HSF Transition from ISS to cis-lunar space and ISS Status

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HEOMD NAC
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Agenda

- HSF transition from ISS to cis-lunar space
  - Goals, objectives and research perspective

- ISS Overview Status

- Utilization Status

- Visiting Vehicle Status
Transitioning HSF from ISS to Cis-Lunar Space
(Earth Reliant to the Proving Ground)

Goal at the end of the 2020s: Mars ready - One year crewed mission(s) in cis-lunar space

Long Duration Human Health & Habitation Research and Demonstrations
* Currently building a plan to demonstration on ISS the Mars habitation systems.

Short Duration Habitation & Transportation system validation

Long duration human health & habitation Validation for Mars transit

Knowledge & Capabilities

Learning how to be Earth Independent

- SLS/Orion performance validation
- Crew health and performance research and validation
- Habitation systems performance validation including EVA
- Radiation shielding characterization and validation
- Guidance and navigation in deep space
- Prox ops and docking in deep space
- Breaking the logistics chain
- Reduced reliance on the ground control
- Validating other spacecraft system validation (power, propulsion, communications, etc.)
# Habitation Systems Objectives

<table>
<thead>
<tr>
<th>System</th>
<th>Includes</th>
<th>Today</th>
<th>Cis-Lunar Goal</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Life Support</strong></td>
<td>Air revitalization, water recovery, waste collection and processing</td>
<td>42% recovery of O2 from CO2; 90% recovery of H2O; &lt;6 mo MTBF for some components</td>
<td>&gt;75% recovery of O2 from CO2; &gt;98% recovery of H2O; &gt;2 yr MTBF</td>
</tr>
<tr>
<td><strong>Environmental Monitoring</strong></td>
<td>atmosphere, water, microbial, particulate, and acoustic monitors</td>
<td>Limited, crew-intensive on-board capability; rely on sample return to Earth</td>
<td>On-board analysis capability with no sample return; identify and quantify species and organisms in air &amp; water</td>
</tr>
<tr>
<td><strong>Crew Health</strong></td>
<td>exercise equipment, medical treatment and diagnostic equipment, long-duration food storage</td>
<td>Large, cumbersome exercise equipment, limited on-orbit medical capability, food system based on frequent resupply</td>
<td>Small, effective exercise equipment, on-board medical capabilities, long-duration food system</td>
</tr>
<tr>
<td><strong>EVA</strong></td>
<td>Exploration suit</td>
<td>ISS EMU’s based on Shuttle heritage technology; not extensible to surface ops</td>
<td>Next generation spacesuit with greater mobility, reliability, enhanced life support, operational flexibility</td>
</tr>
<tr>
<td><strong>Fire</strong></td>
<td>Non-toxic portable fire extinguisher, emergency mask, combustion products monitor, fire cleanup device</td>
<td>Large CO2 suppressant tanks, 2-cartridge mask, obsolete fire products. No fire cleanup other than depress/repress</td>
<td>Unified fire safety approach that works across small and large architecture elements</td>
</tr>
<tr>
<td><strong>Radiation Protection</strong></td>
<td>Low atomic number materials including polyethylene, water, or any hydrogen-containing materials</td>
<td>Node 2 CQ’s augmented with polyethylene to reduce the impacts of trapped proton irradiation for ISS crew members</td>
<td>Solar particle event storm shelter based on optimized position of on-board materials and CQ’s with minimized upmass to eliminate major impact of solar particle event on total mission dose</td>
</tr>
</tbody>
</table>
Human Health and Performance Research
Transition from ISS to cis-lunar space

ISS Goals for Space Exploration

- Fully utilize ISS to understand human health risks and verify capabilities to mitigate these risks
- Develop and test exploration biomedical technologies and tools
- Extend mission durations to one-year to validate six-month research and countermeasures
- Understand visual impairment/intracranial pressure risk and assess countermeasures
- Develop space radiation human protection & monitoring systems
- Investigate long-term spaceflight stressors and changes to the immune system and microbiome
- Develop and test exploration food system
- Develop, test, and verify crew habitation systems and models

Cis-Lunar Space Goals

- Validate advanced countermeasures against deconditioning for transit vehicle (bone, muscle, cardiovascular capacity)
- Validate crew performance, psychological well-being, and intervention toolkit under long-duration flight operations
- Validate integrated exploration medical capabilities (autonomous medical capability for diagnosis and treatment)
- Validate human health, performance, and environmental health in a closed spacecraft environment (immune system, microbiome)
- Validate exploration food system
- Validate space radiation human protection and monitoring systems for exploration
- Validate crew habitation systems for exploration
- Validate robustness and reliability of crew exploration exercise systems
What could we accomplish along the way with humans in cis-lunar space

