
NASA Advisory Council Space Operations Committee

Ames Research Center
August 2-3, 2011

Presented to the NASA Advisory Council on August 4, 2011

Space Operations Committee

Meeting at Ames Research Center, August 2-3, 2011

- Col. Eileen Collins (ret.), Chair
- Dr. Pat Condon, Vice Chair
 - Aerospace Consultant, former Commander of the Ogden Air Logistics Center, the Arnold Engineering Development Center, and the Air Force Armament Laboratory
- Dr. Leroy Chiao
 - Former NASA Astronaut and International Space Station Commander
- Dr. John Grunsfeld
 - Former NASA Astronaut, Deputy Director, Space Telescope Science Institute
- Ms. JoAnn Morgan
 - Former Kennedy Space Center Associate Director, KSC Safety & Mission Assurance Director
- Mr. Bob Sieck
 - Former Space Shuttle Launch Director
- Mr. Jacob Keaton, Executive Secretary, NASA

Not attending:

- *Mr. Tommy Holloway*
 - *Former Space Shuttle and International Space Station Program Manager*

Summary of Activities

Joint meeting of the Space Operations and Exploration Committees

Briefings:

- Task Group on Analysis Groups (TagAG) Final Report – with Science Committee
- Space Operations / Exploration System Mission Directorate Unification Update
- ISS-Mars Analog Status Update
- Update on Commercial Orbital Transportation System (COTS), Commercial Resupply Services (CRS), and Commercial Crew Development (CCDev) – with Commercial Space Committee
- Multipurpose Crew Vehicle (MPCV) and Space Launch System (SLS) Update

Fact Finding:

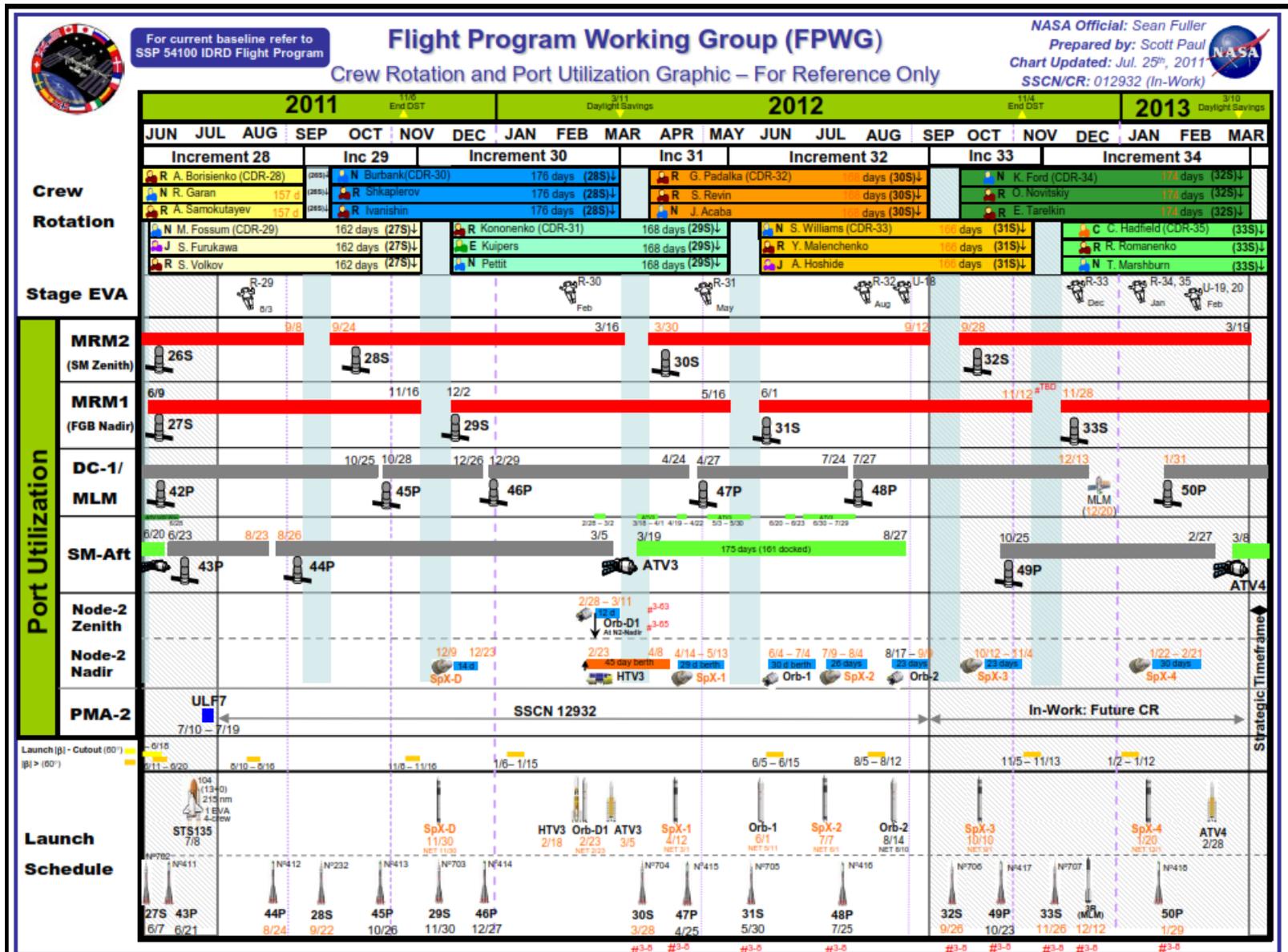
- Exploration Systems Mission Directorate Status Update
- Meeting with NASA Administrator Bolden

