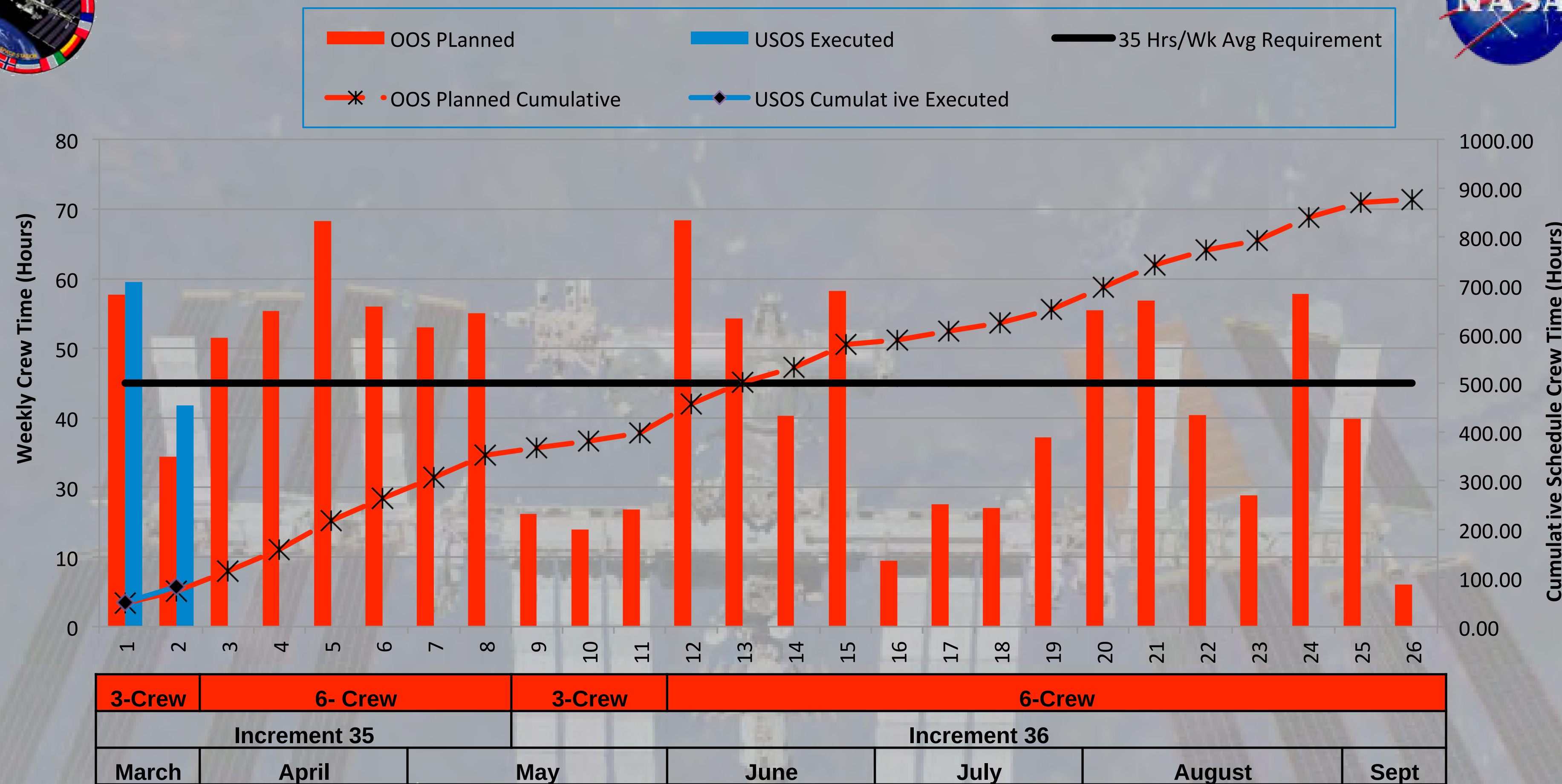
For current baseline refer to SSP 54100 Multi-Increment Planning Document (MIPD)