- **Research objectives - origins of the universe**
  - Asteroid Redirect Mission – *currently in formulation*
  - Human/robotic Lunar exploration of far side and Shackleton crater
    - Some of the techniques and technologies/systems have been demonstrated on ISS already – more could be done
  - Human assisted Lunar sample return
  - Point of departure for human missions to asteroids in their native orbit

- **Research objectives - search for life**
  - Human/robotic construction of large diameter telescope at L2 (18-20m, ATLAS, Space Telescope Science Institute)
    - Some of the techniques and technologies/systems have been demonstrated on ISS already – more could be done

- **Earth/sun/moon environs monitoring**

- **Basic research for exploration**
  - Deep space radiation exposure characterization of materials and biological samples – extension of current ISS research
  - Long term zero boil off technology

- **Other basic research**
  - Astrophysics – *follow on to CREAM and AMS-02?*
### INCREMENTS 45 & 46

#### Increment 45
- **Stage 45-6 (94 Days)**
  - **Utilization**
    - STP-H4, SMILES, MCE disposal (HTV5)
    - JEM A/L: J-SSOD #4, NRCSD #6, ExHAM #2
    - RRM Phase 2 Science
  - **EVA, Robotics, Systems, Software**
    - SM 8.08
    - X2R14 Software Transition
    - USOS ISS Upgrades EVA
    - USOS P6 RTOC EVA
    - USOS Reconfig: N1 Nadir prep for VV
    - NORS AIK installation
    - Galley Rack transfer (HTV5)
    - RPCM P12B_A replacement
  - **Complete 1 year crew science**
  - Rodent Research-3 (SpX-8)
  - BEAM berth (SpX-8)
  - Airway Monitoring
  - JEM A/L: SIMPL, NRCSD #7

#### Increment 46
- **Stage 46-6 (72 Days)**
  - **Utilization**
    - USOS ISS Upgrades
    - USOS (P6 RTOC)
    - **Stage 46-9 (8 Days)**
  - **EVA, Robotics, Systems, Software**
    - USOS IDA3 Cables EVA (Below the line)
    - RS EVA #42
    - USOS Reconfig: Install C2V2 rack, comm units, perform C2V2 checkout
    - USOS Reconfig: Install IMVs, VAPs

#### Crews
- **Inc 45**:
  - O. Kononenko (FE-4): Inc 45: 102 days, Inc 46: 72 days
  - S. Volkov (FE-1): Inc 45: 102 days, Inc 46: 72 days
  - Y. Malenchenko (FE-4): Inc 45: 102 days, Inc 46: 72 days
- **Inc 46**:
  - K. Lindgren (FE-6): Inc 45: 102 days
  - Y. Malenchenko (FE-4): Inc 45: 102 days
  - M. Kornienko (FE-2): Inc 45: 102 days, Inc 46: 72 days

#### U/R Dates
- **43S**: 12/6
- **44S**: 12/22
- **45S**: 1/5
- **46S**: 2/4

#### Key Events
- **SpX-8**: 12/9
- **OA-4**: 12/22

#### Updates
- Updated 10/29/2015: All Dates GMT

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**https://iss-www.jsc.nasa.gov/nwo/mio/riit/inc_45/web/**

Pre-decisional, Internal Use Only
Increment 45 Overview: Crew

42S Dock 3/28/15
44S Dock 9/2/15
44S Undock 3/3/16

Scott Kelly
CDR (U) – 42S↑ / 44S↓

Mikhail Kornienko
FE (R) – 42S↑ / 44S↓

Sergei Volkov
FE (R) – 44S

44S Undock 3/3/16

Oleg Kononenko
FE (R) – 43S

Kjell Lindgren
FE (U) – 43S

Kimiya Yui
FE (J) – 43S

43S Dock 7/23/15
43S Undock 12/22/15
Increment 45 Overview: Major Stage Objectives
(Based on Final OOS Assumptions)

- Increment 45:
  - Stage 45-6: 42S Undock to 45S Dock: 94 days
  - Stage 45-9: 45S Dock to 43S Undock: 8 days
  - EVAs
    - ISS Upgrades – October 28
    - P6 Return to Original Config – Nov 6
  - Cargo vehicles:
    - 61P Dock to SM Aft (10/1)
    - HTV-5 Unberth/Release (9/28)
    - SpX-8 (1/3 – U/R)
    - 60P Undock from DC1 (11/19)
    - 62P Dock to DC1 (11/21 U/R)
    - OA-4 Capture/Berth (12/6)
  - Science/Utilization:
    - Fluid Shifts FD150
    - RRM Phase II
  - Software
    - SM 8.08 (10/8) – successfully completed
    - X2R14 (10/16-10/21) – successfully completed
  - Stowage Ops
    - HTV left completely full
  - Maintenance/Outfitting
    - N1 Nadir Prep for USOS Cargo VV Berthing
    - NORS AIK Install in airlock
ISS Reconfiguration Status