International Space Station Status





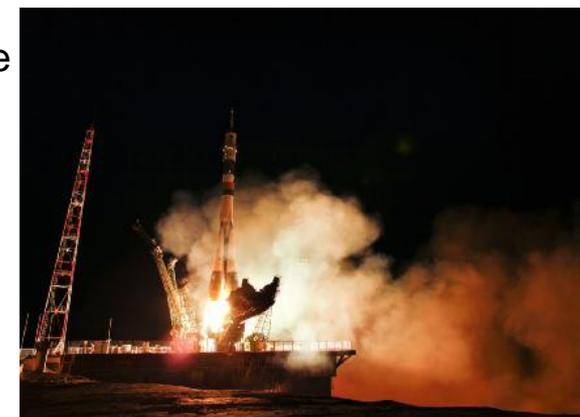
Flight Program Overview



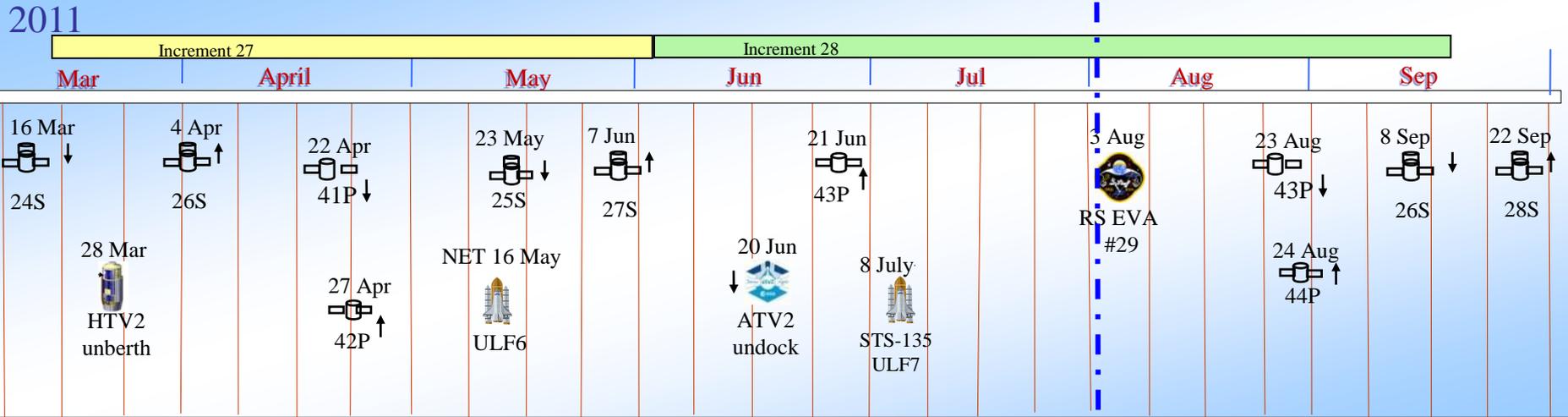
Recent On-Orbit Highlights

May/June/July 2011

- Successful completion of the STS-134/ULF6 mission in May, delivering the Alpha Magnetic Spectrometer (AMS) and ExPRESS Logistics Carrier 3 (ELC 3) to ISS. Its 4 EVAs replenished ammonia in the P6 radiator, lubricated the Port Solar Alpha Rotary Joint (SARJ), and permanently stowed the Orbiter Boom Sensor System (OBSS) on the ISS truss.
- Soyuz 25S undocking from the ISS on May 23, during the STS-134 mission, the first ever dual-docked operations with the Shuttle. Prior to departure, the Soyuz crew took the first photos of the ISS with the Shuttle attached, before landing safely in Kazakhstan.
- Launch of Expedition 28 crew on Soyuz 27S, the second of the new digital Soyuz vehicles, on June 7 and docking to ISS on June 9.
- Departure of the European Automated Transfer Vehicle (ATV2) on June 20 after a flawless mission. Prior to its departure, the remaining propellant in ATV2 was used to reboost the ISS to a higher orbit.
- Arrival of Progress 43P at the ISS on June 23.
- Successful completion of the last Space Shuttle flight, STS-135/ULF7, in July, delivering the Robotics Refueling Mission and a Multipurpose Logistics Module full of food/supplies and pre-positioned critical spares. STS-135 also returned the ISS thermal control system Pump Module, which failed in August 2010, for failure analysis and refurbishment.



