
# The International Space Station

Aeronautics and Space Engineering Board
April 2015

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NASA Headquarters

# NASA's and America's goals onboard the Station

Enable long duration human spaceflight beyond LEO

Enable a commercial market in LEO

Advance benefits to humanity through research

Basis for international HSF exploration partnerships

# Where we are Today

In January 2014 the Administration extended the life of ISS  at least to 2024

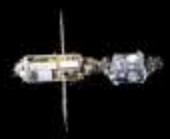
Each International Partner is working within their own policy framework to determine ISS future beyond 2020

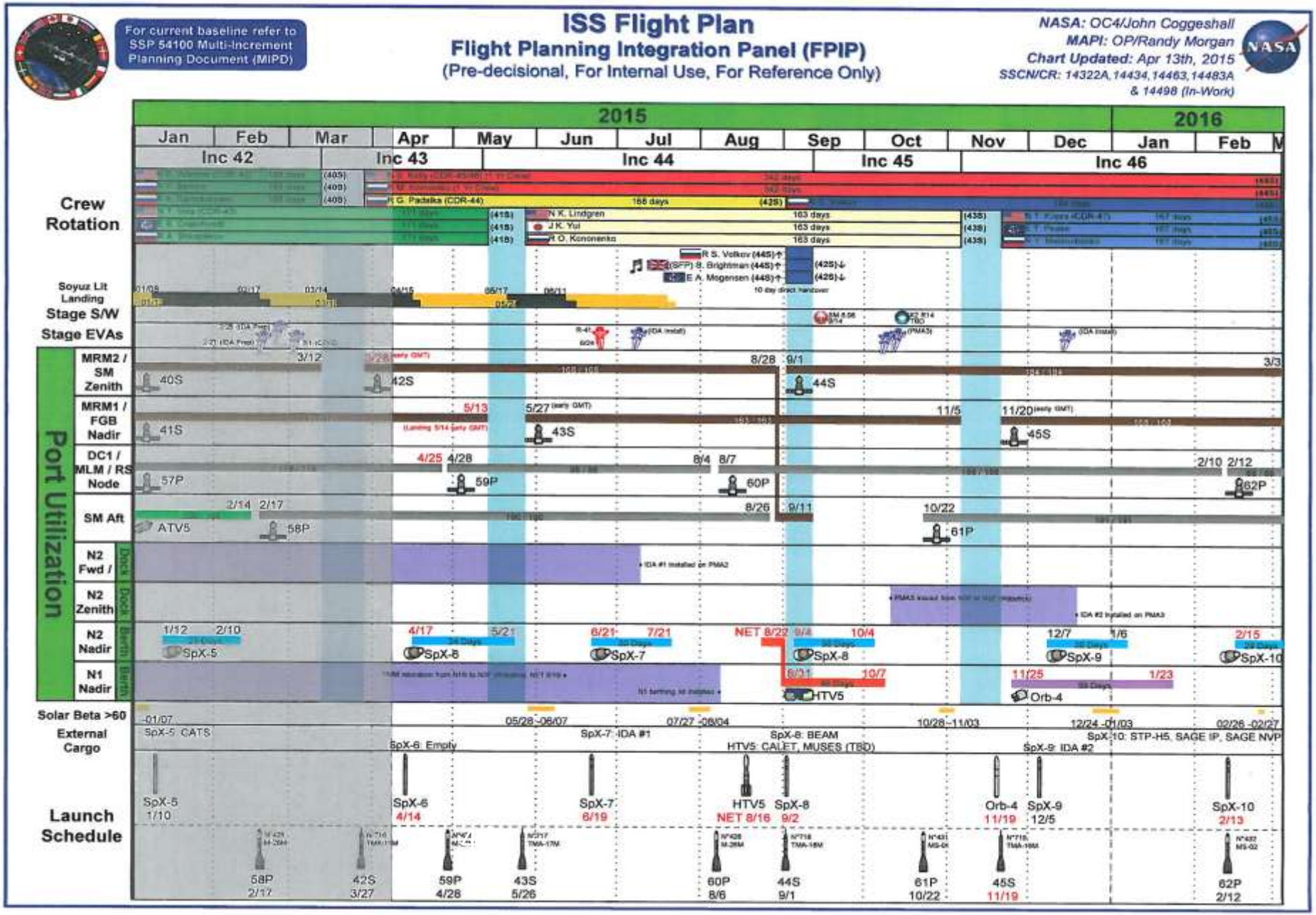
Begun 1 year crew expedition and associated long duration human performance research

Together with CASIS, NASA is expanding the commercial demand for micro-gravity research and LEO access

ISS has become an important space and earth science platform expanding our knowledge of our home planet and the universe

