

Research Needs & Directions - ISS Perspective

Spring 2019 Meeting of the Committee on Biological & Physical
Sciences

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ISS Technology Demonstration Fly-Off Plan

- NASA has ongoing exploration technology development needs that require continuous human presence in LEO.
 - Transition period from ISS to commercial destinations
 - Purchase of services from commercial LEO destinations to continue technology development post-ISS

	FY19				FY20				FY21	FY22	FY23	FY24	FY25	FY26	FY27	FY28
	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4								
Capability Gap																
Environmental Control and Life Support																
Reliable CO ₂ Removal + ppCO ₂ <2 mmHg				al amine	▲	▲			▲	▲			Expl system			
Trace contaminant sorbents/siloxane control				CHARPA Filters						▲			Expl system			
Regen particulate filtration/surface dust pre-filter								▲								
Smaller, more maintainable O ₂ Gen									OGA Upgrades	▲						
High pressure O ₂ (3000 psi) for EVA & medical use											HP OGA or concentrator	▲				
Reliable urine processing =85% recovery					DA mods	▲			▲	alt purge pump						
Reliable H ₂ O processing w/ reduced expendables				MF lifext	▲			CR mod								
Compact waste & trash mgmt, stable, 90% water recov					UWMS								▲	TCPS		
Additional O ₂ recovery from CO ₂ >75%									PPA	▲			alt tech			
>90% recovery of water from urine brine					BPA	▲										
Condensing HX robust, inert, anti-microbial				UKD	▲						▲		Upgrade CHX			
Environmental Monitoring, Safety and Emergency Response																
Atmosphere Monitoring (on orbit, no grab sample return)				SAM	▲											
Targeted Gases (fire products, NH ₃ , hydrazine)						▲			AGA on saffire for Orion							
Water (individual compounds)											▲		final fit suite			
Microbial (ID & qty species)											▲		Expl PCR			
Particulates				aerosol sampler	▲			flight monitor								
Acoustic (automated, alerting, no crew time)																
Emergency Mask (single cartridge)																
Large scale fire propagation, monitoring, and clean up				▲	▲			Saffire-IV-VI								
Large scale fire response on realistic hazard									▲	▲			Saffire-VII, VIII			
Parametric flammability studies									▲				SoFIE & MWT			
Water Mist PFE									▲				Exploration Size, lightweight tank for Orion			
Extravehicular Activity																
Exploration Extravehicular Mobility Unit (xEMU)														▲	ISS flight demo	
Active Thermal Management for xEMU				▲	SERFE											
Human Health & Performance																
Human Health Countermeasures/Exercise Equipment									▲				Exploration Exercise Device			
Diagnostic and Treatment Capabilities				nd Autonomy	▲	▲		Blood Lab Analysis	▲	▲	▲	▲	▲	▲	▲	▲
Advanced Food Production											▲					
Radiation																
Radiation Monitoring				▲	ISS HERA											
Communications, Navigation, and Networking																
High speed comm/internetworking										▲	ILLUMA-T	▲	TDRS Ka-band upgrades			
Position, navigation, and timing																
Materials, Manufacturing, Sustainability, and Supportability																
10:1 volume reduction logistical & clothing													simple laundry	▲		
Autonomous Logistics Management					REALM-2	▲		Auto. Logistics	▲			REALM-3				
In-Space Recycling & Fabrication				▲	Refabricator			ERASMUS								
Multi-Material Fabrication Laboratory (metals, electronics, etc)										▲			Fablab Prototype and Flight Demo			
Avionics, Software and Autonomy																
Augmented Reality				▲	T2 AR											
Automated Mission Operations				▲	AMO Express 2.5											
Gateway Uncrewed Operations				▲	Astrobee											

- ▲ ISS demo - flying
- ▲ ISS demo - in development
- △ Proposed ISS demo

Key Ongoing Challenges

- Life support system long-term reliability & loop closure
- Ability to test new technologies with system in ug before relying on them for deep space missions
- Reliance on on-orbit environmental monitoring with no sample return
- Partial gravity behavior - can we simplify ug systems?
- Dormancy/intermittent crew considerations
- Dust mitigation
- Food production, long-duration stability/viability
- Designing for in-space manufacturing/maintainability
- Autonomous operations