Upcoming Events - Increment 27-28

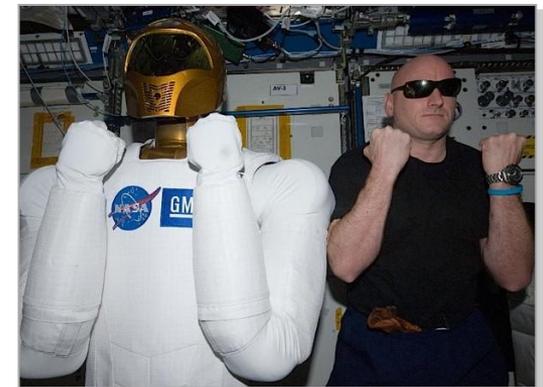
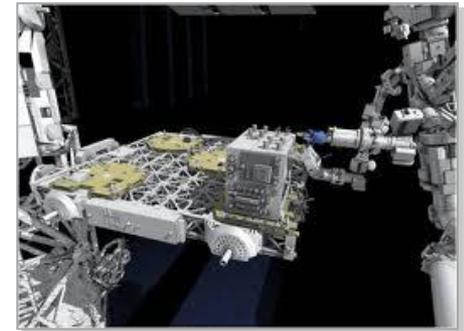


25 Soyuz Crew	26 Soyuz Crew	27 Soyuz Crew
 Dmitri Kondratyev Exp 27 CDR	 Andrey Borisenko Exp 27 FE2 / Exp 28 CDR	 Sergei Volkov Exp 28 FE4
 Paolo Nespoli Exp 27 FE5	 Alexander Samokutyaev Exp 27/28 FE1	 Satoshi Furukawa Exp 28 FE5
 Catherine Coleman Exp 27 FE6	 Ronald Garan Exp 27/28 FE3	 Michael Fossum Exp 28 FE6

All dates are Eastern

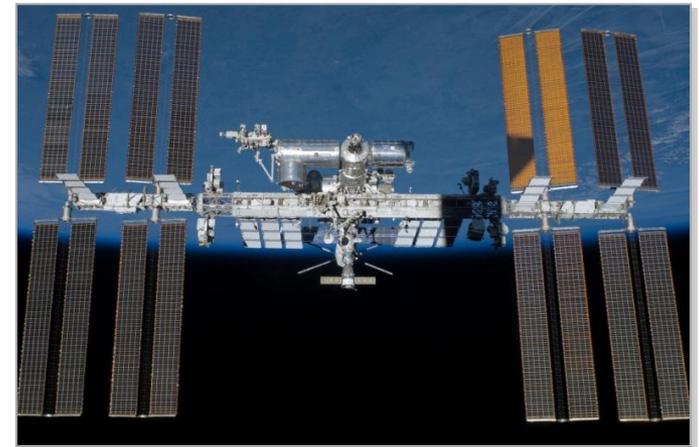
Recent Research and Development Highlights

- Launch and installation of the Alpha Magnetic Spectrometer (AMS) state-of-the-art particle physics detector
 - Constructed, tested and operated by an international team of 56 institutes from 16 countries and organized under U.S. Department of Energy (DOE) sponsorship
 - At 15,000 pounds, AMS is the largest scientific payload on ISS
- Launch and installation of the Robotic Refueling Mission (RRM) to demonstrate and test tools, technologies and techniques needed to robotically refuel satellites in space
- Launch and checkout of Robonaut 2 the first human-like robot in space
 - Built in partnership between NASA and General Motors, it is first American-built robot on Station and is capable of handling a wide range of astronaut tools and interfaces to eventually perform some of the repetitive and mundane astronaut tasks
- Launch and installation of the 4th Express Logistics Carrier (ELC) to house and support external payloads and spares



ISS National Lab Cooperative Agreement

- The 2005 NASA Authorization Act designated the U.S segment of the ISS as a national laboratory and directed NASA to develop a plan to "increase the utilization of the ISS by other Federal entities and the private sector..."
- NASA recently announced selection of the Center for the Advancement of Science in Space, Inc. (CASIS) as an independent, nonprofit research management organization to develop and manage the U.S. portion of the station
- Sponsored by Space Florida and located at the Space Life Sciences Lab near the Kennedy Space Center, CASIS will stimulate uses of the station as a national laboratory and maximize the U.S. investment in the ISS
- It will develop and manage a diversified research and development portfolio based on U.S. needs for basic and applied research in a variety of fields
- The Cooperative Agreement has a value of up to \$15 million per year through 2020