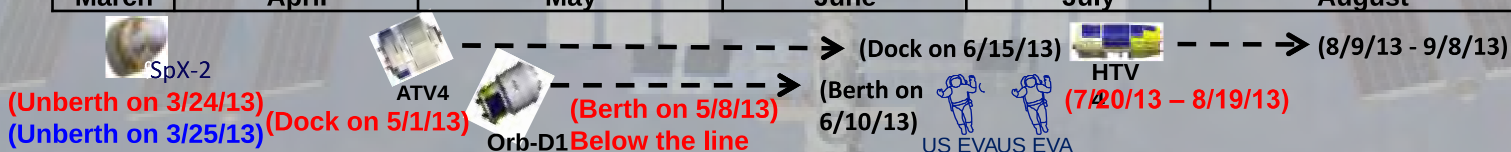
ISS Flight Plan

NASA: *OC4/John Coggeshall*
MAPI: *OP/Scott Paul*
Chart Updated: *April 3rd, 2013*
SSCN/CR: *13681A + Tact. Mods (In-Work)*



Increment 35_36 Utilization Crew Time





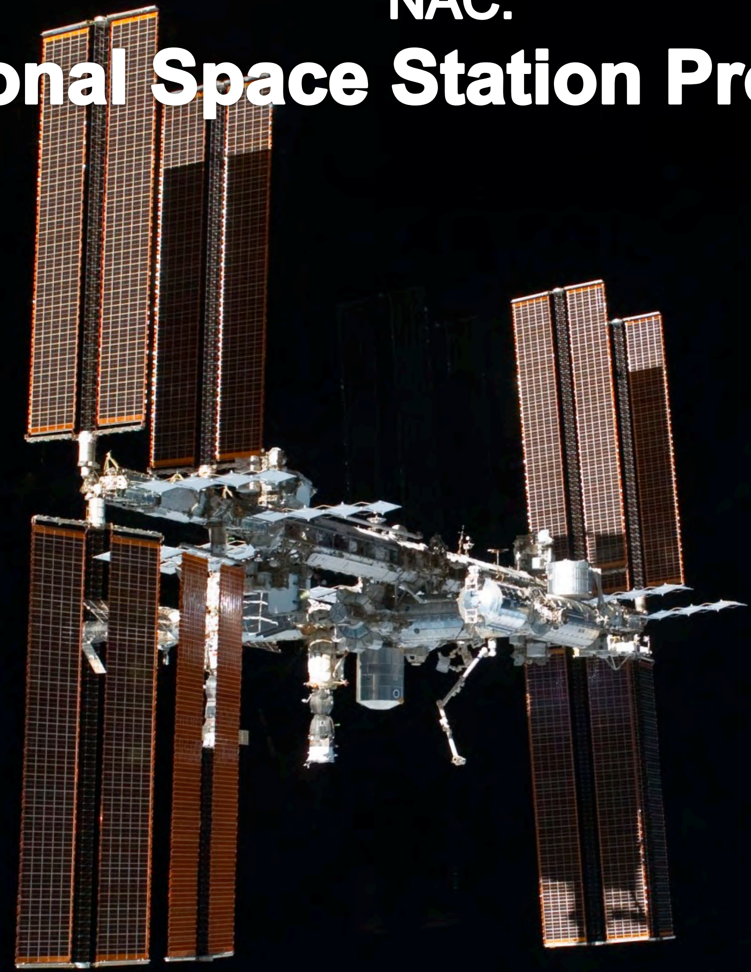
Date Color Key:
Completed
35-36 Final OOS
FPIP Plan

OC/OZ reconciliation completed as of Week 2.

Executed through Increment Wk (WLP week) 2 =	2.0	of	24.4	work weeks
			8.20	% through the Increment
USOS IDRD Allocation:	875	hours		
OOS USOS Planned Total:	876.5	hours		
USOS Actuals:	81.41	hours		
	9.3	% through IDRD Allocation		
	9.3	% through OOS Planned Total		
Total USOS Average Per Work Week:	40.71	hours/work week		
Voluntary Science Totals to Date:	0.00	hours (Not included in the above totals or graph)		

NAC:

International Space Station Program Status



April 2013

Kirk Shireman
Deputy Manager, ISS Program

ISS Research Statistics

as of Feb 28, 2013

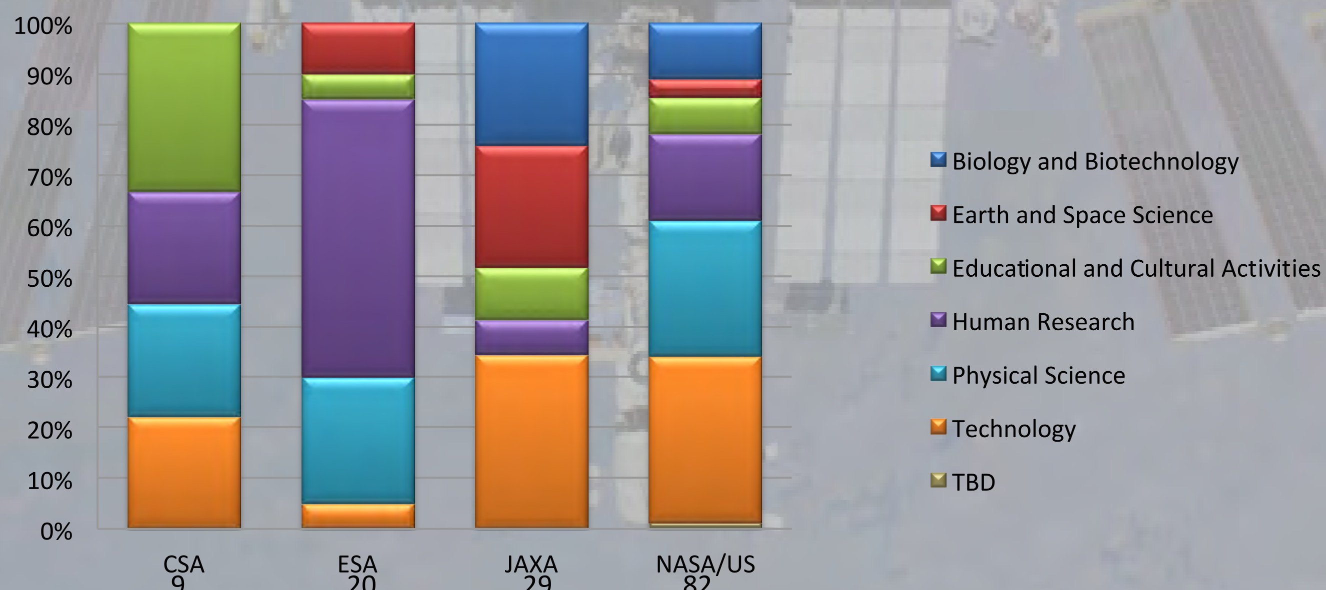
Number of USOS Investigations for 35/36 : 140

- 82 NASA/U.S.-led investigations
- 58 International-led investigations
- 30 new USOS investigations
  - 1 CSA
  - 4 ESA
  - 7 JAXA
  - 18 NASA/U.S.

Roscosmos data still in work

- Over 400 investigators represented
- Over 500 scientific results publications (Exp 0 - present)

ISS Research Disciplines by Partner Agency Increments 35/36



Number of Investigations Expedition 0-32: 1549*

*USOS + Roscosmos

Total ISS Consumables Status: Total On-orbit Capability
28-March-13 51P SORR, 51P (Dock 26-Apr-13)

	T1: Current Capability with no resupply		T2: Current Capability with 51P	
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% (1) (2)	September 28, 2013	November 13, 2013	October 18, 2013	December 10, 2013
KTO	June 11, 2014	July 26,2014	August 1, 2014	September 15, 2014
Filter Inserts	October 9, 2014	December 2, 2014 (2)	December 1, 2014	January 15, 2015
Toilet (ACY) Inserts (2)	April 15, 2014	June 6, 2014	May 11, 2014	July 1, 2014
EDV (UPA Operable) (2) (3) (4)	August 21, 2013	November 9, 2013	November 29, 2013	February 7, 2014
Consumable - based on system failure				
EDV (UPA Failed) (3)	July 16, 2013	August 30, 2013	September 10, 2013	October 31, 2013 **(2)**
Water, if no WPA (Ag & Iodinated) (2) (5)	August 24, 2013	October 16, 2013	October 12, 2013	December 4, 2013
O_2 if Elektron supporting 3 crew & no OGA (2) (6)	July 5, 2013	December 2, 2013	July 18, 2013	December 15, 2013
O_2 if neither Elektron or OGA (2) (6)	May 1, 2013	July 6, 2013	May 7, 2013	July 13, 2013
LiOH (7) (CDRAs and Vozdukh off)	~4 Days	~18 Days	~4 Days	~18 Days