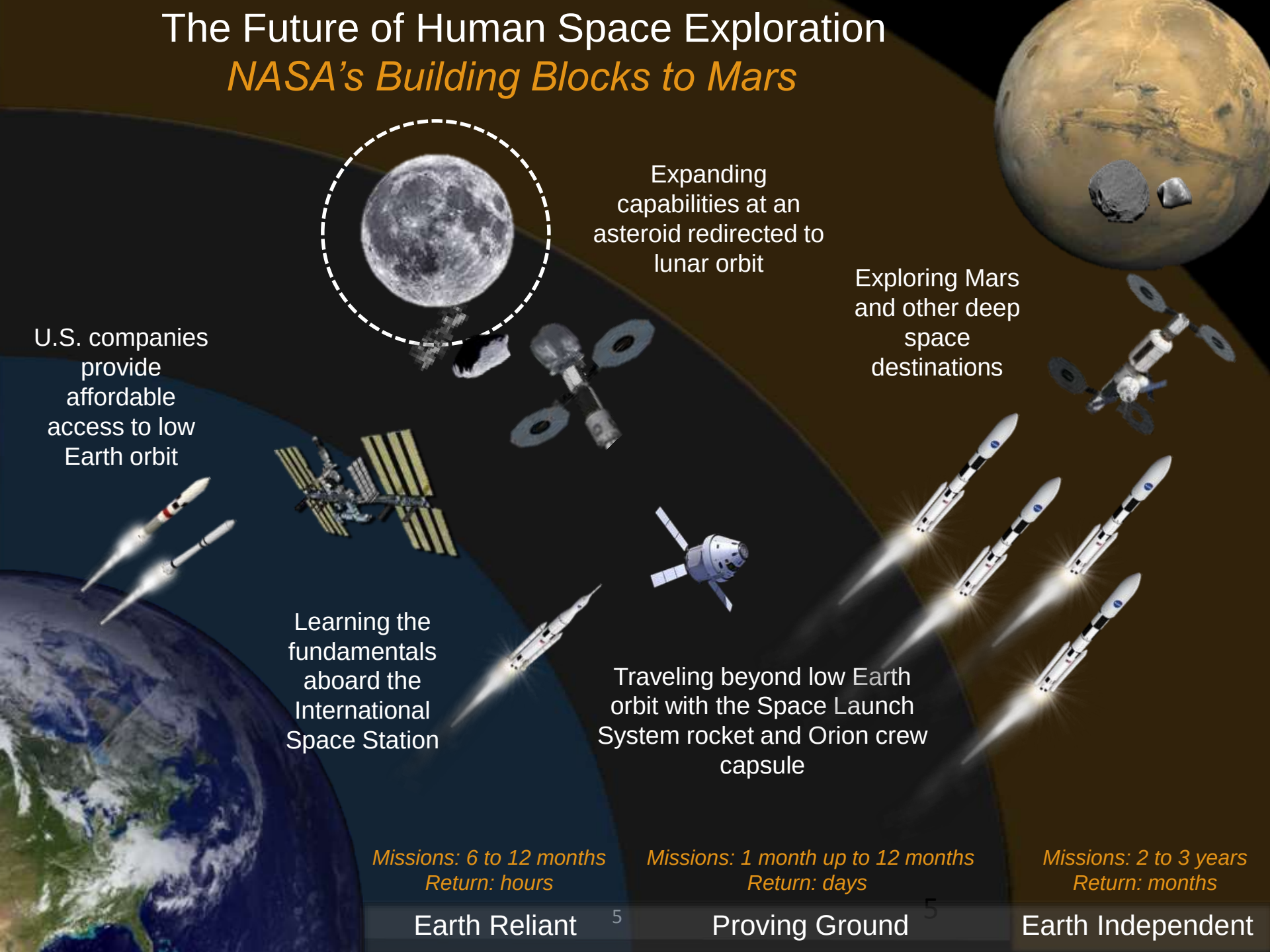
Commercial transportation development and operations for ISS is having a significant influence on the aerospace industry; considering the next commercial activity in LEO


