STS-132/ ISS-ULF4

HCAT Mission Familiarization Briefing

May 2010

Agenda

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- **Contingency Action Plan (CAP)**
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  - Plan Activation
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  - Roles and Responsibilities: Administrator and Deputy Administrator
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  - Roles and Responsibilities: HCAT Coordinator
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  - International Space Station and Space Shuttle (Standing) Interagency Investigation Board
  - Roles and Responsibilities: Assistant Administrator for International and Interagency Relations
  - Office of International and Interagency Relations STS-132 Trans-Atlantic Abort (TAL) / Emergency Landing Site (ELS) Support
- **Backup – Additional Mission and Space Operations Mishap Information**

STS-132/ ISS-ULF4 Mission Overview

STS-132 / ISS-ULF4 Crew and Mission Summary

STS-132 Crew, clockwise from bottom:

Ken Ham	Commander
Garrett Reisman	Mission Specialist #1
Michael Good	Mission Specialist #2
Tony Antonelli	Pilot
Piers Sellers	Mission Specialist #4
Steve Bowen	Mission Specialist #3

Expedition 23 Crew, from left to right:

Mikhail Kornienko	Flight Engineer #3
Tracy Caldwell Dyson	Flight Engineer #2
Alexander Skvortsov	Flight Engineer #1
Oleg Kotov	Commander
T. J. Creamer	Flight Engineer #6
JAXA **Soichi Noguchi**	Flight Engineer #5

Orbiter: OV-104 (*Atlantis)*

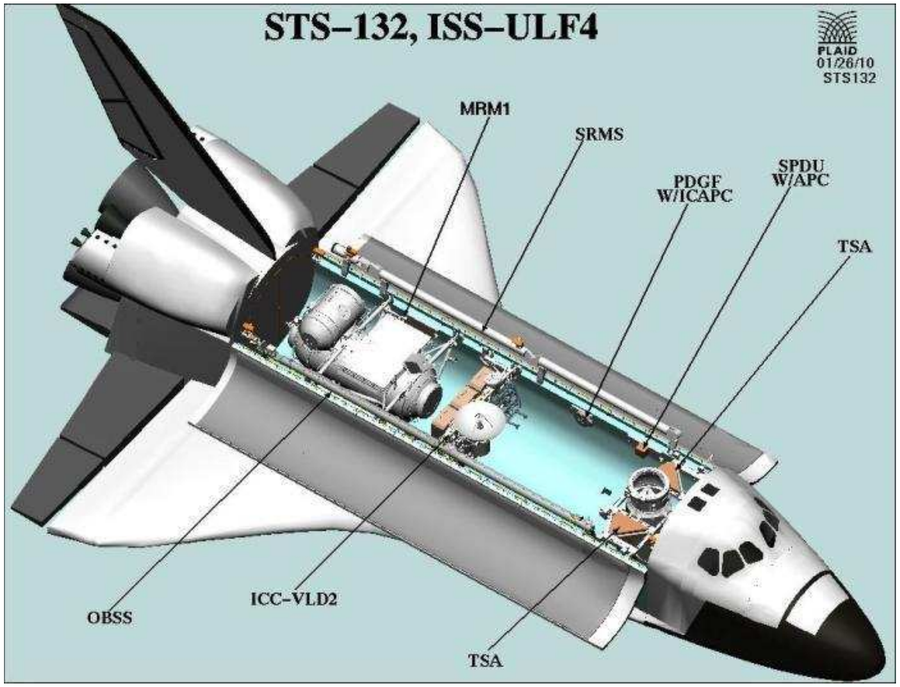
Launch Window Opens:
May 14, 2010

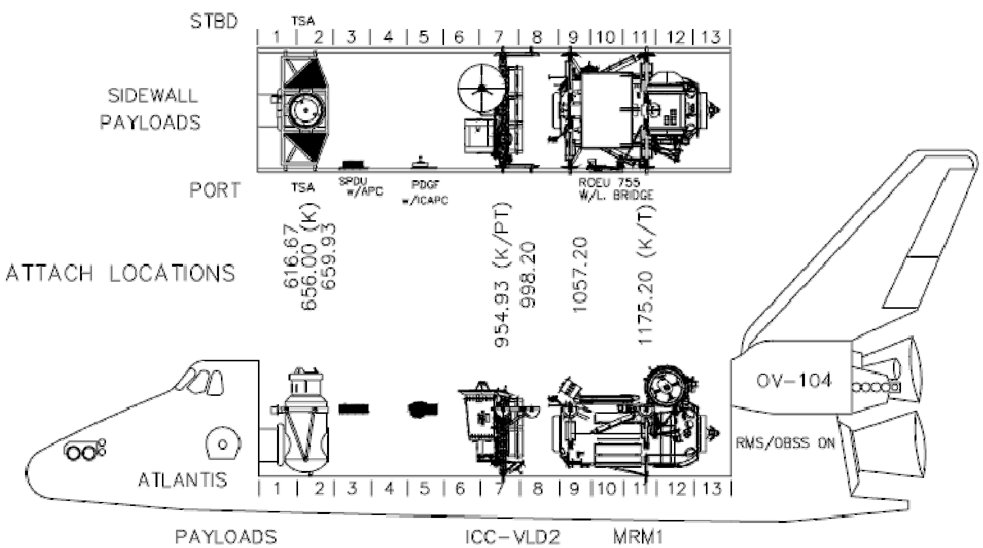
Mission Duration:
12 days nominal + 0 extension + 2 contingency

Mission Highlights:

- Last scheduled flight of the Space Shuttle *Atlantis*
- Deliver the Russian-built Mini-Research Module 1 (MRM-1), also known as Rassvet (Dawn), and install on the earth-facing port of the Functional Cargo Block (FGB) module
  - Provides extra cargo storage, research accommodations, and a docking port for Soyuz/Progress vehicles
  - Outfitting hardware for the Multipurpose Laboratory Module (MLM), a Russian research module to be launched at a later date, is mounted externally on MRM-1
  - 1400 kg of NASA cargo is launched inside (6.0 m^3 of usable on-orbit stowage volume)
  - First launch of a Russian module to ISS via the Space Shuttle
- Deliver ISS external hardware on the Integrated Cargo Carrier – Vertical Light Deployable 2 (ICC-VLD2):
  - Redundant Ku-band Space-to-Ground Antenna (SGANT)
  - Six P6 truss batteries for replacement during this mission
  - Enhanced Orbital Replacement Unit (ORU) Temporary Platform (EOTP) for the Special Purpose Dexterous Manipulator (SPDM), which is also known as "Dextre"
- Conduct three EVAs (Extravehicular Activity)
  - Install spare SGANT dish and boom on the ISS Z1 truss
  - Install EOTP on the SPDM
  - Remove and replace six batteries on the ISS P6 truss
  - As time permits, retrieve a Power Data Grapple Fixture (PDGF) from orbiter sidewall carrier (to be used for a stage EVA in July)
- Return the ICC-VLD2, carrying six spent P6 truss batteries, to the shuttle payload bay

STS-132 / ISS-ULF4 Payload





PAYLOAD BAY PAYLOADS:

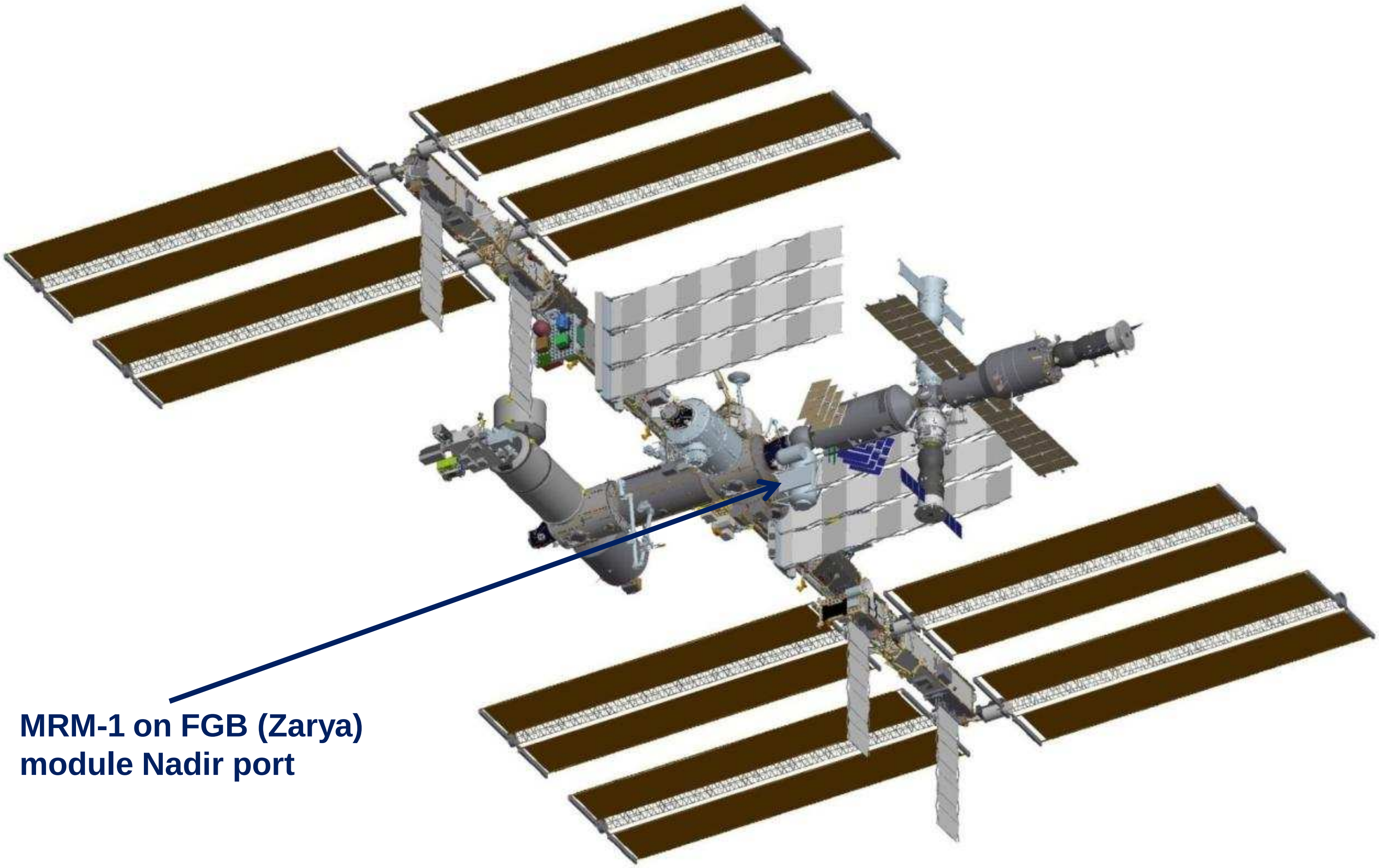
MRM-1	Mini-Research Module 1
ICC-VLD2	Integrated Cargo Carrier – Vertical Light Deployable 2, with ISS hardware - Spare SGANT: Space to Ground Antenna - Six P6 batteries for R&R during STS-132 - Enhanced ORU Temporary Platform (EOTP) for the Special Purpose Dexterous Manipulator (SPDM)
PDGF	Power Data Grapple Fixture (sidewall)