- Goal: Establish 2 docking ports and 2 berthing ports on ISS USOS to support crew and cargo vehicles
- Initial configuration: Berthing ports at Node 2 nadir, Node 2 zenith
  - PMA 2 on Node 2 forward, PMA 3 on Node 3 port
- Final configuration: Berthing ports at Node 2 nadir, Node 1 nadir
  - Docking ports at Node 2 forward (PMA 2 / IDA 2), Node 2 Zenith (PMA 3 / IDA 3)
- Move PMM from Node 1 nadir to Node 3 forward (completed)
- Configure Node 1 nadir to support berthing (completed)
- Move PMA-3 from Node 3 port to Node 2 zenith (required EVA deferred with loss of IDA 1)
- Install IDA 1 on PMA 2 (Node 2 forward) – SpaceX-7 (IDA 1 lost)
- Install IDA 2 on PMA 2 (Node 2 forward) – SpaceX-9
- Install IDA 3 on PMA 3 (Node 2 zenith) – SpaceX-14 (new IDA 3)
- Install C2V2 antenna system on truss elements P3 and S3 (completed)
- Configure Node 3 aft to support BEAM (completed)
- Move ARED configuration in Node 3 (completed)

ISS ready to receive IDA 2, EVA Oct 28 to route cables in support of PMA-3 relocate Node 1 nadir and Node 2 nadir ready to receive CRS vehicles
# Increment 44/45 Overview: EVAs

<table>
<thead>
<tr>
<th>Time Critical Nature</th>
<th>ISS Upgrades &amp; PMA3 Cable Install</th>
<th>EV1</th>
<th>EV2</th>
</tr>
</thead>
<tbody>
<tr>
<td>No Time Critical Nature</td>
<td>ISS Upgrades &amp; PMA3 Cable Install</td>
<td>Egress / Setup</td>
<td>AMS Cover Install &amp; AMS TTCS Pump MLI (1:30)</td>
</tr>
<tr>
<td>Egress / Setup</td>
<td>AMS Cover Install &amp; AMS TTCS Pump MLI (1:30)</td>
<td>PMA3 / IDA3 Cables Route</td>
<td>PMA3 Power Cable Route</td>
</tr>
<tr>
<td></td>
<td>MBSU MLI &amp; Skirt Tie Down (0:45)</td>
<td>LEE B Lube Lube (02:45)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>LEE B Lube Lube (02:45)</td>
<td>PORT CETA Cart (0:30)</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>No Time Critical Nature</td>
<td>No Time Critical Nature</td>
<td>Egress / Setup (0:30)</td>
<td>Egress / Setup (0:30)</td>
</tr>
<tr>
<td>EVA P6 RIOC</td>
<td>EVA P6 RIOC</td>
<td>Egress / Setup (0:30)</td>
<td>P3/P4 NH3 Jumper Install (0:45)</td>
</tr>
<tr>
<td>Egress / Setup (0:30)</td>
<td>Vent Tool Setup (0:45)</td>
<td>PVR FQDC OPEN</td>
<td>PS/P6 Mate/Open (0:45)</td>
</tr>
<tr>
<td>Egress / Setup (0:30)</td>
<td>EGR VENT STOW (0:40)</td>
<td>STBD CETA Cart Reconfig</td>
<td>AJIS STRUT #4 (0:20)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>No Road to Items (Thomason, Wray)</td>
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<td>Egress / Setup (0:30)</td>
<td>P3/P4 NH3 Jumper Install (0:45)</td>
</tr>
<tr>
<td>Egress / Setup (0:30)</td>
<td>P3/P4 NH3 Jumper Install (0:45)</td>
<td>PVR FQDC OPEN</td>
<td>ATA Vent Panel (0:30)</td>
</tr>
<tr>
<td>Egress / Setup (0:30)</td>
<td>STBD CETA Cart Reconfig</td>
<td>ATA Vent Panel (0:30)</td>
<td>P3/P4 Jumper Stow (0:30)</td>
</tr>
<tr>
<td>Egress / Setup (0:30)</td>
<td>STBD CETA Cart Reconfig</td>
<td>ATA Vent Panel (0:30)</td>
<td>P3/P4 Jumper Stow (0:30)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>VENT TOOL CLEAN UP</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>TTCR Stow (1:30)</td>
</tr>
</tbody>
</table>