(1) Includes food on Soyuz; after RS goes to zero, both sides share USOS food. **(2)** Reserve level to Zero is different than 45 days due to varying crew size. **(3)** Progress tanks included in assessment for urine dumping only. **(4)** A-RFTA operations as of 8/6/12. Assumes 74% recovery rate and no RS urine processing. **(5)** RS processes all condensate in event of WPA failure. **(6)** Includes metabolic O2 for 45 day/6-crew reserve and the O2 for greater of CHeCs or 4 contingency EVAs. **(7)** LiOH Canisters will be used for CO2 removal from the ISS if the CDRAs are inoperable. Total LiOH Reserve Level is 14 days for 6 crew. (Reserve Level for USOS LiOH is ~13.3 days for 3 crew (20 canisters), and for RS LiOH is 15 days for 3 crew (15 canisters).)

USOS System Enhancements

- **The ELC Wireless system provides a COTS solution for external high data rate 802.11n wireless capability to payloads on the Express Logistic Carrier (ELC)**
- **The system consists of two separate segments**
  - US Lab
    - COTS Wireless Access Points (WAP) placed inside the lab with external antennas to provide the core wireless capability
  - Payloads/Users
    - Characterization of a wireless solution for the payloads/users to integrate and provide piece parts to the developers
- **External Wireless users can connect using two methods:**
  - Use an IEEE 802.11n Network Interface Card in their device
    - The NIC can be integrated directly into the Payload. (e.g. a PCI card)
    - NASA can provide a USB NIC to a user that can be integrated into the Payload.
  - Provide an IEEE 802.3 wired Ethernet interface and connect to Wireless Media Converter
    - NASA is investigating providing a hardware (circuit card with wired Ethernet port and antenna out port) solution that will allow a Payload to use a standard wired Ethernet port and this hardware perform the wired to wireless conversion
    - This hardware will be “smart” and require some configuration by the Payload in order to access the network
    - Radiation testing on candidate hardware is being performed January 16 – 18

USOS System Enhancements

- In an effort to increase the utilization of Commercial off the Shelf (COTS) hardware with limited or no modifications to support on-orbit operations, the ISS Program worked with commercial industry to develop a power inverter which converts the DC power generated from the ISS solar arrays to AC power just as you would find in your home.
- The provision of AC power allows ISS systems and payload developers to simplify and reduce the schedule and cost for the development, integration and delivery hardware into the ISS.
- The ISS power inverter (pictured below) comes in two models: 120Vdc-to120Vac and 28Vdc-to-120Vac respectively to support the primary power input voltages provided throughout the ISS (USOS and Russian Segments) and payload power interfaces.
- The 120Vdc-to120Vac power inverter provides power AC power provides: four (4) standard three prong AC power outlets and is capable of providing a total of 750W @ 60hz.
- The 28Vdc-to120Vac power inverter provides power AC power provides: four (4) standard three prong AC power outlets and is capable of providing a total of 400W @ 60hz.

International Space Station
SpaceX-2

SpX-2

- **Cargo**
  - 577 kg of pressurized launch cargo included the following:
    - 95 kg of crew supplies and computer and EVA hardware
    - 347 kg of utilization hardware including 2 GLACIERs and 5 double cold bags
    - 135 kg of vehicle hardware including 2 Carbon Dioxide Removal Assembly (CDRA) desiccant absorbent beds
  - 221 kg of unpressurized external cargo (first SpaceX flight with external cargo to ISS) included the following:
    - Two (2) Heat Rejection Subsystem Grapple Fixtures (HRSGF) (Grapple Bars)
  - 1235 kg of pressurized return cargo plan included the following:
    - 197 kg of crew supplies and computer and EVA hardware
    - 576 kg of utilization hardware including 1 GLACIER and 5 double cold bags
    - 462 kg of vehicle hardware
- **Status**
  - Successfully launched on 3/1 and berthed to ISS on 3/3
  - Grapple bars were successfully extracted on 3/6
  - Dragon unberthing/re-entry occurred on 3/26 with early destow cargo arrival at Long Beach on 3/27 and nominal return cargo arrival at McGregor scheduled for 4/2
  - Post-flight briefing to NASA occurred on 4/16