SUPPORT HARDWARE:

OBSS	Orbiter Boom Sensor System
ODS	Orbiter Docking System
ROEU	Remotely Operated Electrical Umbilical
SPDU	Station Power Distribution Unit
SRMS	Shuttle Remote Manipulator System
TSA	Tool Stowage Assembly

MRM-1: 23 feet long and 17,147 pounds

STS-132 / ISS-ULF4 ISS Configuration Change



MRM-1 on FGB (Zarya)
module Nadir port

STS-132 / ISS-ULF4 Timeline Summary

FD 1	**Launch; Shuttle Remote Manipulator System (SRMS) checkout; Mini-Research Module 1 (MRM-1) activation in the payload bay**	**FD 8**	**EVA 3 (Good & Reisman):** • Remove and replace the final 3 P6 channel 4B batteries; if time permits, retrieve Power Data Grapple Fixture (PDGF) from payload bay
FD 2	**Thermal Protection System (TPS) inspection using Orbiter Boom Sensor System (OBSS); spacesuit checkout; rendezvous prep**	**FD 9**	**Return ICC-VLD2 to payload bay; transfers; crew off-duty time; reboost**
FD 3	**Rendezvous and docking; hatch open; rendezvous pitch maneuver image download; ICC-VLD2 removal from payload bay and transfer to ISS Payload ORU Accommodation (POA); EVA1 prep**	**FD 10**	**Final transfers; hatch closure; undocking and flyaround**
FD 4	**EVA 1 (Bowen & Reisman):** • Install Space-to-Ground antenna; install tool platform on Special Purpose Dexterous Manipulator (SPDM); prep for battery replacement during EVA 2	**FD 11**	**Late inspections**
FD 5	**Focused inspection (if required); MRM-1 installation on ISS Russian segment; EVA 2 prep**	**FD 12**	**Entry prep; flight control system checkout; cabin stow**
FD 6	**EVA 2 (Bowen & Good):** • Remove and replace 3 of 6 P6 channel 4B batteries	**FD 13**	**Deorbit and Landing**
FD 7	**Crew off-duty time; MRM-1 leak checks & air sampling; EVA3 prep**		

undocked day (blue) **docked day** (yellow)

Useful Web Sites

"Agency Contingency Plan for Space Operations" as posted on NMIS under Current Events (only available within NASA firewall)

http://nmis.nasa.gov

ISS Contingency Response Web Site (only within NASA firewall):

https://mod2.jsc.nasa.gov/da7/imc/index.cfm

Shuttle Mission Management Team (MMT) and ISS MMT (IMMT) (only within NASA firewall):

https://sspweb.jsc.nasa.gov/mmt/

http://iss-www.jsc.nasa.gov/nwo/ppco/cbp_issmmt/web/

Mission Updates:

http://www.spaceflightnow.com/

http://spaceflight.nasa.gov/shuttle/index.html

http://www.nasa.gov/mission_pages/station/main/index.html

Ground Tracks and Sightings (Shuttle and ISS):

http://spaceflight1.nasa.gov/realdata/tracking/index.html

http://spaceflight1.nasa.gov/realdata/sightings/

http://www.heavens-above.com

More Information on the ISS Research and Facilities:

http://www.nasa.gov/mission_pages/station/science/index.html

Mission Animations/Images**:**

http://iss-www.jsc.nasa.gov/nwo/pio/magik/web/movie.shtml

http://spaceflight.nasa.gov/gallery/images/shuttle/sts-132/ndxpage1.html

STS-132/ULF4 Flight Readiness Review charts (only within NASA firewall):

https://sspweb.jsc.nasa.gov/webdata/launch/STS-132/132.htm

ISS ULF4 Stage Operations Readiness Review charts (only within NASA firewall):

http://iss-www.jsc.nasa.gov/nwo/ppco/cbp_pr/bbt_docs/bbtcal/ULF4_SORR_Agenda.11.22-Apr-2010.htm

Space Operations Center (SOC) Mission Support

Space Operations Center (SOC) Overview

SOC Staff Functions:

- Maintain situational awareness during routine and critical mission events
  - Provide linkage between flight management teams and Headquarters senior managers
  - Provide mission status reports to senior Space Operations Mission Directorate (SOMD) and NASA Headquarters management
- In the event of a mission contingency, initiate the appropriate contingency response per the "Agency Contingency Action Plan for Space Operations" as posted at http://nmis.nasa.gov

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THE SOC IS AVAILABLE AT **(202) 358-4456** OR AT

HQ-SpaceOperationsCenter@mail.nasa.gov

Nominal SOC Coverage for Shuttle missions:

- **Shuttle Staff**
  - Pre-Launch: Support significant events, such as L-2 and L-1 MMT
  - Launch to Landing: Based on crew work schedule*
- **ISS Staff**
  - Pre-Launch to Docking: Support significant events
  - Docking to Undocking: Based on crew work schedule *
  - Undocking to Landing: Support significant events

* SOC staff will also be on duty for all mission-critical activities, including External Tank (ET) tanking and de-orbit prep. SOC staff may not be on duty for some non-critical mission activities.

Mission Management Team (MMT)

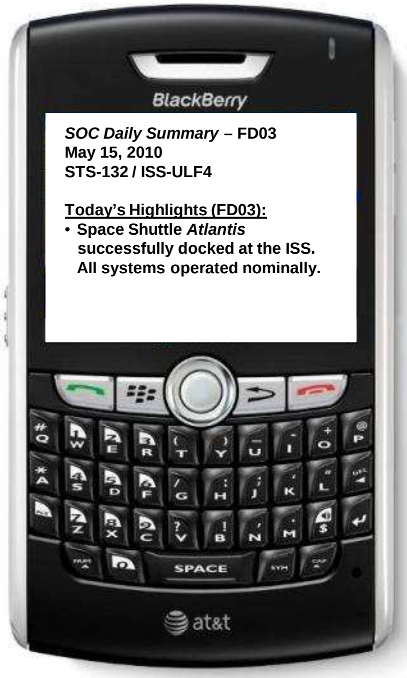
Shuttle MMT

- **Meet daily from Launch -2 Days (L-2) through Landing decision day**
  - Typically held at 2:00 PM Eastern
  - Meet post undocking as required
- **MMT agenda**
  - Project/element status of systems and operations
  - Review integrated in-flight anomalies
  - Decisions
    - Changes to upcoming mission timeline events
    - Changes to mission priorities
  - Thermal Protection System (TPS) assessment process
    - Imagery/inspection data reports
    - Analysis results
    - Damage prediction & prioritization
      - Requirements for additional imagery, inspection, or analysis
    - Decisions
      - Indications of repair
      - Requirements for repair, additional EVA, or Orbiter Repair Maneuver (ORM)
      - Potential for Contingency Shuttle Crew Support (CSCS)

ISS MMT (IMMT)

- **Meet daily during docked operations**
  - Typically held at 9:00 AM Eastern
  - Prior to Shuttle MMT
- **ISS MMT agenda**
  - Status reports of systems and operations
    - ISS
    - Shuttle
    - International Partners
  - Review mission progress and in-flight anomalies
  - Decisions
    - Changes to upcoming mission timeline events
    - Changes to mission priorities

Space Operations Center Reports



Report	Content
SOC Daily Summary	Highlights of the day's events: ✓ Summary of completed activities ✓ Description of off-nominal conditions, mission impacts, and resolution plans ✓ Concise summary of upcoming key events
Event Updates	Brief text message describing progress or completion of critical mission events, such as launch, docking, or EVA

SOC Daily Summary for STS-132 / ISS-ULF4
Flight Day XX (May XX, 2010)

Today's Highlights (FD XX):
- **Major accomplishments, crew activities, significant joint issues**

Shuttle Status
- **Shuttle specific accomplishments, crew activities**
- **Brief status of Shuttle systems, performance and consumables**
- **Potential impact to mission objectives**
- **Significant MMT results, decisions, and ongoing actions**
- **Shuttle Thermal Protection System (TPS) assessment status**

