

The background of the slide is a composite image. On the left, the International Space Station (ISS) is shown in orbit above Earth. An astronaut in a white spacesuit is visible in the foreground on the left. On the right, the planet Mars and the Moon are shown against a starry space background. The ISS consists of several large solar panel arrays and a central structure.

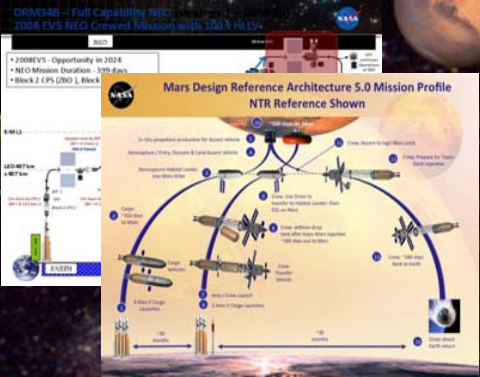
# Practicing for Mars: The International Space Station (ISS) as a Testbed

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# ISS Role in Exploration Preparations



Design Reference Missions and Architectures

Allows demonstration and development of exploration capabilities to help accomplish future missions sooner with less risk to crew and mission

**Human & Architectural Risks**

Human Spaceflight Architecture Team (HAT) Exploration Risks		
ID	Exploration Mission Risk	
M-EDL	EDL	EDL
M-EDL	EDL	EDL
Human Spaceflight Architecture Team (HAT) Architectural Questions		
ID	Exploration Mission Architectural Questions	
CSM	Q1	What is the safest way to approach a small/non-cooperative/non-stable object? (i.e. NEA, satellite)
DPE	Q2	What is the safest way to approach a small/non-cooperative/non-stable object? (i.e. NEA, satellite)
A-ASP	Q3	What is the safest way to approach a small/non-cooperative/non-stable object? (i.e. NEA, satellite)
Env	Q4	What is the safest way to approach a small/non-cooperative/non-stable object? (i.e. NEA, satellite)
Stork	Q5	What is the safest way to approach a small/non-cooperative/non-stable object? (i.e. NEA, satellite)
Sys	Q6	What is the safest way to approach a small/non-cooperative/non-stable object? (i.e. NEA, satellite)
EVA	Q7	What is the safest way to approach a small/non-cooperative/non-stable object? (i.e. NEA, satellite)
Comm	Q8	What is the safest way to approach a small/non-cooperative/non-stable object? (i.e. NEA, satellite)
Health	Q9	What is the safest way to approach a small/non-cooperative/non-stable object? (i.e. NEA, satellite)
NAV	Q10	What is the safest way to approach a small/non-cooperative/non-stable object? (i.e. NEA, satellite)
Hum	Q11	What is the safest way to approach a small/non-cooperative/non-stable object? (i.e. NEA, satellite)
AV	Q12	What is the safest way to approach a small/non-cooperative/non-stable object? (i.e. NEA, satellite)
ASAT	Q13	What is the safest way to approach a small/non-cooperative/non-stable object? (i.e. NEA, satellite)

## Characteristics of ISS as a testbed

- High fidelity human operations platform in LEO:
  - Continuously operating habitat and active laboratory
  - High fidelity systems
  - Astronauts as test subjects
  - Highly experienced ground operations teams
- Offers a controlled test environment:
  - Consequences to systems performance and decision making not offered in ground analogs
- International participation
- Continuously improving system looking for new technology and ideas to improve operations



Earth-based Analogs



# What are we doing on ISS?

## Technology Demos & Critical Systems Maturation

**Long Duration Clothing**

**Fluid Physics**

**Robotics and Tele-robotics**

**Combustion Technology**

**Life Support Systems**

**Delay Tolerant Networks & Advanced communications**

## Human Health and Performance

## Operations Simulations and Techniques

Voice    Cmd/Tlm

Video    Data    Text

**plans**

**Procedures**

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# Exploration testing plans

- Exploration prep testing on ISS has been ongoing since 2012
  - Number of tests increasing with each ISS expedition
- One Year Crew Expedition starting in Spring 2015
  - ROSCOSMOS and NASA are partnering on the Participating Crew are Mikhail Kornienko and Scott Kelly
  - Majority of testing is an extension of current Human Biomedical Research investigations
  - Plan for extending & expanding upon current operations techniques and tech demo studies
- ESA 10 Day Mission in Fall 2015
  - ESA astronaut focus on testing exploration technologies
- Many more opportunities throughout the life of ISS!



NASA HRP Pre-flight Milestones for One-Year Mission  
Corresponding FSA, JAXA, ESA, CSA milestones to be provided through MHRPE

18 July 2013

Year	Month	Event	Status
2012	30 Nov	L28	✓
	February		L
	March		L
	June		L
2013	August		L
	September		L
	November		L
	December		L
	January		L
	February		L
	March		L
	early April		L
	April		L
	May		L
	June		L
2015	30 Mar		L

## US and Russian Candidate Investigations for One-Year Mission

## International Partner Candidate Investigations for One-Year Mission

Partner	PI	Title	Possible Match	
			NASA	Roscosmos
JAXA	Mukai	Biological Rhythms – 48 hours	ActiWatch	Pilot-T
	Mukai	ICP – 1 year	Ocular Health	(Medical mandatory)
	Mukai	Myco	Microbiome	(Under review)
ESA	Blanc	Energy	Fluid Shifts (under review)	Chibis
	Chouker	Immuno-2 (co-investigator)	Biochemical Profile, Surveillance	Immuno-2