**Notes:**
- **EVA P6 RIOC:** Vent Tool Setup (0:45), PVR FQDC OPEN, PS/P6 Mate/Open (0:45), TTCR Retract (0:20), AJIS Jumper Retract (0:20), P1/P5 Vent (0:15), AJIS STRUT #2 (0:20), P3/P4 Jumper Stow (0:30), VENT TOOL CLEAN UP, TTCR Stow (1:30), ATA Vent Panel Reconfig (0:30), Clean up / Ingress (0:40)
- **No Road to Items (Thomason, Wray):** P3/P4 NH3 Jumper Install (0:45), PVR FQDC OPEN, ATA Vent Panel (0:30), STBD CETA Cart Reconfig, P3/P4 Jumper Stow (0:30), VENT TOOL CLEAN UP, TTCR Stow (1:30), ATA Vent Panel Reconfig (0:30), Clean up / Ingress (0:40)

**Legend:**
- Needed for IDA2
- Needed for IDA3
- Needed for IDA4
- Needed for IDA5
- IDA MNRs
- LEE Lube
- AMS MLI
- P6 Reconfig / TTCR Stow
- Ingress / LEE Lube
- ISS Upgrades
- STBD CETA Cart Reconfig
- AJIS STRUT #4 (0:20)
- STBD CETA Cart Reconfig
- P3/P4 Jumper Stow (0:30)
- VENT TOOL CLEAN UP
- TTCR Stow (1:30)
- ATA Vent Panel Reconfig (0:30)
- Clean up / Ingress (0:40)
Inc 45 - 46 Utilization Crew Time

Color Key:
- Completed
- Final OOS
- FPIP Plan

OA-4
- 4

SpX
- 8

Executed through Increment Wk (WLP Week) 7 = 5.6 of 23.6 work weeks (23.73% through the Increment)

USOS IDRD Allocation: 826.0 hours (35 hrs/wk)
OOS USOS Planned Total: 832.91 hours
USOS Actuals: 197.42 hours
23.90% through IDRD Allocation
23.70% through OOS Planned Total

Total USOS Average Per Work Week: 35.25 hours/work week
Voluntary Science Totals to Date: 0.00 hours (Not included in the above totals or graph)
RSA/NASA Joint Utilization to Date: 4.50 Hours (not included in the above totals or graph)
ISS Research Statistics

Number of Investigations for ISS Increments 45 & 46: 261

- 97 NASA/U.S.-led investigations
- 164 International-led investigations
- 49 New investigations
  - 3 CSA
  - 2 ESA
  - 7 JAXA
  - 35 NASA/U.S.
  - 2 Roscosmos (prelim)

Expeditions 45/46
Research and Technology Investigations

- Over 800 Investigators represented
- Over 1200 scientific results publications (Exp 0 – present)

Estimated Number of Investigations
Expedition 0-46: 2053*

[Bar Chart showing the percentage of investigations in different categories for each expedition]
In increments 45 & 46, the research complement snapshot includes:

### Biology & Biotechnology
- **Animal Biology**: Rodent Research-3 (SpX-8), Micro-10, Embryo Rad (SpX-8), Mouse Epigenetics (HTV5, SpX-9), Space Pup (SpX-10)
- **Cellular Biology**: Cell Science-01 (SpX-9), Heart Cells (SpX-9), OsteoOmys (SpX-9), NanoRacks SyNRE (SpX-9), Stem Cells (SpX-9), SPHEROID (SpX-9)
- **Macromolecular Crystal Growth**: CASIS PCG 4 (SpX-9), CASIS PCG 5 (SpX-10), NanoRacks PCG (SpX-9, SpX-10), PCG Crystal Hotel Validation (JAXA PCG)
- **JAXA PCG Demo**: CASIS PCG 4 (SpX-9), Microbiology (RJR) Microbial Sampling (SpX-9), Microbial Observatory-1 (SpX-9, SpX-10), Microbial Observatory-2 (SpX-9, SpX-10)
- **BRC-NP**: SpX-9 (1)
- **Microbe-IV**: SpX-8 (1), SpX-9 (1)
- **Myco** (for 1YM): SpX-9, SpX-10
- **Plant Biology**: APEX-04 (SpX-9, SpX-10), Auxin Transport (SpX-9, SpX-10), Plant Rotation (SpX-9, SpX-10)