ISS Status
- **ISS specific accomplishments, crew activities**
- **Brief status of ISS systems, performance and consumables**
- **Potential impact to mission objectives**
- **Significant IMMT results, decisions, and ongoing actions**

Mission Timeline Look-ahead:
Example:
May 16 (FD 03) Rendezvous/docking, ICC-VLD 2transfer to POA, EVA #1 prep
Major activities, with times in EDT
Meetings (ISS MMT at 9:00 am Eastern, Shuttle MMT at 2:00 pm Eastern)
May 17 (FD 04) EVA #1 (SGANT, EOTP, battery prep)
May 18 (FD 05) Focused Inspection – if required, MRM-1 installation, EVA #2 prep
May 19 (FD 06) EVA #2 (P6 battery R&R)
May 20 (FD 07) Crew off-duty time, MRM-1 leak checks, EVA #3 Prep
May 21 (FD 08) EVA #3 (P6 battery R&R)
May 22 (FD 09) ICC-VLD2 reberth in payload bay, reboost, crew off-duty time
May 23 (FD 10) Final transfers, hatch closure, undock, flyaround
May 24 (FD 11) Late inspection
May 25 (FD 12) Orbiter FCS checkout, RCS hot fire, cabin stowage
May 26 (FD 13) Deorbit and landing (nominal landing)

NASA Headquarters
Space Operations Center (SOC), 7D61
202-358-4456, HQ-SpaceOperationsCenter@mail.nasa.gov

Acronym List

Contingency Action Plan

Definition of a Space Operations Mishap

A Space Operations (SO) mishap is defined as any mishap, mission failure or high visibility close call that causes or may cause a major impact to Space Operations or prevents accomplishment of a primary mission objective involving Space Operations Mission Directorate (SOMD)-controlled personnel, hardware, support equipment, or facilities or any personnel, hardware, software, equipment, or facilities that have been integrated with SOMD-controlled flight related systems.

A SO mishap can involve any SOMD space operations or development program, including suspected mishap situations at contractor facilities and/or government facilities operated under contract.

Mishap Classifications

Classification Level & Investigation Type	Property Damage	*AND/OR*	Injury	Board Appointing Official (Summary)** & ***
High-Visibility Mishap or Close Call				Mission Directorate Associate Administrator (MDAA) or Center Director (CD) or Associate Administrator (AA) for the Office of Infrastructure and Administration (OIA) or the Chief Health and Medical Officer (CHMO)
Type A Mishap	Total direct cost of mission failure and property damage is $1M or more, ***or*** Crewed aircraft hull loss ***or*** Unexpected aircraft departure from controlled flight		Occupational injury and/or illness that resulted in: A fatality, ***or*** A permanent total disability, ***or*** Hospitalization for inpatient care of 3 or more people within 30 workdays of the mishap	Administrator, AA, CD, or AA/OIA or MDAA or CHMO
Type B Mishap	Total direct cost of mission failure and property damage of at least $250K but less than $1M		Permanent partial disability ***or*** Hospitalization of 1-2 people within 30 days of the mishap	CD or AA/OIA or MDAA or CHMO
Type C Mishap	Total direct cost of mission failure and property damage of at least $25K but less than than $250K		Nonfatal occupational injury or illness that caused any workdays away from work, restricted duty, or transfer to another job.	CD designee or AA/OIA or MDAA or CHMO
Type D Mishap	Total direct cost of mission failure and property damage of at least $1K but less than $25K		Any nonfatal OSHA recordable occupational injury and/or illness that does not meet the definition of a Type C mishap.	CD designee or AA/OIA or MDAA or CHMO
Close Call	An event in which there is no equipment/property damage or minor damage (less than $1K) but which possesses a potential to cause a mishap.		Minor injury requiring first aid or an occurrence or condition with no injury which possesses the potential to cause a mishap.	CD designee or AA/OIA or MDAA or CHMO

Plan Activation

- The “Agency Contingency Action Plan for Space Operations” is activated when the Associate Administrator for Space Operations declares a Space Operations Contingency and following consultation with the NASA Administrator or Deputy Administrator.
- For Type A mishaps and close calls, the Administrator:
  - Will appoint or delegate appointment of a Mishap Investigation Board (MIB)
  - May activate the Headquarters Contingency Action Team (HCAT) to oversee the investigation and insure consistency in the dissemination of accident investigation information.
  - **May decide to activate NASA’s standing Interagency Investigation Board.**
- Note: For Space Shuttle Missions, a standing Mishap Investigation Team (along with a standing Crew Recovery Team and a Rapid Response Team) will serve as the Initial Response Team. They will hand off the investigation once a NASA Mishap Investigation Board (MIB) or Interagency Investigation Board is established.

Roles and Responsibilities
Associate Administrator for Space Operations (AA/SO)

The AA/SO, or designated representative:

- Declares whether a SO mishap, mission failure, or high-visibility close call is a SO contingency based on the recommendation of the reporting organization.
- Determines, with the Chief Safety and Mission Assurance Officer, the Mishap Board determining official and potential board membership. If a Commission is appointed, the AA/SOMD will determine (with support from the Chief Safety and Mission Assurance Officer, General Counsel, and the Office of International and Interagency Relations) if a separate NASA investigation is required.
- Identifies who will initiate the mishap response telephone conference and lead the discussion at the conference.
- Reports preliminary information concerning the mishap to the HCAT.
- Considers, upon consultation with the Administrator, reassigning without prejudice individuals in positions to influence the investigation, should it be deemed a real or perceived conflict of interest potentially damaging the integrity of the investigation.

Roles and Responsibilities
Administrator and Deputy Administrator

- **Mishap notification + 60 minutes:**
  - Confers with SOMD to get a "first story"
  - Begins external notifications (e.g., key members of the Administration and Congress)
  - Determines media response and arranges for a "first story" press release
  - Appoints a Mishap Investigation Board (or Independent Interagency Investigation Board)
- **Mishap Notification + 2 hours and 30 minutes:**
  - Participates in the first mishap formal tag up – Mishap Response Teleconference (MRT)
    - Can activate the HCAT to oversee the mishap investigation
    - Can appoint a Senior Agency Official – Washington (SAO-W) to be a liaison with the Administration
  - Participates in a Press Conference with Program personnel, as appropriate (following the MRT)
  - Completes external notifications (e.g., International Partners)
- **Mishap Board appointment is typically accomplished within 48 hours.**

The Chief, Safety and Mission Assurance:

1. Advises the Administrator and AA/SO on an appropriate course of action.
2. Serves as the appointing official and approving official for Type A mishap investigation boards if directed by the Administrator, or for other high visibility mishaps or close calls, at his discretion. Provides guidance to the Administrator and AA/SO if a Presidential Commission is appointed.
3. Concurs with the membership of an AA/SO-appointed mishap investigation board and serves as the approving official for its report.
4. Participates or designates a NASA official to serve as the ex-officio member of the mishap investigation board.
5. Participates in the mishap response telephone conference and on the HCAT.
6. Provides support staff for the HCAT Action Center.

Headquarters Contingency Action Team (HCAT) Membership

• Administrator	Charles Bolden
• Deputy Administrator	Lori Garver
• Associate Administrator	Chris Scolese
• Chief of Staff	David Radzanowski
• Associate Deputy Administrator	Charles Scales
• Deputy Chief of Staff/White House Liaison	David Noble
• Chief Engineer	Michael Ryschkewitsch
• Chief Health and Medical Officer	Richard Williams
• Chief Safety & Mission Assurance	Bryan O'Connor
• General Counsel	Michael Wholley
• Associate Administrator for Communications	Bob Jacobs (Acting)
• Associate Administrator for Independent Program and Cost Evaluation	W. Michael Hawes
• Associate Administrator for International and Interagency Relations	Michael O'Brien
• Associate Administrator for Legislative and Intergovernmental Affairs	Seth Statler
• Associate Administrator for Space Operations	William Gerstenmaier
• Deputy Associate Administrator for Space Operations	Lynn Cline
• Associate Administrator for Mission Support	Woodrow Whitlow
• SSP & ISS Technical Authority	Michael Coats (JSC-AA)
• Senior Agency Official in Washington (SAO-W)	*Administrator Designee*

Note: Additional HCAT members may be assigned depending on the SO program/project affected by the declared contingency.

Roles and Responsibilities

HCAT Coordinator

Prior to a Space Shuttle launch, the HCAT Coordinator is typically the Assistant Associate Administrator for Space Shuttle Program. When the AA/SO declares a Space Operations Contingency, he will designate the HCAT Coordinator, appropriate to the type of contingency and the program(s) affected.

The HCAT Coordinator:

1. Convenes the HCAT and establishes the location of the meetings and teleconferences. If a telecon is required, makes telecommunications arrangements through the NASA Conferencing Service
2. Activates an HCAT Action Center to track the status of the investigation and control the dissemination of accident investigation information.
3. Initiates the mishap response telephone conference, if directed by the AA/SOMD.
4. Ensures that the HCAT members, and other NASA personnel, are kept informed of the on-going contingency status and any direction given by the Administrator.
5. Keeps HCAT contact information current for the HCAT members to facilitate constituting the HCAT when directed by the Administrator.
6. Distributes the International Contact listing maintained by the Office of International and Interagency Relations to the HCAT.
7. Serves as a liaison and point of contact for other NASA Headquarters organizations.
8. Provides the Administrator with a list of potential candidates for participation in an investigation board, when requested.
9. Provides the SAO-W with required support and ensures appropriate communication between the SAO-W and the HCAT.