Dragon 4 (SpX-2) berthed to ISS on 3/3

Grapple bars in Dragon trunk ready for extraction

Photo Credits: NASA

Orbital Status

- **7K Hot Fire Test successfully completed on 2/22**
  - Post-test flame trench inspection yielded positive results; no rework prior to Test Flight
  - On-pad inspections and cleaning of Engines 2 & 3 completed
  - Pad modifications on track for addition of a helium heat exchanger
    - Will improve the Liquid Nitrogen (LN2) subcooler's ability to chill down helium entering the vehicle to meet launch vehicle requirements
- **Test Flight status**
  - Payload simulator mated on 2/20
  - Launch planned for NET 4/20
- **Demo Launch status**
  - Pressurized Cargo Module (PCM) Initial Cargo Load occurred on 3/22
  - PCM-to-SM mate occurred on 4/1 – 4/2
  - Final Flight Software regression testing conducted on 3/19 and Joint Test 4 Software Stage Verification conducted on 4/2 – 4/5
  - Joint Multi-Segment Training (JMST) #10 (long rendezvous) simulation was successfully conducted on 3/21
  - NASA's Vehicle Assessment Review (VAR) is planned on 5/2
  - Cargo upmass allocation is 704 kg
    - Ascent manifest consists of crew provisions, food, laptops, and other non-critical hardware (no utilization)

Successful 7K Hot Fire Test

Test Flight Fairing and Payload Simulator

Photo Credits: OSC

International Space Station
ATV4

ATV4: *Albert Einstein*

- **Launch**
  - The launch date for ATV4 was moved out due to a connector inside of the pressurized module requiring a repair as well as a Digital Signal Processing Unit (DSPU) being removed and replaced
- **Cargo**
  - Nominal cargo load is complete
  - Late load is planned at L-3 weeks
  - Manifest (in kg): ~2200 prop for ISS use, 860 prop for transfer, 100 (air and O2), 570 water, and ~2700 packed dry cargo
- **Status**
  - ATV target on Service Module has contamination which has caused pitch/yaw noise on all ATVs. Noise has been worsening on each flight. ESA management has decided to have RSCE swap out target during 4/19 Russian EVA
  - ATV2 and ATV3 cabin fan failure investigations largely complete with no clear identification of root cause. Spare fan on board ISS will be installed if ATV4 fan should fail. Most ATV operations may continue without operational ATV cabin fan (covered by a Flight Rule)
  - Stage Operations Readiness Review is planned for 5/13

Pressurized module for *Albert Einstein* (ATV4) on production line

Photo Credits: ESA

International Space Station
HTV4

HTV4

- **Cargo –** (Manifest Requests (MRs) pending)
    - ~3144 kg currently manifested for ISS
        - 2257 kg of pressurized cargo, including crew supplies and computer resources (582 kg), water bags and flight support equipment (571 kg), vehicle hardware (676 kg), utilization hardware (357 kg), EVA supplies (71 kg), and
        - 887 kg of unpressurized cargo
    - External cargo includes:
        - Space Test Program – Houston 4 (STP-H4)
        - Main Bus Switching Unit (MBSU)
        - Utility Transfer Assembly (UTA)
        - For disposal: STP-H3
- **Status**
    - Launch date moved due to a potential Earth Sensor Assembly(ESA) issue found during acceptance test on an HTV7 unit.
    - STP-H4, UTA, and MBSU have been integrated onto the Exposed Pallet. For MBSU/UTA IAs, this was the first time JAXA performed all physical integration at TNSC without NASA touch labor (observers only); STP-H4 personnel performed offline testing and checkouts prior to turnover to JAXA;
    - Processing of water and filling of the Contingency Water Containers – Iodine (CWCI) began in early March; leak subsequently discovered on one bag and replacement bags have been shipped. NASA is flying 24 CWCIs