### Earth & Space Science
- **Astrobiology & Astrophysics**: AMS-02 (Ext), Metor (SpX-10), CALET (Ext) (HTV5), MAXI (Ext), MOG (Ext) (HTV5)
- **Earth Remote Sensing**: CATS (Ext)
- **Heliophysics**: Solar-SOLACES, Solar-SOLSPEC
- **Near-Earth Space Environment**: SEDA-AP (Ext)

### Technology Development
- **Repair/Fabrication Technologies**: 3D Printing in Zero-G, Robonaut (RJR), RRM-P2 (Ext)
- **Small Satellites Technologies**: NanoRacks Microsat-SIMPL (Orb-4), NanoRacks-MicroSat (SpX-9, SpX-10)
- **Space Structures**: BEAM (Ext) (SpX-8)
- **Spacecraft & Orbital Environments**: ISS External Leak Detector (SpX-9), IPS-1 (SpX-10)
- **Materials Science**: NanoRacks-Gumstix (SpX-8), NanoRacks-MicroSat-04 (SpX-9)

### Human Research
- **Bone & Muscle Physiology**: Bisphosphonates Hip OCT (P), Intervertebral Disc Damage (P), Spinal Cord Injury (P)
- **Cardiovascular & Respiratory Systems**: Cardio Ox, IPVI (SpX-9)
- **Circadian Rhythms**: Human Behavior & Performance
- **Fluid Shifts**: Human Research

### Education & Outreach
- **Commercial Demonstrations**: JAXA-Commercial (HTV5)
- **Educational Demonstrations**: NanoRacks Module-48 (SpX-9), NanoRacks Module-9 (SpX-9)
- **Student-Developed Investigations**: Nanoracks-Cap (SpX-9)

### Physical Science
- **Combustion Science**: FLEX-2J (SpX-9)
- **Complex Fluids**: ACME (SpX-9), LMM Biophysics 1 (SpX-10), LMM Biophysics 3 (SpX-10)
- **Fluid Physics**: Solar-SOLSPEC (SpX-9), Solar-SOLACES (SpX-9)
- **Interactions-2**: Human Research
- **Sleep ISS-12**: Human Research

### TBD Category
- **CASIS Dev 11**: SpX-10
- **NanoRacks-SMiLE**: SpX-9
- **Payload Card Multilab-X**: SpX-9
- **Payload Card-X**: SpX-10

### Key
- **NASA National Lab (P) = Pre/Post BDC only
- **JAXA**: (RJR) = Russian Joint Research
- **ESA**: (L) = Launch only
- **CSA**: (R) = Return only
- **RJA**: (C) = Crossover
## Total ISS Consumables Status

<table>
<thead>
<tr>
<th>Consumable – based on current, ISS system status</th>
<th>Date to Reserve Level</th>
<th>Date to zero supplies</th>
<th>Date to Reserve Level</th>
<th>Date to zero supplies</th>
</tr>
</thead>
<tbody>
<tr>
<td>Food – 100%</td>
<td>February 09, 2016</td>
<td>April 02, 2016</td>
<td>May 28, 2016</td>
<td>July 15, 2016</td>
</tr>
<tr>
<td>Consumable - based on system failure</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Water, if no WPA (Ag &amp; Iodinated)</td>
<td>March 05, 2016</td>
<td>May 23, 2016</td>
<td>April 12, 2016</td>
<td>June 24, 2016</td>
</tr>
<tr>
<td>O₂ if Elektron supporting 3 crew &amp; no OGA</td>
<td>November 28, 2015</td>
<td>March 31, 2016</td>
<td>December 26, 2015</td>
<td>May 21, 2016</td>
</tr>
<tr>
<td>O₂ if neither Elektron or OGA</td>
<td>November 09, 2015</td>
<td>January 02, 2016</td>
<td>November 09, 2015</td>
<td>January 20, 2016</td>
</tr>
<tr>
<td>LiOH (CDRAs and Vozdukh off)</td>
<td>~0 Days</td>
<td>~14 Days</td>
<td>~0 Days</td>
<td>~14 Days</td>
</tr>
</tbody>
</table>
### USOS Consumables Status