HQS Contingency Action Team (HCAT) Summary Roles and Missions

- The Administrator can activate the HCAT to oversee an accident investigation, and may appoint a Senior Agency Official to be a liaison with the Administration
- Space Operations makes the decision to identify a mishap as a contingency, provides initial information to the HCAT members, and recommends Board selection
- The Office of Communications manages and coordinates news inquiries
- Safety and Mission Assurance provides advice to the Administrator and approval and concurrence as the Board is formed
- International and Interagency Relations provides International Partner and U.S. State Department notifications and provides and analyzes international agreements
- Legislative and Intergovernmental Affairs assists with notifications to members of Congress
- The Mission Support Directorate assists with payments for supplies, services, travel
- SOMD Center Directors provide mishap information & implement contingency decisions
- The Health and Medical Officer provides contingency-related medical support

International Space Station and Space Shuttle (Standing) Interagency Investigation Board

- **BOARD CHAIR:**
  - Appointed by the NASA Administrator
- **STANDING BOARD MEMBERS:**
  - Commander, Naval Safety Center, Rear Adm. Arthur J. Johnson
  - Commander, Air Force Flight Test Center, Maj. Gen. David J. Eichhorn
  - USAF Chief of Safety, Maj. Gen. Frederick F. Roggero
  - DOT Chief of Aviation Safety Division, Dr. Kim M. Cardosi
  - FAA Office of Accident Investigation, Mr. Tony Fazio
  - Commander, 14th Air Force, Lt. Gen. Larry D. James
  - NASA Field Center Director or NASA Program Associate Administrator (Non-SOMD or non-Mission-Related)
- **STANDING BOARD SUPPORT:**
  - Ex-Officio Member: NASA, Chief Safety and Mission Assurance Officer, Bryan D. O'Connor
  - Executive Secretary: NASA Chief Engineer, Michael Ryschkewitsch
  - Contracts and Procurement Specialist: Will be designated by the Assistant Administrator for Institutions and Management

Roles and Responsibilities

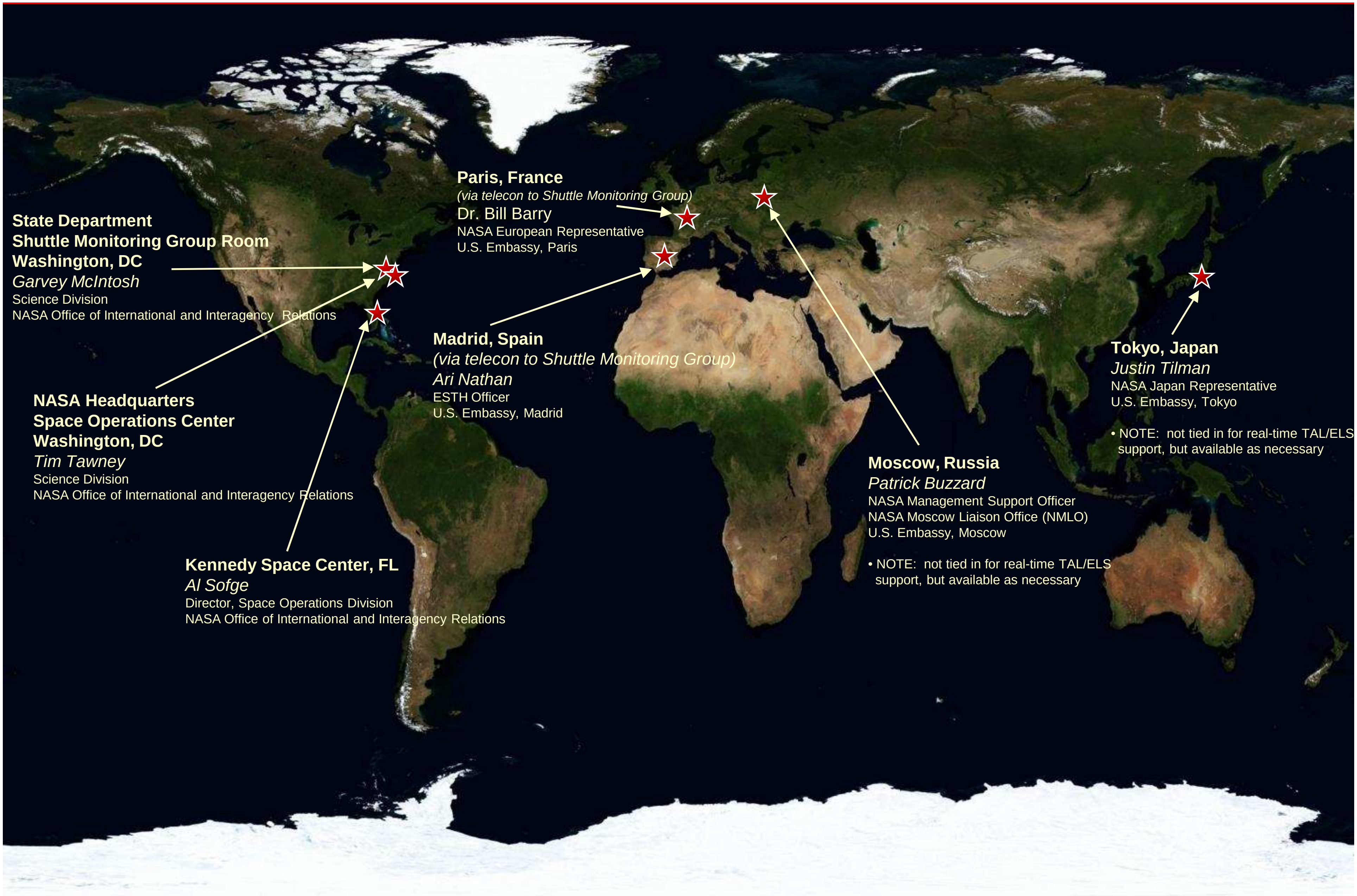
Associate Administrator for International and Interagency Relations

The Associate Administrator for International and Interagency Relations works with the NASA Administrator, AA/SO and the Office of Communications to help distribute contingency information to the International Partners. Specifically, they will:

1. Notify members of the Administration including the U.S. Department of State of the contingency and actions being taken.
2. Notify International Partners of the contingency and actions being taken; interface with the U.S. Department of State for mission related activities and contingencies.
3. Provide the NASA Administrator with copies and analyses of any international agreements that might be impacted by the contingency.
4. Advise the NASA Administrator on appropriate dissemination of information to members of the Administration and Congress.

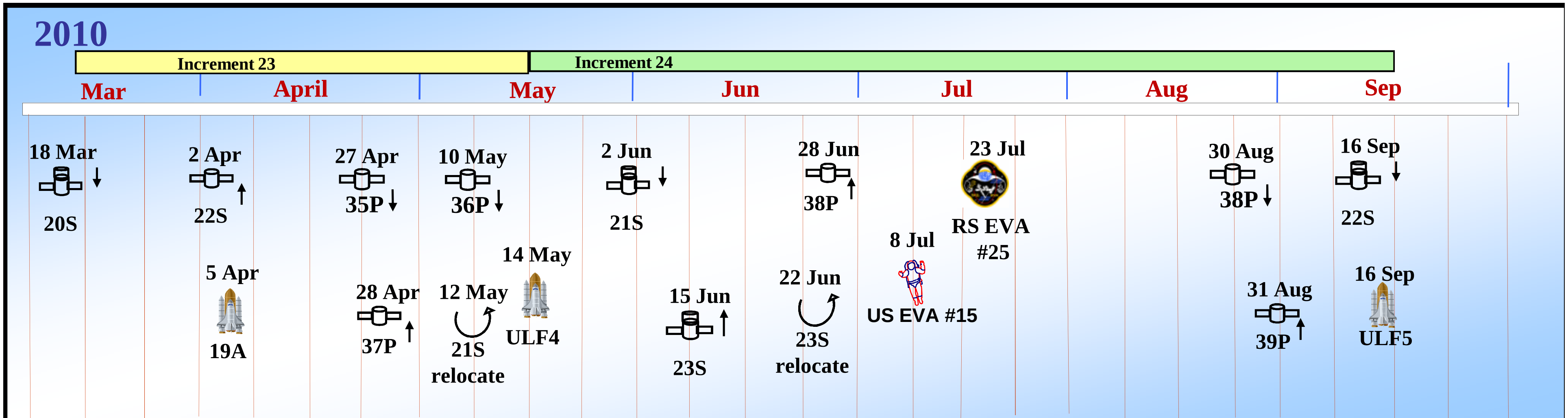
Office of International and Interagency Relations

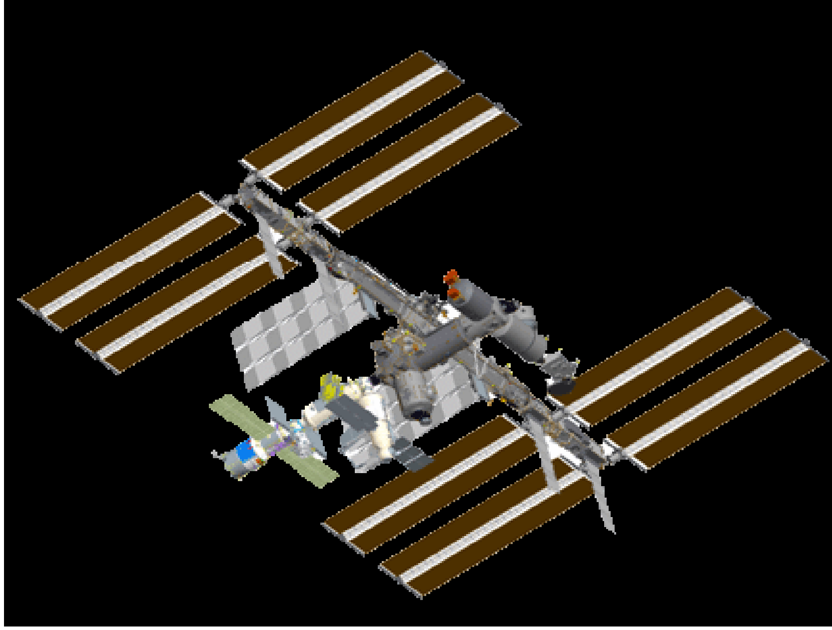
STS-132 Trans-Atlantic Abort (TAL) / Emergency Landing Site (ELS) Support