HTV launch from Tanegashima Space Center

HTV on approach to ISS

Photo Credits: JAXA/NASA

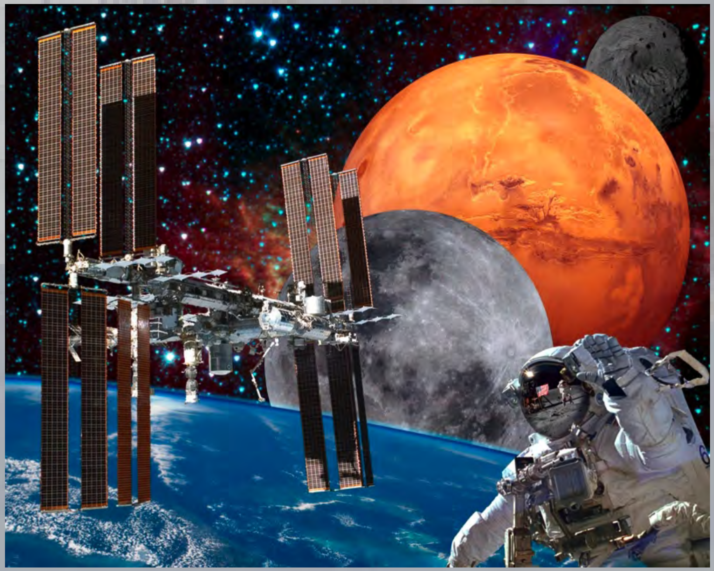
ISS Program Focus

Tactical

- Maintain/increase crew time & resources for utilization
- Continue preparations for 1 year Increment
- FY13 budget posture
- Execute SpaceX-3 mission & complete Orbital test and demonstration missions
- ATV 4 launch
- HTV 4 launch
- Better utilize on-orbit stowage to improve crew time efficiency
- Commercial Crew Integration

Strategic

- Maximum utilization of ISS as a National Lab
- Technology development and demonstration
- Test bed for Exploration and extension of ISS capabilities for use in deep space
- Crew transportation plan
- Technical analysis & planning of ISS life exten**sion**
- Budget formulation to address challenges over the budget horizon



Recommendation

Short Title of Recommendation: Elevate Priority of the Commercial Crew Development

Recommendation: NASA elevate priority of the Commercial Crew development and vigorously protect its funding, and reduce the number of funded providers. These NASA actions are needed to avoid undesired growth in Commercial Crew development time and risky increased reliance on a single provider, Soyuz.

Major Reasons for the Recommendation: Rapid establishment of US domestic crew transportation to the International Space Station 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 the past two years, typically of 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. The resulting outcome will be increased reliance on a single provider, Russian Soyuz, for transportation of US crew to ISS.

Consequences of No Action on the Recommendation: Increased risk to ISS due to dependency on single source provider for crew transport to and from station.

Recommendation

Short Title of Recommendation: Advocate a justification and strategy for NASA's Asteroid Retrieval Mission.

Recommendation: NASA should expand and actively advocate the strategy for NASA's asteroid mission to highlight multiple benefits to be gained. NASA should herald mission spin-offs that benefit humankind as well as achieve NASA goals, while furthering science and technology.

- Benefits U.S. advanced science and technology by developing operational capabilities like propulsion, life sciences, human performance.
- Benefits NASA as a stepping stone to NASA's ultimate goal of a manned mission to Mars. Involves operations that apply to future missions, including ground and space operations, on-orbit rendezvous and capture, asteroid sampling, storage and analysis, and advanced propulsion.
- Benefits the United States by forging new industrial capabilities and partnerships.
- Benefits humankind by advancing a defense strategy for Earth-bound asteroids.

Major Reasons for the Recommendation: Current budget constraints result in federal agencies having to advocate, justify and fight for annual budgets. It is in NASA's best interests to communicate and advocate the benefits of the current Asteroid Retrieval Mission strategy to educate the public and Congress.

Asteroid impact is in the public's mind after the Russian event. NASA can take action to identify asteroids that might impact the Earth. A NASA capture capability could lead to technology to assist in planet protection from asteroids, leading to an asteroid defense strategy.

Consequences of No Action on the Recommendation: The NASA Asteroid Retrieval Mission in the absence of public knowledge and advocacy might miss external interest and lead to loss of public and congressional support. The window of opportunity for public interest after the Russian event will be short.