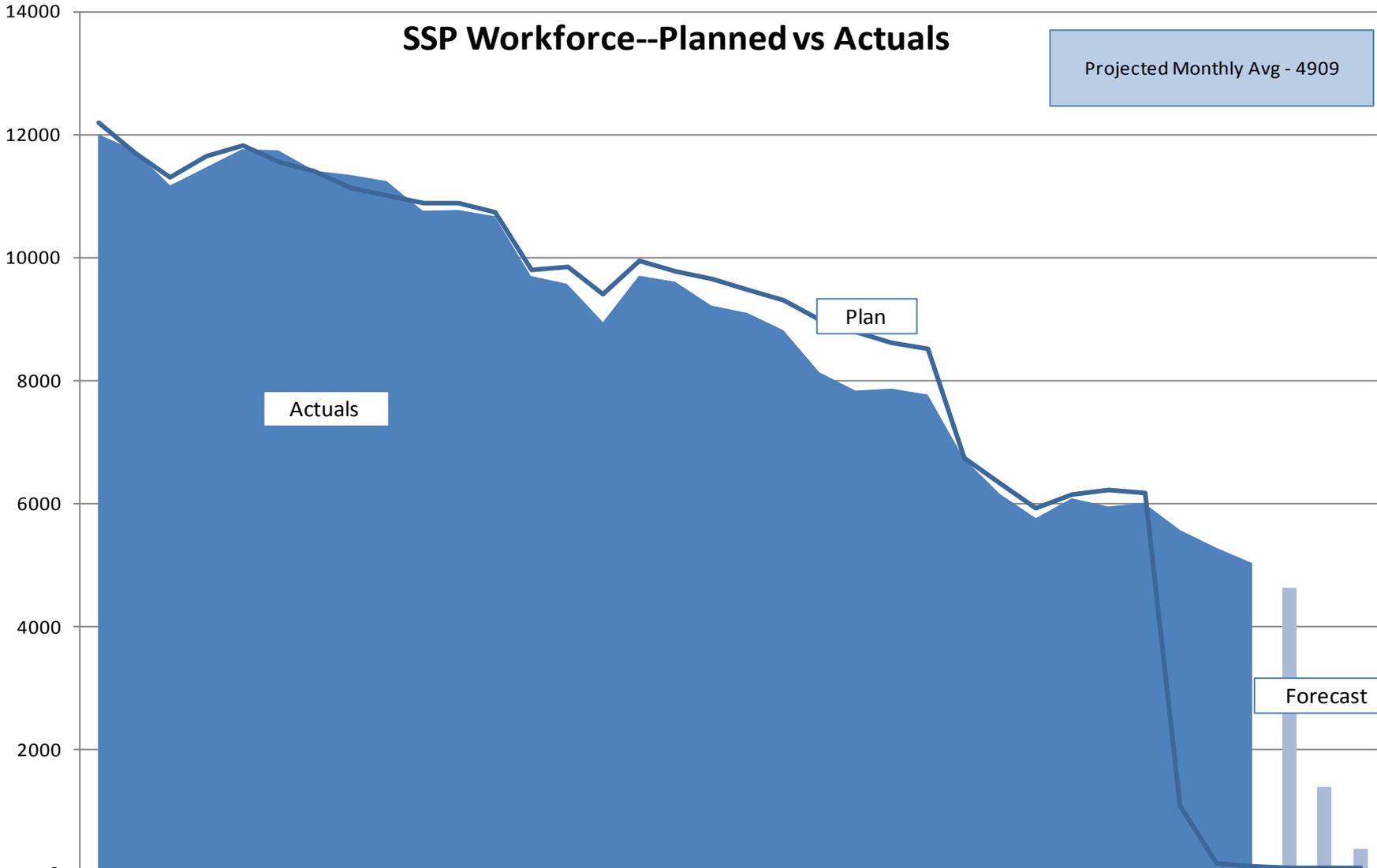


Atlantis Re-entry - July 21, 2011



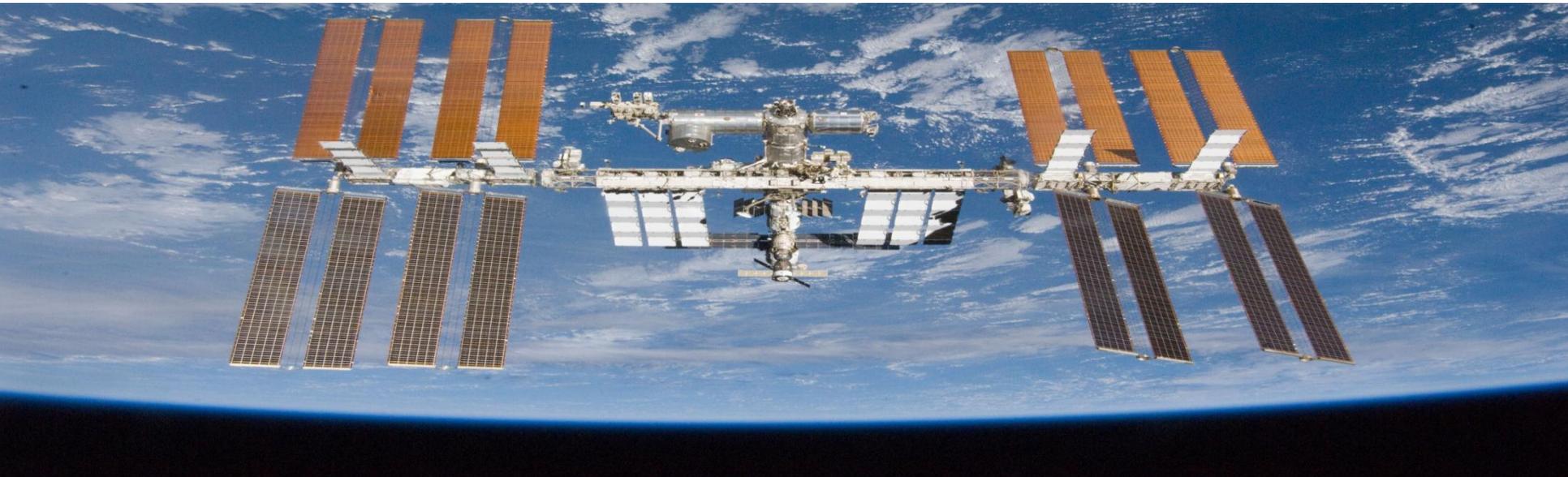
SSP Workforce--Planned vs Actuals

Projected Monthly Avg - 4909



	O 08	N 08	D 08	J 09	F 09	M 09	A 09	M 09	J 09	J 09	A 09	S 09	O 09	N 09	D 09	J 10	F 10	M 10	A 10	M 10	J 10	J 10	A 10	S 10	O 10	N 10	D 10	J 11	F 11	M 11	A 11	M 11	J 11	J 11	A 11	S 11	
SSP Actuals	12001	11741	11166	11461	11758	11737	11406	11336	11237	10756	10766	10665	9693	9566	8942	9698	9599	9213	9092	8811	8125	7828	7860	7763	6731	6148	5753	6076	5943	5999	5559	5272	5022				
SSP Forecast																																			4630	1393	381
SSP Plan	12183	11703	11308	11640	11816	11545	11387	11116	11008	10888	10875	10726	9786	9851	9404	9938	9768	9643	9477	9297	8967	8771	8596	8512	6739	6321	5910	6143	6202	6172	1084	142	78	74	73	71	

Why ISS as a Mars Analog?



- The ISS provides crew durations that mimic Mars transit phase (approx 6 mos)
- The ISS continuous operations in micro-g provides systems durations that span the Mars mission – validates system performance requirements
- Long duration microgravity environment – pressurized and un-pressurized payloads
- Science Laboratories from four international space agencies – US, Europe, Japan, and Russia
- Life support, power, data, and facilities for 6 crew (subjects and operators)
- Ground control and on-orbit support for 24/7 operations

ISS as an Exploration Test Bed - Objectives

- ◆ **Evaluate new exploration technologies as they become available**