BACKUP
Additional Mission Information

Increment 23-24 Summary





21 Soyuz Crew

Oleg Kotov
Exp 23 CDR

Soichi Noguchi
Exp 23 FE5

T. J. Creamer
Exp 23 FE6

22 Soyuz Crew

Aleksandr Skvortsov
Exp 23 FE1 / Exp 24 CDR

Tracy Caldwell
Exp 23/24 FE2

Mikhail Kornienko
Exp 23/24 FE3

23 Soyuz Crew

Doug Wheelock
Exp 24 FE4

Fyodor Yurchikhin
Exp 24 FE5

Shannon Walker
Exp 24 FE6

All dates are Eastern

STS-132 / ISS-ULF4 Contingency Shuttle Crew Support (CSCS)

- With standard assumptions, duration for all consumables is greater than the Shuttle Launch On Need (LON) capability of 125 days (May 14 STS-132 launch to September 16 STS-133 LON launch)
  - Food (125 days)
  - Water (224 days)
  - Waste containment (252 days)
  - Oxygen (O2) (342 days)
  - Carbon Dioxide removal (CO2) (unlimited days)
- If the Elektron fails, the O2 capability is 174 days
- If the Urine Processing Assembly (UPA), Water Processing Assembly (WPA), and Oxygen Generation System (OGS) fail, the ISS capability is still greater than the LON capability
  - O2 (132 days), water (170 days) and Waste containment (169 days)
- If both Carbon Dioxide Removal Assemblies (CDRA) fail, the ISS capability (35 days) is not greater than LON capability
  - ULF4 launches 2nd new CDRA bed (20A delivered 1st) resulting in 2 complete CDRAs on ISS

CSCS TPS Duration Report as of 4/2/2010

L-1 Month Report

- Assumes STS launch date of: 5/14/2010
- Based on current projected ISS consumables and system health
- Assumes CSCS TPS duration begins at STS dock
- LON rescue flight must dock to ISS by: 12/26/10

ISS Failure @ MECO	Engineering Estimate	No ISS Failures
35 Days (CO2 Removal)	224 Days (Water)	238 Days (Water)
O2 Generation		
Same as Eng estimate except:	Progress O2 tanks: 123.41 lbs	Same as Eng estimate
	STS O2 Xfer: 18 lbs	
	SFOG-2: 88 cartridges	
	SFOG-3: 78 cartridges	
	Elektron: ON-5 crew	
OGS: FAILED	OGS: ON-210.6 days	
	A/L tanks: 606 lbs	
Total Days: 115+17(STS) = 132 Days	Total Days: 325+17(STS) = 342 Days	
	Duration with no Orbiter Support = 323 Days	
CO2 Removal		
Same as Eng estimate except:	STS LiOH: 43 cans available	Same as Eng estimate
	ISS LiOH: 29 cans	
	RS LiOH: 17 cans	
	Vozdukh: ON-5 crew	
CDRA: FAILED	CDRA: Dual Bed (7 crew)	
Total Days: 35 Days	Total Days: Unlimited Days	
	Duration with no Orbiter Support = Unlimited Days	
Water		
Same as Eng estimate except:	ISS H2O: 3400 L	Same as Eng estimate except:
	STS H2O Xfer: 903 L	
	Elektron: 50 Amp mode	
OGS: FAILED	OGS: ON-210.6 days	
UPA: FAILED	UPA: ON	
WPA: FAILED	WPA: ON	
	RFTA: 3.86 on ISS+ 2 on STS	
	MF Beds: 1.1 on ISS+ 0 on STS	
	CFU: OFF	CFU: ON
	SRV-K: ON	
Total Days: 153+17(STS) =170 Days	Total Days: 207+17(STS) =224 Days	Total Days: 221+17(STS) =238 Days
	Duration with no Orbiter Support = 166 Days	
Waste Management		
Solid Waste	ASU: 167 Days	Same as Eng estimate
Same as Eng estimate	Back-Up Hardware: 98.1 Days	
	Total: 265 + 15.6(STS) = 280 Days	
Liquid Waste		
Same as Eng estimate except:	ASU: 225.6 Days	
UPA: FAILED	Back-Up Hardware: 11.7 Days	
Total: 154 + 15.6 (STS) = 169 Days	Total: 237.3 + 15.6(STS)=252 Days	
	Duration with no Orbiter Support = 237 Days	
Food		
Same as Eng estimate except:	Total Rations: 938 rations	Same as Eng estimate except:
Caloric Intake: 2400 kcal/day	Caloric Intake: 2000 kcal/day	Caloric Intake: 2000/1000 kcal/day
Total Days: 104 Days	Total Days: 125 Days	Total Days: 187 Days
	Duration with no Orbiter Support (middeck or MRM) = 84.5 Days (2000 kcal/day rate)	

STS-132 / ISS-ULF4 Mission Priorities

Category 1 priorities

- Dock the orbiter and perform mandatory safety briefing
- Activate and checkout MRM-1 in the shuttle payload bay
- Robotically install MRM-1 to Nadir port of FGB
- Transfer mandatory quantities of water (none identified)
- Transfer critical cargo items
- Transfer ICC-VLD2 from the payload bay and install on the mobile transporter POA

Category 2 priorities

- Install the SGANT dish and boom on Z1 truss
- Install the EOTP on the SPDM
- Replace the six P6 channel 4B batteries with new batteries from the ICC-VLD2 and install old batteries on the ICC-VLD2
- Return the ICC-VLD2 with old batteries to the shuttle payload bay
- Transfer mission success items
- Remove the PDGF from the shuttle sidewall carrier and transfer to ISS *(now a get-ahead task)*

Category 3 priorities

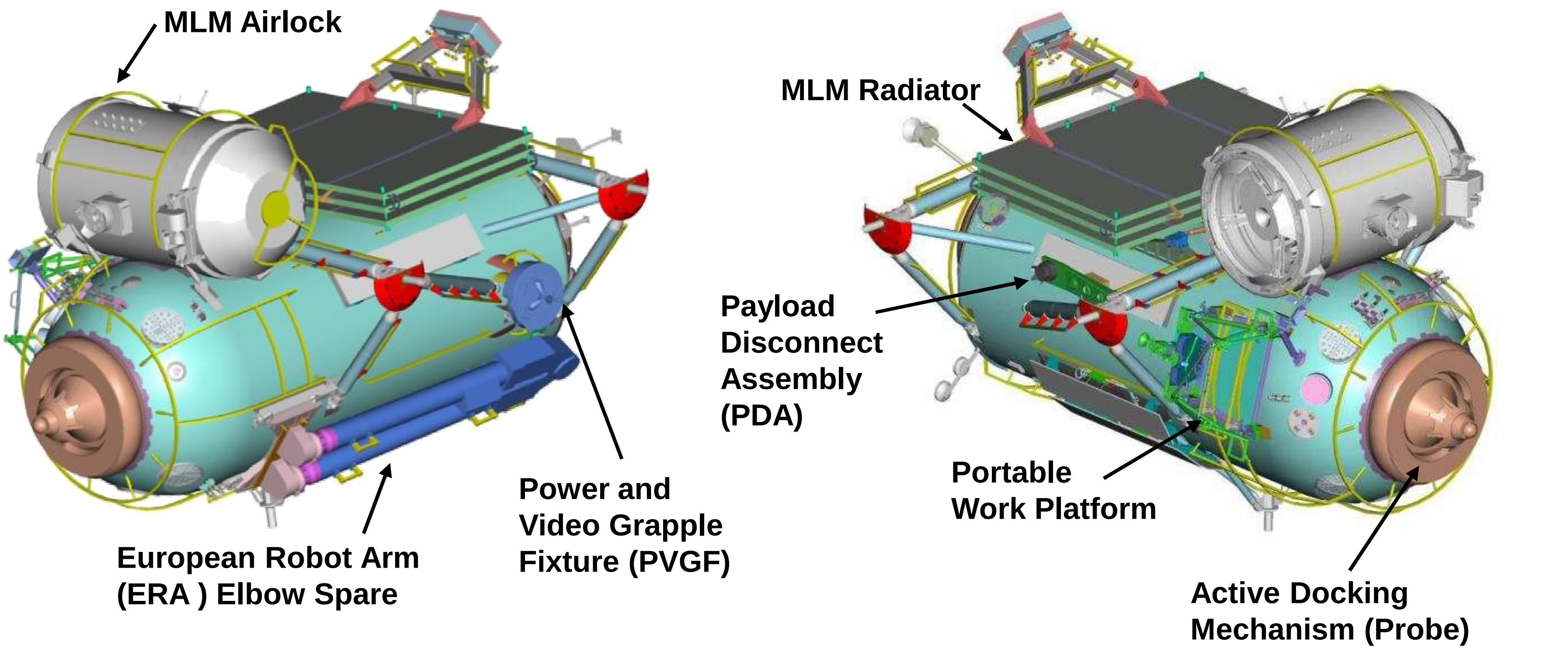
- Perform ISS payload status checks as required
- Perform critical non-recoverable ISS utilization activities
- Transfer remaining water quantities
- Transfer remaining cargo items
- Perform Extravehicular (EVA) tasks deemed to fit within EVA timelines
- Perform daily middeck activities to support payloads
- Perform remaining ISS payload research operations tasks