EVOLVING ECLSS FOR EXPLORATION

National Aeronautics and
Space Administration



Evolution of ISS
ECLSS Into
Exploration ECLSS



ISS

Continue ECLSS
Fleet Leader
Testbed in LEO



Notional Commercial
Platform

Initial Short-duration
ECLSS Evolving to
Full Regenerative ECLSS



Gateway



DST

Surface Systems Ground Test



Lunar Surface ECLSS: Excursion – Short Duration | Base – Regenerative



Mars Surface Regenerative ECLSS



Exploration ECLSS Roadmap

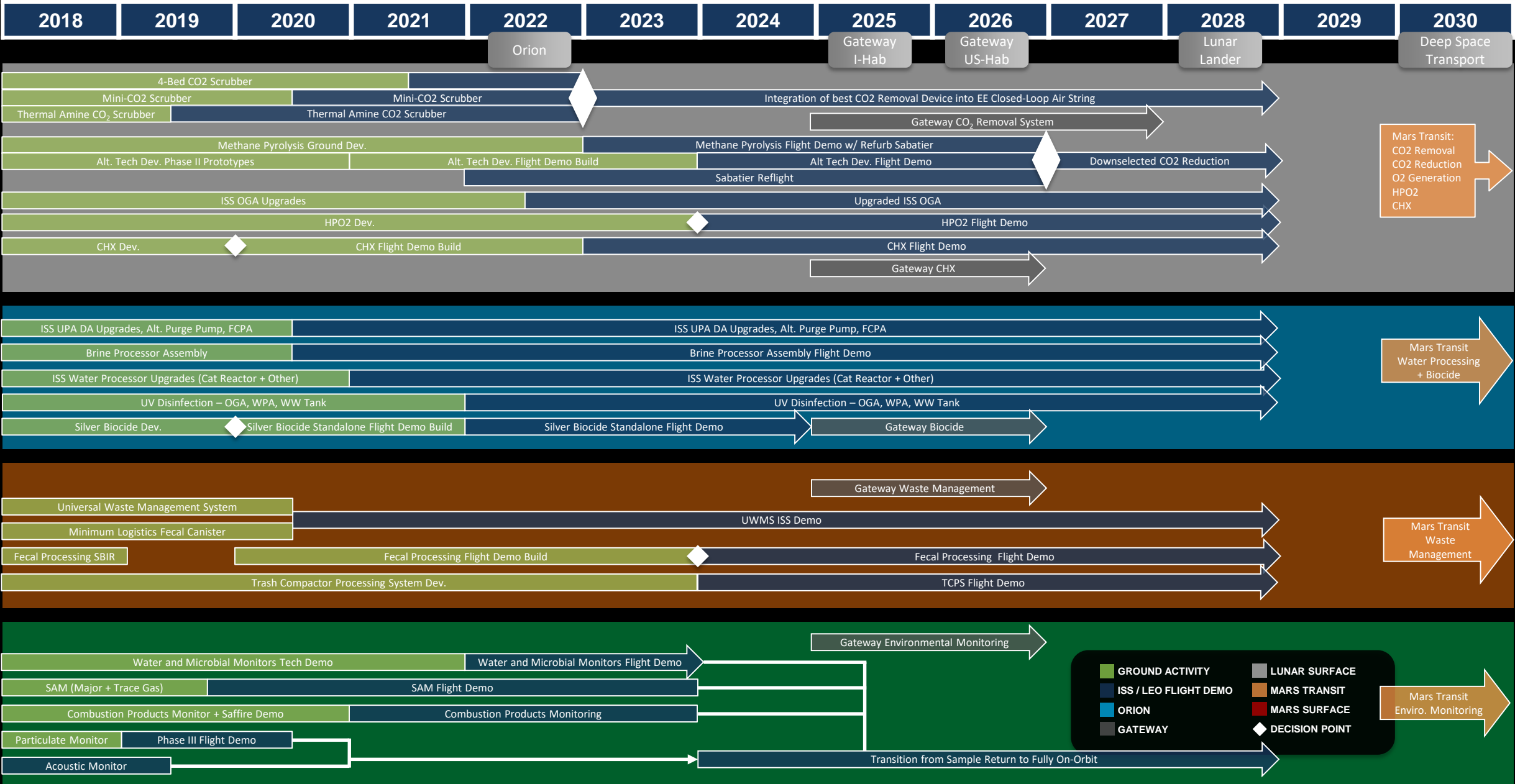
Revised: 03/26/2019

ATMOSPHERE MZANAGEMENT

WATER MANAGEMENT

WASTE MGMT

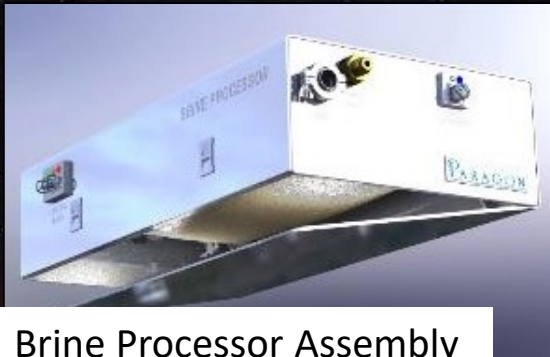
ENVIRO. MONITOR.