- ◆ **Advance preparations for crew autonomous operations for Mars or NEA exploration**
- ◆ **Exercise ground elements training and technology development**
- ◆ ***Long Term Goal***
.....Conduct long duration Mars Transit and Landing Transition simulations using technology and operational tools & concepts developed and tested during previous On-Orbit and Earth-based Analogs

New Technology

(Collaborative Efforts with NASA/JSC Engineering)



- **Air Revitalization**
 - **Oxygen Production/Regeneration from Carbon Dioxide with Solid Oxide Electrolysis (SOE)**
- **Crew Clothing** ✓✓
 - **Lightweight Long-Wear Crew Clothing Evaluation**
 - **Passive Dryer for Clothing**
 - **Simple Laundry System**
- **Emergency Equipment**
 - **Portable Crew Emergency Air / Respirator**
- **Fire Detection & Control**
 - **The Big Fire Test: Large-Scale Microgravity Fire Characterization on a Re-entering Cargo Vessel** ✓
- **Food** ✓✓
 - **Optimization of Ground-based and In-Flight Food Quality Testing**
 - **Understanding Taste in Microgravity**
- **In-Space Fabrication**
 - **On-Orbit Free-form Fabrication Experiment**
- **Microbial Detection & Control**
 - **Microbial Monitoring** ✓
 - **Robust, Biocidal Condensing Heat Exchanger**
 - **Microbial Load of Space-Grown Hydroponic Vegetables** ✓
 - **Real-Time in-flight Microbial Monitoring**
 - **MS for Water Quality Monitoring**
 - **Development of Differential Mobility / Mass Spectrometer for Volatile Organic Compound Analysis**