<table>
<thead>
<tr>
<th>Consumable – based on current, ISS system status</th>
<th>U1: Current Capability</th>
<th>U2: Current Capability + 62P + OA-4</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Food – 100%</strong></td>
<td>Date to Reserve Level: February 23, 2016</td>
<td>Date to zero supplies: April 13, 2016</td>
</tr>
<tr>
<td><strong>KTO</strong></td>
<td>Date to Reserve Level: March 09, 2016</td>
<td>Date to zero supplies: April 26, 2016</td>
</tr>
<tr>
<td><strong>Filter Inserts</strong></td>
<td>Date to Reserve Level: &gt; December 31, 2016</td>
<td>Date to zero supplies: &gt; December 31, 2016</td>
</tr>
<tr>
<td><strong>Toilet (ACY) Inserts</strong></td>
<td>Date to Reserve Level: November 30, 2016</td>
<td>Date to zero supplies: &gt; December 31, 2016</td>
</tr>
<tr>
<td><strong>EDV + TUBSS (UPA Operable)</strong></td>
<td>Date to Reserve Level: December 13, 2015</td>
<td>Date to zero supplies: June 29, 2016</td>
</tr>
<tr>
<td><strong>Pre-Treat Tanks</strong></td>
<td>Date to Reserve Level: April 19, 2016</td>
<td>Date to zero supplies: June 14, 2016</td>
</tr>
<tr>
<td><strong>Water (Nominal Usage)</strong></td>
<td>Date to Reserve Level: November 08, 2016</td>
<td>Date to zero supplies: &gt; December 31, 2016</td>
</tr>
</tbody>
</table>

**Consumable - based on system failure**

| **EDV + TUBSS (UPA Failed)**                  | Date to Reserve Level: November 06, 2015 | Date to zero supplies: December 28, 2015 | Date to Reserve Level: November 06, 2015 | Date to zero supplies: January 18, 2016 |
| **Water, if no WPA (Ag & iodinated)**        | Date to Reserve Level: December 23, 2015 | Date to zero supplies: February 16, 2016 | Date to Reserve Level: December 23, 2015 | Date to zero supplies: February 16, 2016 |
| **O₂ if neither Elektron or OGA**            | Date to Reserve Level: November 11, 2015 | Date to zero supplies: January 15, 2016 | Date to Reserve Level: November 11, 2015 | Date to zero supplies: January 30, 2016 |
| **LiOH (CDRAs and Vozdukh off)**             | ~0 Days | ~13.3 Days | ~0 Days | ~13.3 Days |
## New Pertinent ISS Vehicle Issues

<table>
<thead>
<tr>
<th>Issue</th>
<th>Impact to Stage Ops</th>
<th>Rationale</th>
</tr>
</thead>
</table>
| SSRMS LEE B Safing Event | No                  | During HTV-5 release on GMT 271 (9/28/2015) the SSRMS LEE B experienced a safing event at the beginning of the Auto Release (start of derigidization). This resulted in a 1 orbit delay to HTV departure  
• Second attempt was successful.  
• Following HTV release, LEE-B completed a nominal grapple at MBS PDGF-1  
• High Speed Data of the safing event was gathered and is currently under review by CSA  
• Leading theory is that the LEE carriage experienced an over speed condition while trying to overcome initial tension  
• LEE-B will be lubed in upcoming US EVAs |
| MELFI-2                | No                  | On GMT 250 (9/7/15), MEFLI-2 (JEM) lost health and status with corresponding decrease in power draw and decrease in LTL out temp (in family with loss of Brayton motor)  
• Science samples were relocated to MELFI-1 (Lab)  
• Troubleshooting isolated failed ORU to the Rack Interface Unit (RIU)  
• 1 RIU was replaces. Nominal ops returned |
## Pertinent ISS Vehicle Issues

<table>
<thead>
<tr>
<th>TOC Status</th>
<th>Yes</th>
</tr>
</thead>
</table>

**The Total Organic Carbon (TOC) Status:**
- High TOC indicates that the WPA MF Beds are saturated
- The R&R of Ion Exchange Bed, Multifiltration Beds, and External Filter Assembly completed on Oct 2
- TOC readings now under detectable limits