Category 4 priorities

- Perform Russian resupply
- Transfer nitrogen from the orbiter to the ISS
- Transfer oxygen from the orbiter to the ISS
- Obtain ISS fly-around imagery
- Perform shuttle-mated ISS reboost
- Perform EVA get-ahead tasks as time permits
- Perform IVA get-ahead tasks as time permits
- Perform ISS Structural Life Validation tests
- Shuttle payloads of opportunity (RAMBO-2, MAUI, SEITE, SIMPLEX)

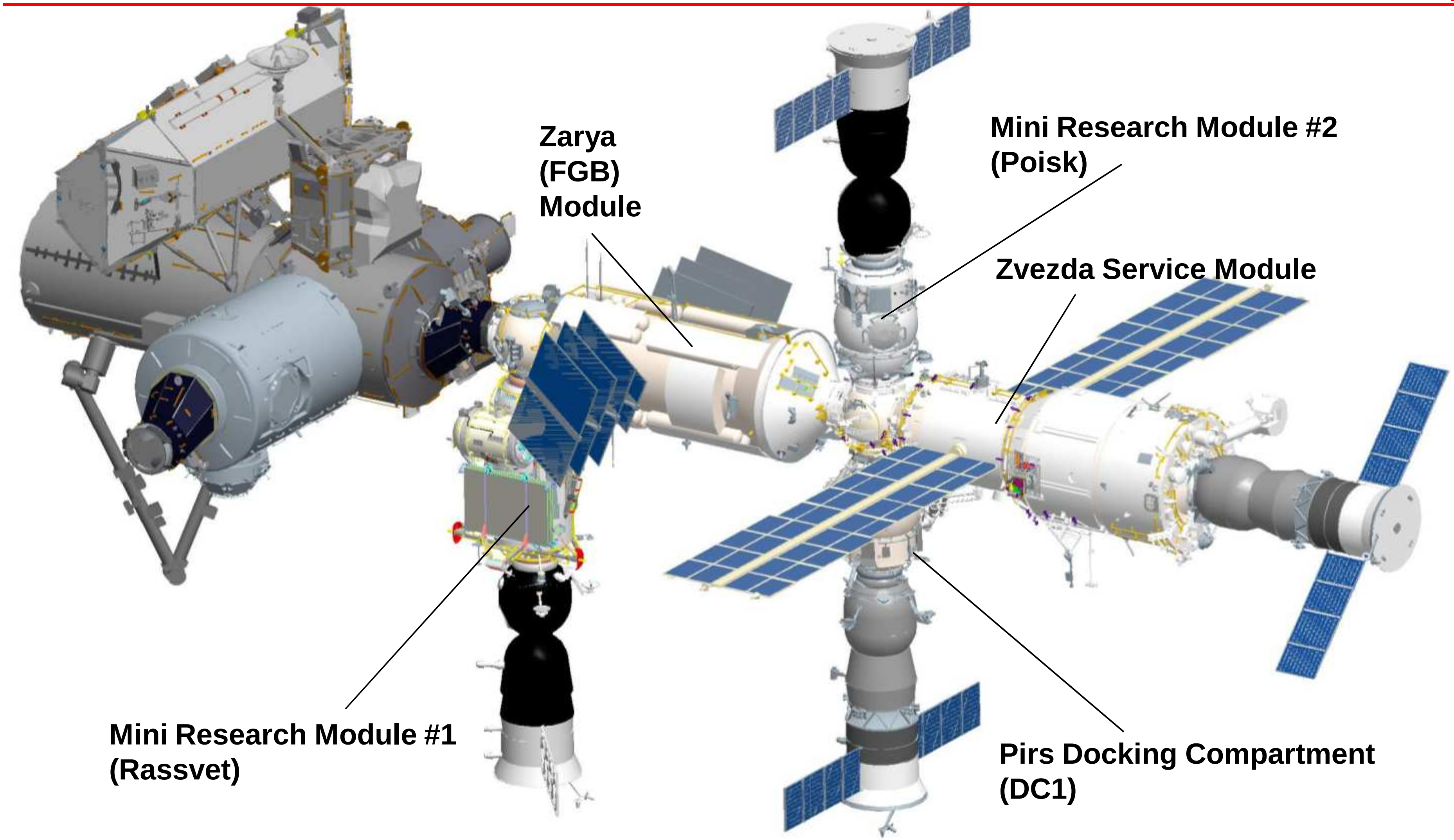
Category 1 – Mandatory for this flight
If not performed, will require a reflight prior to continuation of the assembly sequence
Category 2 – Very highly desirable
If not performed will result in significant changes to subsequent mission tasks and timeline
Category 3 – Highly desirable
If not performed will impact activities on subsequent flights, but the primary training and timeline for subsequent flights will not be affected
Category 4 – Desirable
"Get-ahead" tasks that will be scheduled as time becomes available

Mini-Research Module 1 (MRM-1)



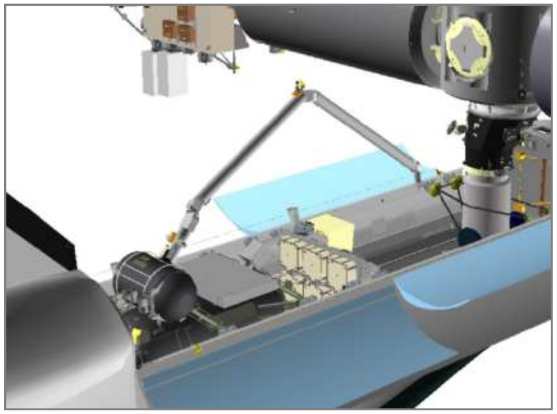
- The Mini Research Module 1 (MRM-1), also known as Rassvet (Dawn), provides cargo storage, research accommodations, and a docking port for Soyuz and Progress vehicles
- Outfitting hardware for the Multipurpose Laboratory Module (MLM), a Russian research module to be launched on a Russian rocket at a later date, is mounted externally on MRM-1
- 1400 kg of NASA cargo launches inside (6.0 m^3 of usable on-orbit stowage volume)

MRM-1 Mated to the ISS

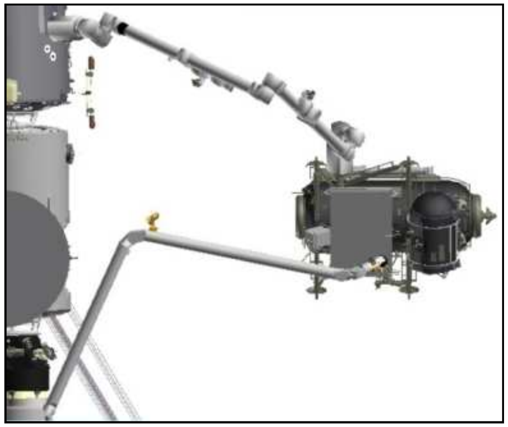


MRM-1 will be attached to the Nadir (earth-facing) port of the Functional Cargo Block (FGB), also known as Zarya

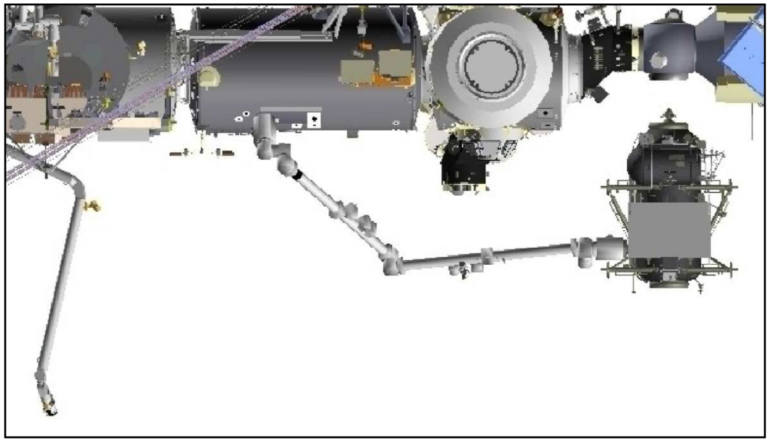
MRM-1 Removal, Transfer & Docking to the FGB



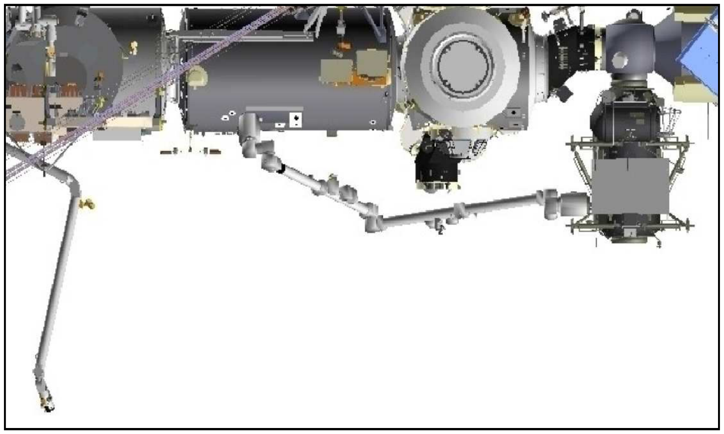
1 - Shuttle robotic arm removes MRM-1 from payload bay