For current baseline refer to SSP 54100 Multi-Increment Planning Document (MIPD)
ISS Flight Plan
Flight Planning Integration Panel (FPIP)
(Pre-decisional, For Internal Use, For Reference Only)
NASA: OC4/John Coggeshall
MAPI: OP/Randy Morgan
Chart Updated: Apr 13th, 2015
SSCN/CR: 14322A, 14434, 14463, 14483A & 14498 (In-Work)
2015
2016
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec Jan Feb M
Inc 42 Inc 43 Inc 44 Inc 45 Inc 46
Crew Rotation
R. G. Padalka (CDR-44)
188 days
(428)
N. K. Lindgren
J. K. Yui
R. O. Kononenko
163 days
R. S. Volkov (445)↑
S. Brightman (445)↑
E. A. Mogensen (445)↑
(425)↓
10 day direct handover
Soyuz Lit
Landing
Stage S/W
Stage EVAs
Port Utilization
MRM2 / SM Zenith
40S
42S
44S
MRM1 / FGB Nadir
41S
43S
45S
DC1 / MLM / RS Node
57P
59P
60P
62P
SM Aft
ATV5
58P
61P
N2 Fwd / Dock
N2 Zenith Dock
N2 Nadir Berth
SpX-5
SpX-6
SpX-7
SpX-8
SpX-9
SpX-10
N1 Nadir Berth
HTV5
Orb-4
Solar Beta >60
External Cargo
SpX-5: CATS
SpX-6: Empty
SpX-7: IDA #1
SpX-8: BEAM
HTV5: CALET, MUSES (TBD)
SpX-9: IDA #2
SpX-10: STP-H5, SAGE IP, SAGE NVP
Launch Schedule
SpX-5 1/10
SpX-6 4/14
SpX-7 6/19
HTV5 NET 8/16
SpX-8 9/2
Orb-4 11/19
SpX-9 12/5
SpX-10 2/13
58P 2/17
42S 3/27
59P 4/28
43S 5/26
60P 8/6
44S 9/1
61P 10/22
45S 11/19
62P 2/12

# The Future of Human Space Exploration

## *NASA's Building Blocks to Mars*



# What is so hard about going to Mars

~228,000,000 kilometers

**~2 - 3 years transit time**

Communications (up to 42 minutes)

**“ Independent Living”**

# Where we are today

**< 2 days transit time**

Communications (near real-time)

Crew exchanges

Crew supplies and logistics

Crew and atmosphere samples

Modified hardware

Emergency Crew Return

Trash

**~400 kilometers**

**“Car Camping in Space”**

So what is the ISS Program doing to close these gaps?

Performing the research and developing countermeasures to keep humans alive and healthy on long duration deep space missions

# Closing the gap in Human Health and Performance

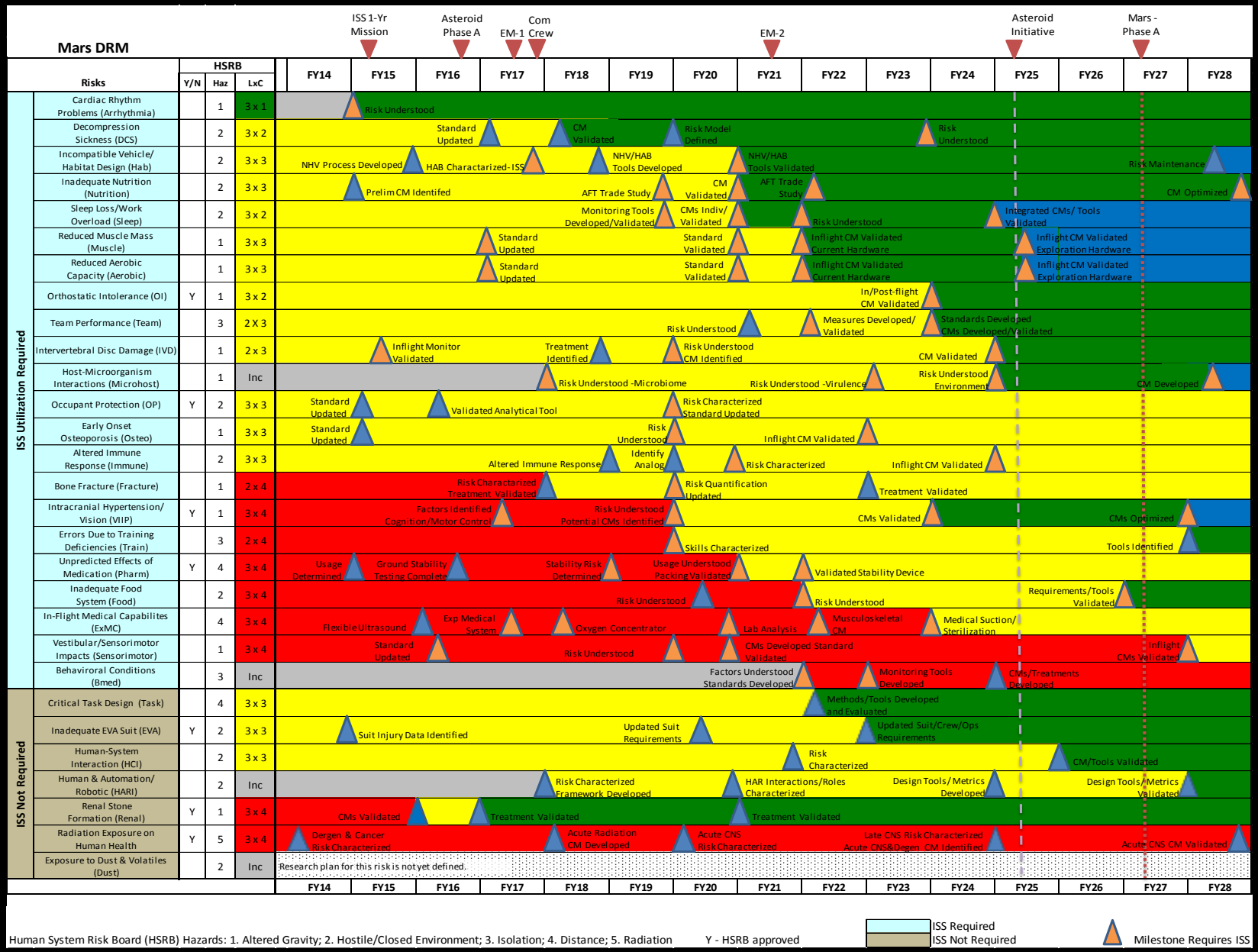
The ISS is necessary to mitigate 21 of the 32 human health risks anticipated on exploration missions