✓ - Relatively short turn-around development required

✓ - Key area for investigation



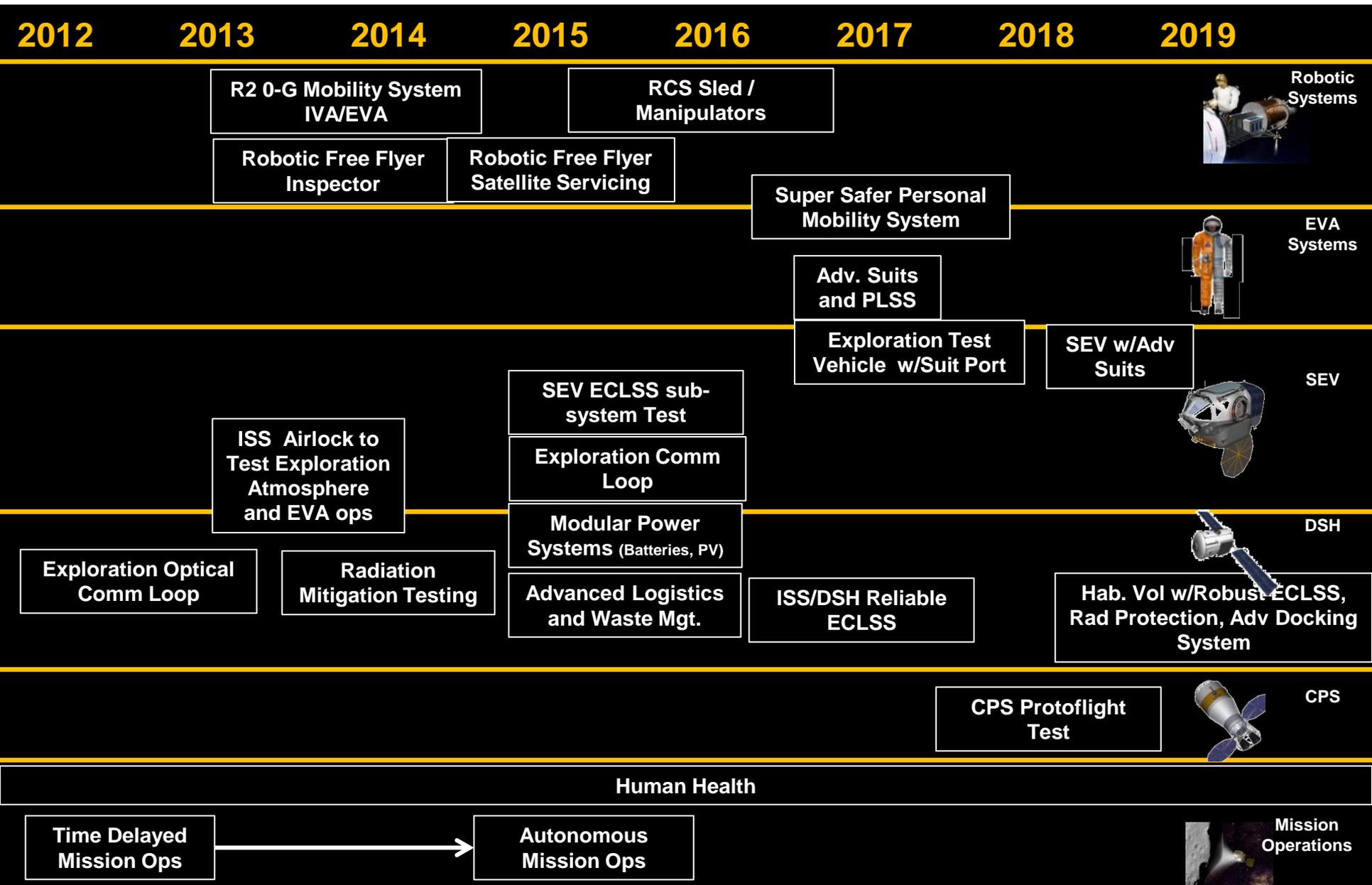
New Technology

(Collaborative Efforts with NASA/JSC Engineering)



- **Noise Reduction** ✓
 - Quiet Fans for Crew Cabins
 - Active Intelligent Ventilation Noise Control System
 - Noise Hazard Inventory (NHI) Development ✓
 - **Radiation Detection & Protection** ✓
 - Active Shielding Proof-of-Concept
 - Medipix Small Active Radiation Dosimeter
 - Autonomous Operation Radiation Event Response
 - **Thermal Control**
 - Phase Change
 - Advanced Thermal Phase Change Material Heat Exchangers
 - Phase Change Material for Thermal Management in Microgravity
 - Advanced Thermal Drainage Demonstration
 - Porous Media Condensing Heat Exchanger for Humidity Control
 - **Trash Management & Recycling** ✓
 - Conversion of Plastic Trash to Radiation Protection
 - **Water Treatment & Recovery** ✓
 - Electrochemical Disinfection for Potable Water Systems
 - Regenerable Biological Water Processor
 - Static Phase Separators
 - Light Weight Contingency Water Recycling System (LWC-WRS)
 - Non-Toxic, Self-Regenerating Water Disinfectant
- ✓ - Relatively short turn-around development required
- ✓ - Key area for investigation