2 - Handoff to the ISS robotic arm

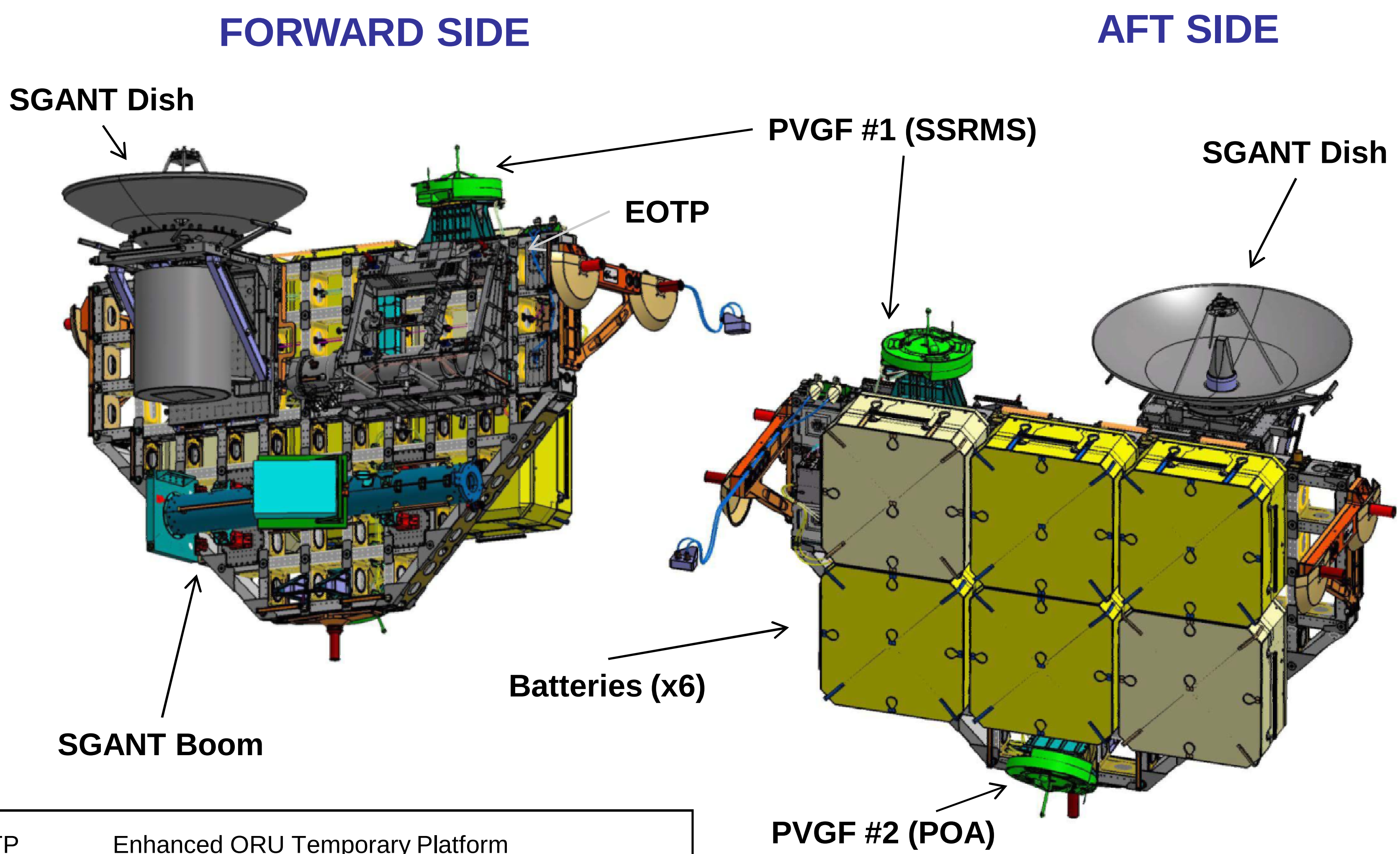


3 – ISS arm moves MRM-1 to the install position



4 - Docking MRM-1 to the FBG (Zarya) Nadir port

Integrated Cargo Carrier – Vertical Light Deployable 2 (ICC-VLD2)

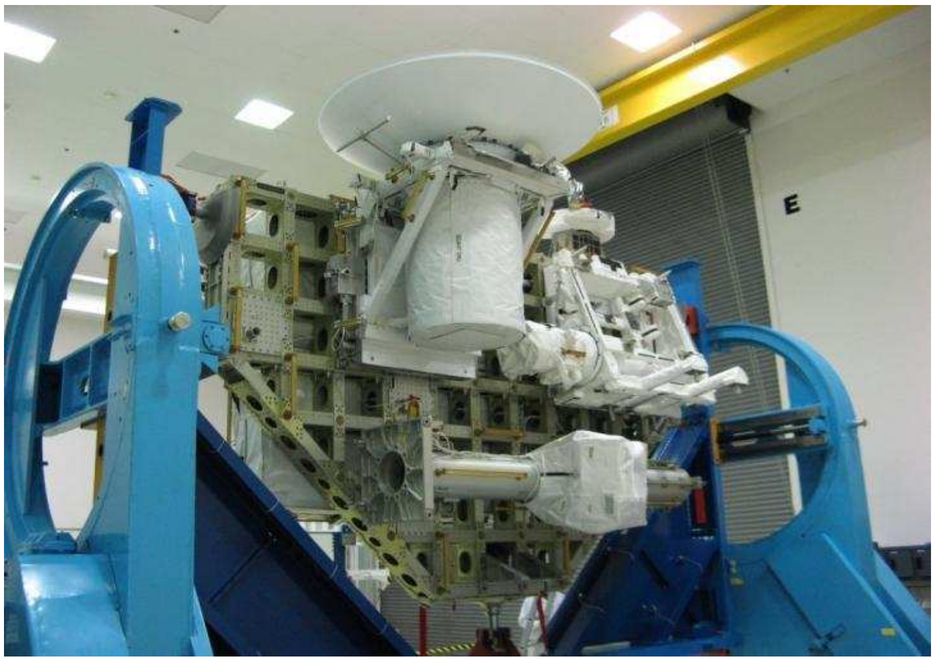


EOTP	Enhanced ORU Temporary Platform
ORU	Orbital Replacement Unit
POA	Payload ORU Accommodation
PVGF	Power and Video Grapple Fixture
SGANT	Space-to-Ground Antenna
SSRMS	Space Station Remote Manipulator System

ICC-VLD2 is a vertical cross-bay carrier for Orbital Replacement Units (ORUs)

ICC-VLD2

FORWARD SIDE



AFT SIDE

STS-132 / ISS ULF4 EVA Overview

EVA 1 — 00:00 · 01:00 · 02:00 · 03:00 · 04:00 · 05:00 · 06:00 · 6:30

EVA 1							
EV 1 (SSRMS) Reisman	Egress	Pallet Prep	SGANT Boom Install	SGANT Dish Install	EOTP Install	SSRMS Clean-up	Cleanup & Ingress
EV 2 (FF) Bowen	Egress	Pallet Prep	SGANT Boom Install	SGANT Dish Install	EOTP Install	P6 Battery Prep	Cleanup & Ingress

EVA 2 — 00:00 · 01:00 · 02:00 · 03:00 · 04:00 · 05:00 · 06:00 · 6:30

EVA 2								
EV 1 (FF) Bowen	Egress	Setup	Worksite Prep	Battery Temp Stow	P6 Battery R&R (3)	Install Temp Stow Battery	EVA 3 Prep	Cleanup & Ingress
EV 2 (FF) Good	Egress	Setup	Worksite Prep	Battery Temp Stow	P6 Battery R&R (3)	Install Temp Stow Battery	EVA 3 Prep	Cleanup & Ingress

EVA 3 — 00:00 · 01:00 · 02:00 · 03:00 · 04:00 · 05:00 · 06:00 · 6:30

EVA 3								
EV 1 (FF) Good	Egress	Setup	Battery Temp Stow	P6 Battery R&R (3)	Install Temp Stow Battery	P6 Clean-up	P6 Clean-up	Cleanup & Ingress
EV 2 (FF) Reisman	Egress	Setup	Battery Temp Stow	P6 Battery R&R (3)	Install Temp Stow Battery	P6 Clean-up	P6 Clean-up	Cleanup & Ingress

- Cat 2 (green)

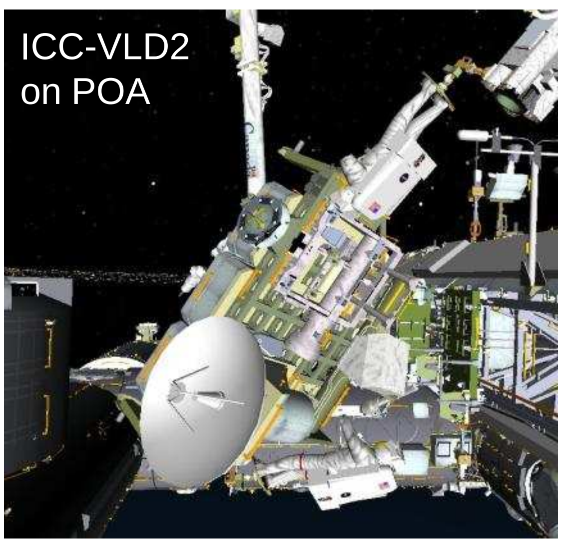
- Cat 3 or Get-ahead (yellow: P6 Clean-up, second entry in EVA 3)

EVA 1 Overview

- **EV1: Reisman**
  EV2: Bowen
- **Duration: 6:30**


- **EVA Operations:**
  – Install redundant Ku-band antenna (Space-to-Ground Antenna (SGANT) dish and boom) on ISS Z1 truss
  – Install Enhanced ORU Temporary Platform (EOTP) on Special Purpose Dexterous Manipulator (SPDM)
  – Prepare for P6 battery replacement by breaking torque on bolts holding new batteries to ICC-VLD2, which will be on the Payload ORU Accommodation (POA) on the ISS mobile transporter