**TOC Readings**
- July 15 – 2379 µg/L
- Aug 19 – 446 µg/L
- Sep 15 – 1943 µg/L
<table>
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<tr>
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</tr>
</thead>
</table>
| Node 3 CDRA Status | No | Node 3 CDRA blower air leak  
  • Post the N3 CDRA blower R&R (5/14/15) a leak was identified through troubleshooting at the V-Band Clamp (blower connection)  
  • The leak does impact to CO2 removal or Sabatier Operations  
  • N3 CDRA has no constraints to operate and is currently operational |
| Lab CDRA RPC Trip (LAD62B-A, RPC 12) | Yes | RPCM LAD62B-A, RPC 12, provides power to the Lab CDRA selector valves, continued true overcurrent trips affects power to valves  
  • RPCM replaced on GMT 205 (7/24/15)  
  • First RPC trip occurrence on new RPCM on GMT 235 (8/23/15)  
  • Second RPC trip event on GMT 273 (9/30/15)  
  • Good ABIT following trip and re-closure of RPC  
  • Troubleshooting cable to be developed and flown |
<table>
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<tr>
<th>Issue</th>
<th>Impact to Stage Ops</th>
<th>Rationale</th>
</tr>
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</table>
| SPDM Arm 2 joint position issue | Yes | On GMT 281 (10/8/15), during Special Purpose Dexterous Manipulator (SPDM) Arm 2 power up, the shoulder yaw measured 0.0 degrees when the last known position was +3.9 degrees.  
• Robotics Refueling Mission (RRM) operations were completed with Arm 1, Multi-Function Tool was stowed with joint unpowered and brakes applied.  
• A quick turnaround diagnostic patch was uplinked on Wed 10/14/15 to gather additional data on SPDM Arm 2. Preliminary investigation indicated issue with Joint Electronics Unit ability to read motor/joint resolver data.  
• SPDM Arm 2 ok for unloaded operations using Degraded Joint Ops.  
• Contact ops require analysis to verify no break slippage or joint loads violations.  
• Next MART scheduled for 11/5/2015.  
• Next potential SPDM Operation is the RPCM P12B_A R&R in early December. |
Mission Planning

- Stage Operations Readiness Review (SORR) completed on 7/27/15
- Successful launch on 8/19/15 and berthing on 8/24/15
- No major issues tracked during mission
- Successful departure on 9/28/15

Cargo

- Pressurized cargo included Node 1 galley rack, MSPR-2 (JAXA rack), 30 Contingency Water Container – Iodine (CWC-I), and additional soft-stow cargo
- MPSR 2 was removed from HTV and installed in JEM in Aug
- Late load shipments #1 and #2 arrives at TNSC on 7/27/15 and 7/30/15 (NASA 992)
- Outstanding coordination post SpaceX-7 failure to adjust and add capability (MPSR front rack)
- Late load #1 and #2 completed on 8/13/15
- Vehicle launched ~ 8000 lbs pressurized, 1450 lbs external
- Trash Removed: 4,350 pounds

External Cargo

- CALorimetric Electron Telescope (CALET) which will investigate the high energy universe was removed from the HTV5 Exposed Pallet (EP) and installed to ISS
- MCE, SMILES and STP-H4 experiments were installed on EP for disposal; EP was returned to HTV5 on 9/15/15
OA-4 (Orb-4) Mission Status

- **Mission Planning**
  - Orbital has contracted with United Launch Alliance (ULA) for an Atlas V launch of Cygnus
  - First use of Atlas V401 with the Cygnus spacecraft
  - Cargo Integration Review (CIR) was conducted on 7/29/15
  - Safety Review Panel (SRP) TIMs on 8/5/15 and 9/15/15
  - Chief Engineer Readiness Review was completed on 9/1/15
  - SRP Phase 3 is planned for completion on 10/13/15

- **Pressurized Cargo complement**
  - NASA delivered ISS cargo manifest in June
  - Planned Upmass: 7,730 pounds

- **Cygnus Status**
  - First enhanced Cygnus with a longer Pressurized Cargo Module (PCM) and lightweight solar arrays
  - Service Module (SM) will accommodate changes to the TriDAR/LIDAR configuration
  - PCM completed FE1410 testing at the Cape on 8/20/15
  - SM completed Final Integrated Systems Test (FIST) and scheduled to arrive at the Cape on 10/15/15
  - Initial cargo arrival is planned for 10/16/15

- **Atlas V 401**
  - Payload Adapter has been manufactured and is ready for integration
  - Booster ship to CCAFS is planned for 10/30/15
OA-6 (Orb-5) Mission Status

- **Mission Planning**
  - ULA/Orbital ATK customer kickoff meeting was held on 8/21/15
  - Ground Operations Readiness Review (GORR) is planned for mid Oct
  - Cargo Integration Review (CIR) is planned for Nov

- **Pressurized Cargo complement**
  - Final ISS cargo manifest planned for delivery in Oct to support CIR
  - Spacecraft Fire Experiment (Saffire) #1 payload will be integrated into Cygnus
  - Planned Upmass : 7,730 pounds

- **Cygnus Status**
  - Schedule rework is in progress to support an Service Module (SM) flight on an Atlas launch vehicle
  - SM has been in storage and will undergo Return to Flight (RTF) regression testing in Dec after TAS-E radio delivery
  - Pressurized Cargo Module (PCM) is planned for delivery to KSC in Jan 2016

- **Atlas V 401**
  - Payload Adapter planned for manufacturing
OA-5 (Orb-6) Mission Status

- **Mission Planning**
  - First enhanced Cygnus on the upgraded Antares Launch Vehicle launched from WFF Pad 0A