Potential Exploration Candidates for ISS Testing Roadmap



Robotic Systems

EVA Systems

SEV

DSH

CPS

Mission Operations

Finding

Short Title of Finding: ISS as a Mars Analog Update

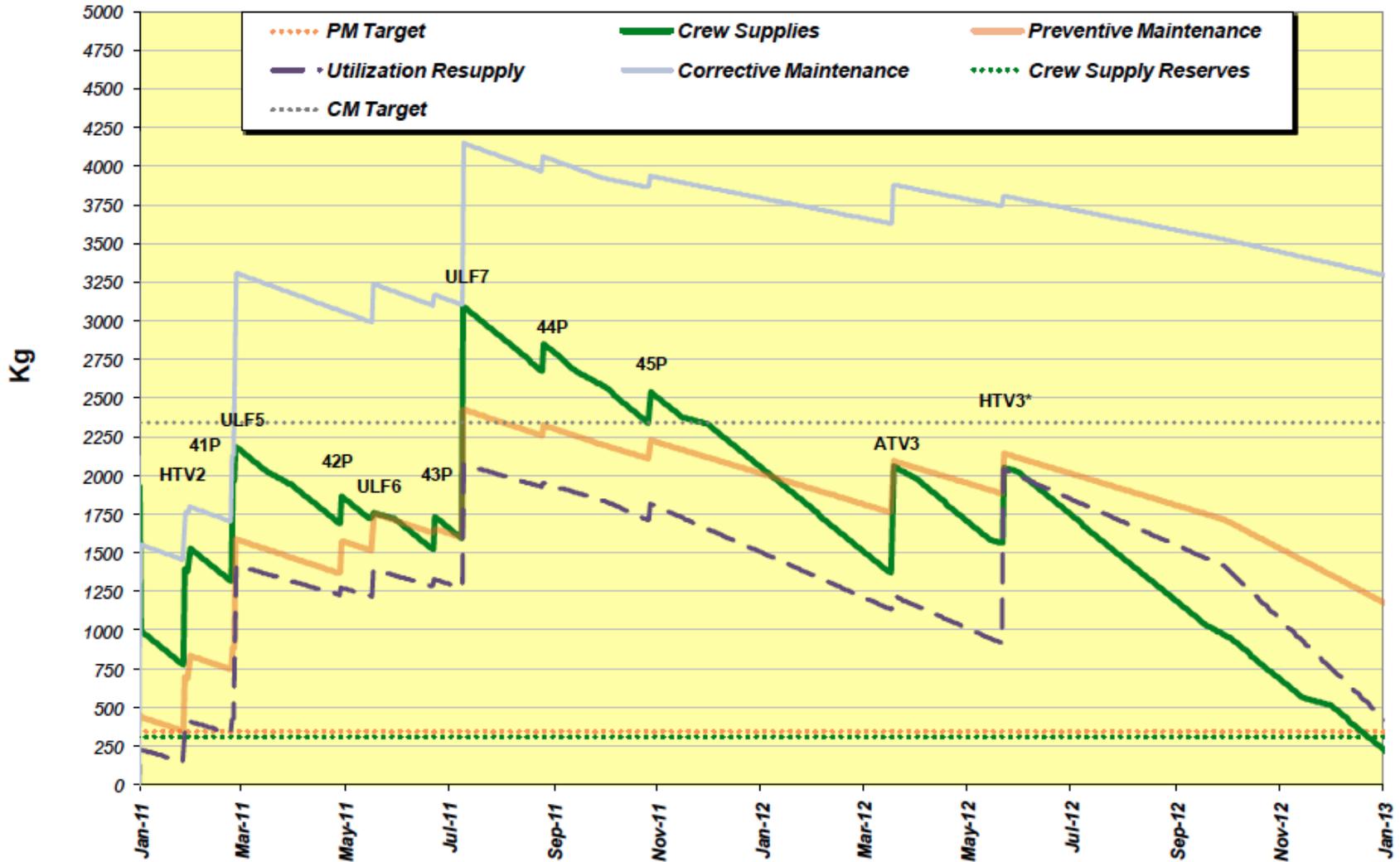
Finding:

The committee is pleased with the initiative that the International Space Station Program has taken with the Mars Analog project. We feel that the project requires a sense of urgency. We request a briefing on the prioritization of the Mars Analog objectives and NASA's plan to provide metrics.

Commercial Resupply Service (CRS)