Recent and Upcoming ISS Demonstrations



Universal Waste Management System and Toilet Stall



Brine Processor Assembly



Min-Ion DNA Sequencer



Aerosol Sampler (Particulates)
Active Sampler (left) and Passive Sampler
(right) deployed in Node 3



Thermal Amine CO2 Scrubber

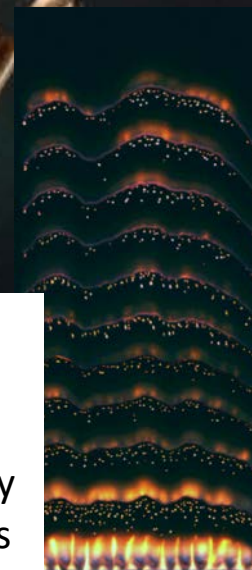


Spacecraft Atmosphere Monitor

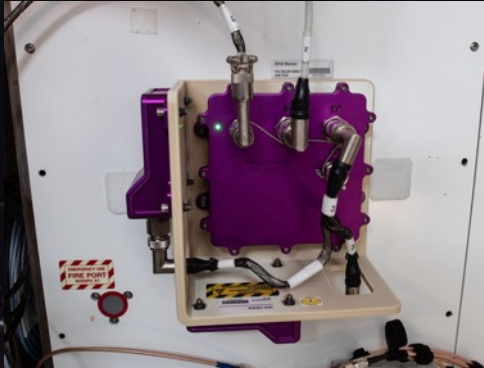
Acoustic Monitor



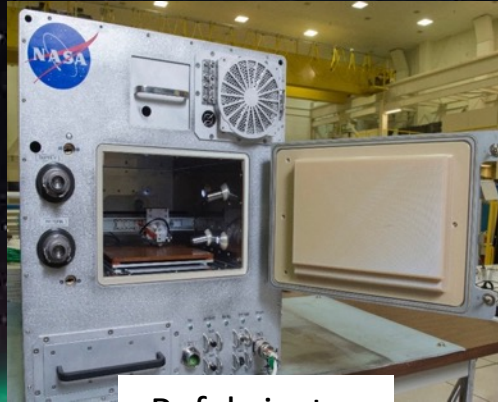
Spacecraft Fire Safety
(Saffire)
Flammability Experiments



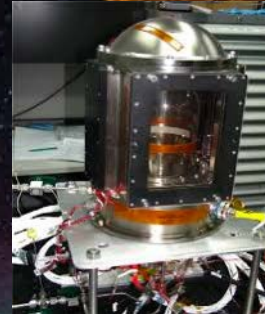
Recent and Upcoming ISS Demonstrations



Hybrid Electronic
Radiation Assessor (HERA)



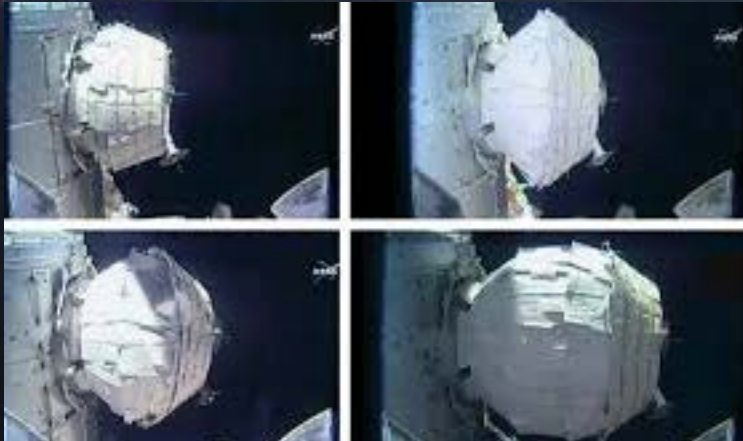
Refabricator



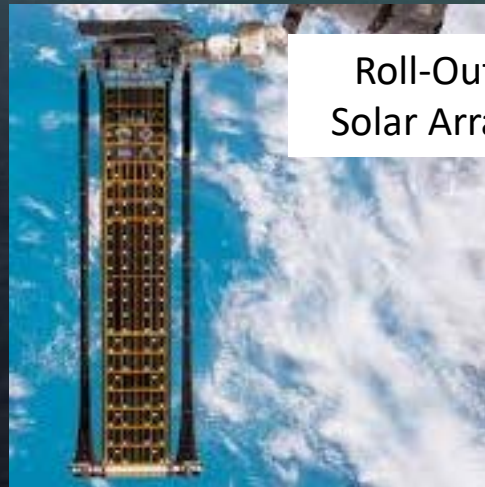
Zero Boil-Off Tank



Phase Change
Material Heat
Exchanger



Bigelow Expandable Activity Module (BEAM)



Roll-Out
Solar Array

RFID-Enabled
Automated Logistics
Management (REALM)



Miniature
Exercise Device