Some of the primary drivers for the length of research onboard ISS are:

- Number of subjects
- Pharmacology
- Visual Impairment and Intracranial Pressure
- Muscle
- Exploration Medical Capability
- Arrhythmia

Given the current number of subjects expected, HRP research and mitigations for long duration deep space missions should be mature enough by the mid-2020's

# Integrated HRP Path to Risk Reduction



# Demonstrate the life support and monitoring systems that will take us to Mars

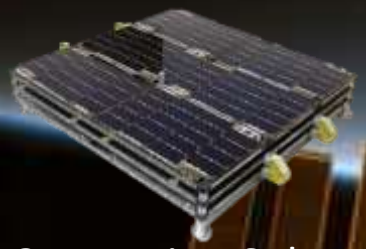
# Learn how to break the bonds to the earth

Logistics, crew health monitoring, ground-to-crew communications, etc.

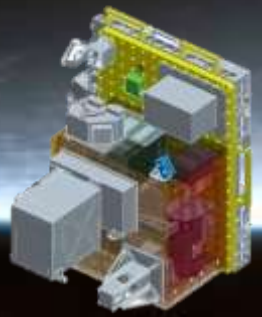
# Demonstrate exploration related systems and technologies

Rendezvous sensors

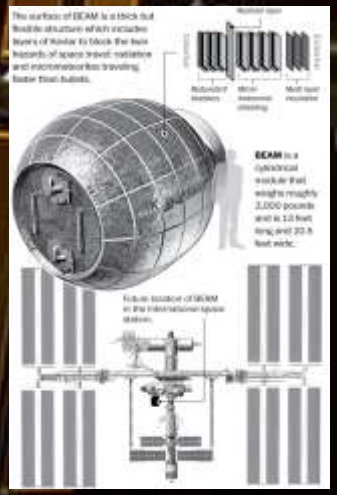
NASA Docking System



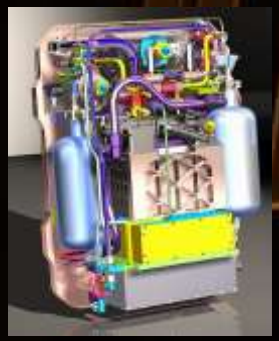
Next Generation Solar arrays



Refueling



Habitation Structures



EVA Systems

Leak detection

Trash compactor

# Some specific design examples of lessons learned from ISS

- Ease of access and commonality for replaceable components such as filters, valves and maintainable components
- Standardized interfaces/components for common uses; communication/data, computers, headsets, fire extinguishers, fluid connectors, docking, etc.
- Incorporate on-orbit repair into the design for all components
- Reduce or eliminate need for EVA maintenance/repair
- Importance of redundancy/cross-strapping for long-duration power systems

# ISS and the development of the commercial market in LEO

NASA is currently exploring how the ISS can be utilized to development the commercial demand and supply market in LEO

It is NASA's intent that a commercial market will replace the ISS in LEO before its end of life

More significantly, NASA is striving to develop the non-NASA demand for research, product development, marketing, tourism, earth sensing and other LEO applications – both in private industry and other government agencies

NASA is conducting a series of workshops to engage the broader US industrial base and other government agencies

- First workshop held in December in DC
- Second workshop is in the planning stages

http://www.nasa.gov/directorates/heo/LEO_commercialization

Vision

Sustained economic activity in LEO enabled by human spaceflight, driven by private and public investments creating value and benefitting Earth through commercial supply and public and private demand

# Developing the demand outside of NASA with private industry and OGA's

NASA has a cooperative agreement with
Center for the Advancement of Science in Space to exploit the ISS National Lab


Also in proposal development with Cargill, John Deere, ADM, Dow, and J&J

# GAIN A NEW PERSPECTIVE

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Leadership

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