- **Pressurized Cargo complement**
  - ISS cargo manifest planned in support of Cargo Integration Review (CIR)
  - Spacecraft Fire Experiment (Saffire) #2 payload will be integrated into Cygnus
  - Planned Upmass: 7,050 Pounds

- **Cygnus Status**
  - Service Module (SM) in storage having completed integrated testing
  - SM plan for post-storage testing is approximately 3 months before launch

- **Antares Status**
  - Hardware Acceptance Review (HAR) for the RD-181 engines was conducted from 7/7/15 – 7/9/15 with delivery to WFF on 7/20/15
  - Antares 230 Stage 1 Core delta Critical Design Review (CDR) was conducted from 7/15/15 – 7/17/15
  - WFF range/FAA Antares 230 status briefing was conducted on 7/23/15
  - Engines 2A and 3A were attached to the Stage Test Article (STA) for fit check
  - RD-181 Certification Test Review was conducted from 9/2/15 – 9/4/15
  - Core is at WFF; modifications to support Antares 230 configuration are nearly complete
  - Engines are being prepared for hot fire test

- **Launch Pad Status**
  - Pad 0A rebuild completion and re-certification planned for Oct.
SpaceX-8 Mission Status

- **Mission Planning**
  - Cargo Integration Review (CIR) Part 1 completed on 5/28/15 with Part 2 planned for Oct
  - Safety Review Panel (SRP) Phase 3 review is planned to be complete by 10/7/15
  - Post Qualification Review (PQR) is planned for Nov
  - Stage Operations Readiness Review (SORR) is planned for Dec

- **Pressurized Cargo**
  - 1 Animal Enclosure Module-Transporter (AEM-T), 3 Polars (2 powered), and a NORS O2 Tank
  - Planned Upmass : 3,810 pounds. Planned Return : 4,100 pounds

- **External Cargo**
  - Bigelow Expandable Activity Module (BEAM) arrived at KSC on 7/23/15 and is dwelling in the SSPF until SpX is ready to integrate

- **Dragon Status**
  - Capsule and trunk stacking for integrated checkouts at Hawthorne was completed on 7/27/15
  - Final hatch blowdown and Acceptance Test Procedure (ATP) was completed on 8/25/15
  - Vehicle in the Loop (VITL) and polarity testing was completed on 8/31/15
  - Trunk and capsule are planned to be shipped by 10/9/15

- **Falcon 9 Status**
  - SpX-8 will be first CRS Falcon flight with full thrust capability (2<sup>nd</sup> or 3<sup>rd</sup> Falcon flight with full thrust)
  - Interstage in final assembly preparing for Stage 1 mate
  - M1D qualification completion is planned for Oct with MVac qualification planned for Nov
  - Stage 1 and 2 are planned to ship to TX by Nov for ATP
**SpaceX-9 Mission Status**

- **Mission Planning**
  - Cargo Integration Review (CIR) is planned for L-4 mo., Dec. 2015

- **Pressurized Cargo**
  - 1 JAXA Rodent Module (first flight – including live mice return), 1 Bioculture, 3 Polar, Short Extravehicular Mobility Unit (SEMU), and 2 NORS Tanks
  - Planned Upmass: 4,620 pounds  Planned Return: 4,100 pounds

- **External Cargo**
  - International Docking Adapter (IDA) #2

- **Dragon Status**
  - Capsule pressure and service section integration mate was completed on 7/15/15
  - All tank welds were completed in Sep
  - Prop tank installation is currently underway
  - Capsule and trunk stacking at Hawthorne for integrated checkouts is planned for 11/3/15

- **Falcon 9 Status**
  - Engine Octaweb currently in final assembly
  - Production for other elements is planned to begin in Oct; engines to begin production and ATP in Oct
62P Progress-MS

- 62P is the first Progress MS vehicle
  - A number of updates to the Progress included in this version of the vehicle
    - MMOD shielding modified on the Orbital compartment (matches Soyuz vehicle updates)
    - Utilizes Kurs-NA rendezvous system instead of Kurs-A
    - GLONASS/GPS satellite navigation system added and previous orbital navigation hardware
    - Kvant radio replaced with S-band satellite communication system

- First Progress flight on Soyuz 2.1A booster since 59P accident
  - Russian specialists conducted coupled loads analysis with the Progress updates and the Soyuz 2.1A Booster
  - NASA has requested Russian specialist to present special topic from this analysis at upcoming reviews
  - NASA has requested a special topic on this at the Vehicle Assessment Review, SORR and FRR.

- Next Steps
  - 62P SORR – under review
  - 62P FRR – under review