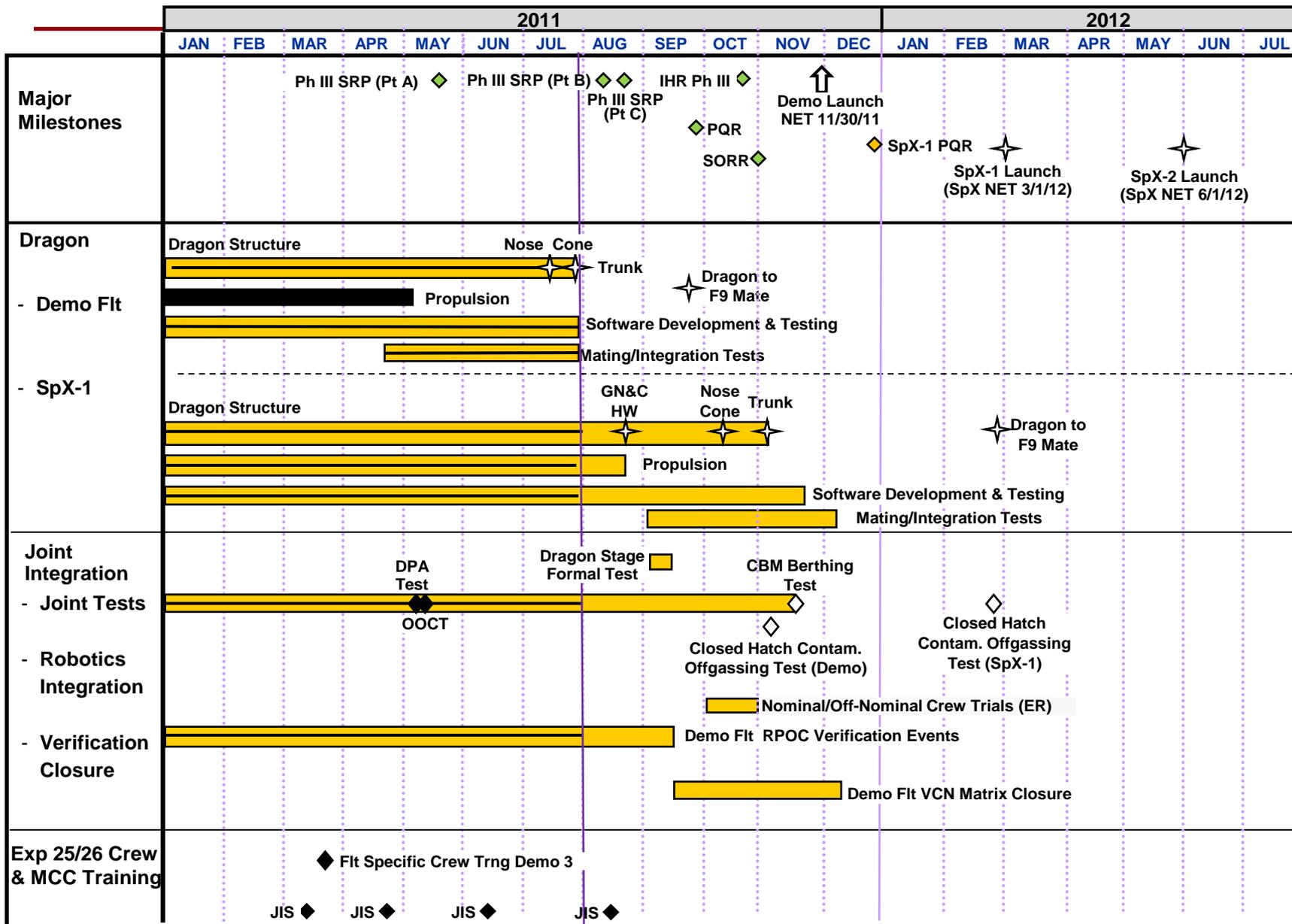
ISS Consumables to 2013 (assumes no CRS)

2011-2012 Pressurized Demand vs. Capability



* Assumes 1100 kg of Utilization is available for HTV3

SpaceX ISS Integration Schedule for Flight Demo



Next Meeting

- First Meeting of the Human Exploration and Operations Committee
- October 2011 (planned)
 - Briefings:
 - FACA Training
 - ISS Non-Profit Organization

Summary of Activities

- Fact Finding:
 - NASA Administrator
 - Exploration Systems Mission Directorate
- Briefings:
 - Task Group on Analysis Groups
 - SOMD/ESMD Unification Update
 - ISS-Mars Analog Status Update
 - COTS, CRS, CCDev Status Update
 - MPCV/SLS Status Update
- Finding: ISS as a Mars Analog Update
- Future Activities

2011 Space Operations Committee Work Plan

1. International Space Station Operations:

- a) Transition from assembly phase to research phase of operations
- b) National Laboratory activities, as well as the independent, nonprofit research management organization which is being set up to develop and manage the U.S. portion of the station
- c) Unique operational issues associated with visiting vehicles, robotics, EVA, efficiencies in conducting science, and other issues facing long-duration astronauts
- d) Examine what kind of technologies and operations might be developed and tested on ISS that could be enabling with respect to human exploration beyond LEO

2. Space Shuttle Operations:

- a) Transition of shuttle to future launch systems (ground ops, training, in-flight mission operations)
- b) Workforce and infrastructure issues concerning shuttle program termination

2011 Space Operations Committee Work Plan

4. Future NASA Human Launch Systems (with Exploration committee):

- a) Study development and proposals for next heavy-lift human deep-space launch system with emphasis on operational impacts to ground and flight crews

5. Commercial Launch Systems (with Commercial Committee):

- a) Cargo to ISS and LEO
- b) Crew launch (including NASA astronauts) to ISS
- c) Review commercial crew certification requirements

6. KSC Spaceport Modernization:

- a) Workforce
- b) Mission accomplishment

7. Human Flight Operations, Present and Future:

- a) Extravehicular activity
- b) Rendezvous & docking
- c) Displays and controls
- d) Micro-meteorite protection
- e) Radiation protection