SGANT Boom and Dish install on Z1


ICC-VLD2 on POA


EOTP install on SPDM

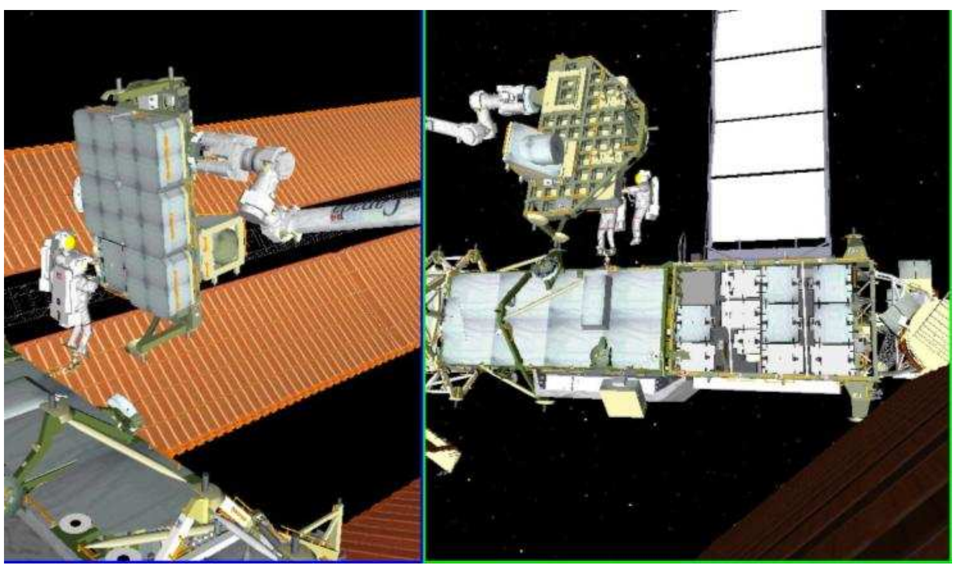
EVA 2 Overview

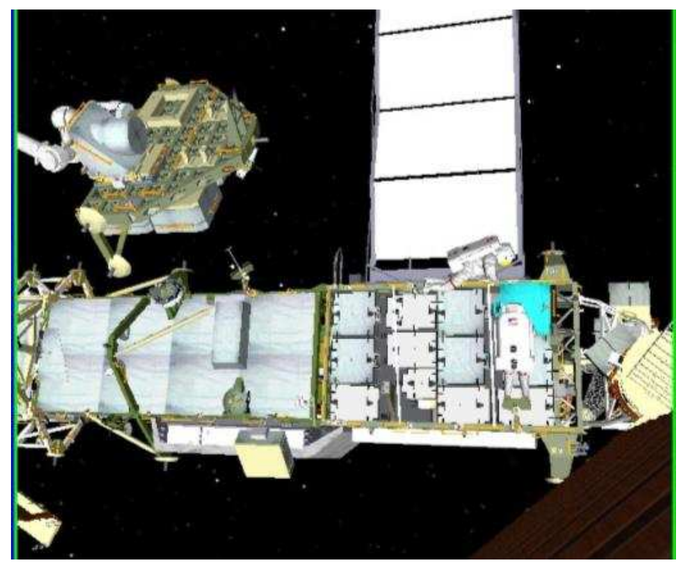
- **EV1: Bowen**
  EV2: Good

- **Duration: 6:30**

- **EVA Operations:**
  – Prepare P6 truss worksite for battery replacement
  – Remove and replace three P6 batteries from the 4B power channel with new batteries on ICC-VLD2
  – Store old batteries on the ICC-VLD2 for return

Remove and temp stow an old battery; retrieve new one from the ICC-VLD2. Install new battery on the truss; repeat with remaining batteries.



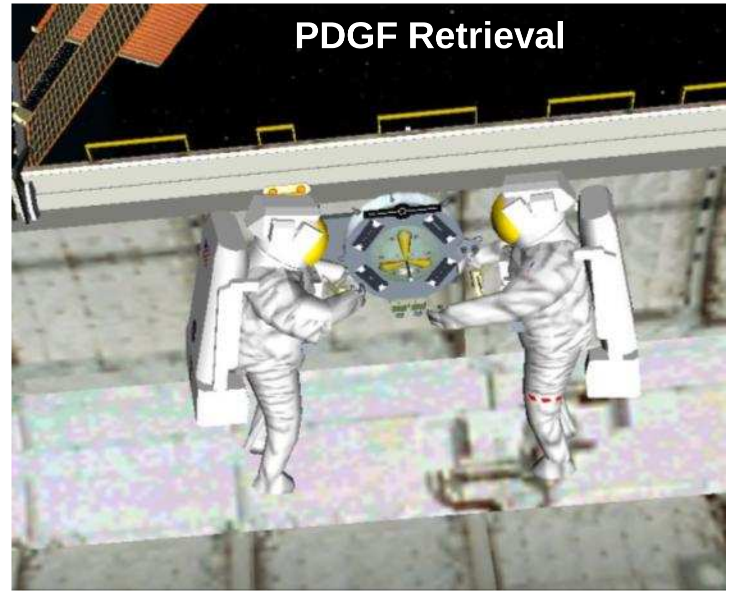


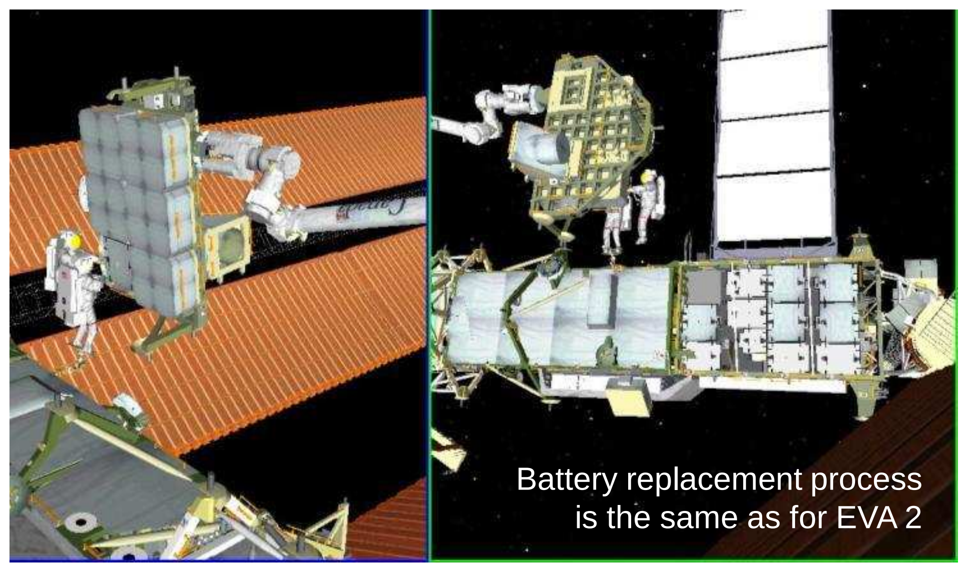
EVA 3 Overview

- **EV1: Good**
  EV2: Reisman

- **Duration: 6:30**

- **EVA Operations:**
  - Remove and replace last three P6 batteries from the 4B power channel with new batteries on ICC-VLD2
  - Store old batteries on the ICC-VLD2 for return
  - Clean up battery worksite
  - As time permits, retrieve Power Data Grapple Fixture (PDGF) from shuttle payload bay sidewall carrier and transfer to ISS *(get-ahead)*





Role of the STS-132/ULF4 in the ISS Research Program

Research activities on the Shuttle and Station are integrated to maximize return during Station assembly. The Shuttle serves as a platform for completing short-duration research, while providing supplies and sample return for ongoing research on Station.

- **Short-duration research to be completed during STS-132/ULF4:**
  - Biology and Biotechnology: NASA – Micro-2, NLP-Cells-4, NLP-Vaccine-9
  - Human Research: NASA – Sleep-Short
  - Technology: NASA – MAUI, RAMBO-2, SEITE, SIMPLEX

- **Research samples to be delivered to Station on Shuttle:**
  - Biology and Biotechnology: ESA – Genara-A; JAXA – Ferulate, Fish Scales, HydroTropi, Microbe-II
  - Educational Activities: JAXA – JAXA-EPO; NASA – Cube Lab
  - Physical and Materials Sciences: NASA – SAME
  - Technology: JAXA – JAXA-Commercial

- **Research to be returned on the Shuttle:**
  - Biology and Biotechnology: CSA – Cambium; ESA – WAICO; JAXA – Hair, Myco, MyoLab, NeuroRad; NASA – SWAB
  - Education: NASA – Cube Lab
  - Human Research: ESA – 3D-Space; JAXA – Myco 2; NASA – Integrated Immune, IVGEN, Bisphosphonates, Nutrition, Pro K, Repository
  - Physical and Materials Science: NASA – MSL-CETSOL and MICAST, CVB
  - Earth and Space Sciences: ESA – DOSIS

Short-Duration Experiments to be Performed on STS-132/ULF4

Biology and Biotechnology

- **Microbiology - 2 (Micro-2)** will expand our understanding of the fundamental basis of how space flight affects the biological and molecular functions of the cell and the molecular mechanisms by which cells and tissues respond to space flight conditions. Cynthia H. Collins, Ph.D., Rensselaer Polytechnic Institute, Troy, NY; Joel L. Plawsky, Sc.D., Rensselaer Polytechnic Institute, Troy, NY; Jonathan S. Dordick, Ph.D., Rensselaer Polytechnic Institute, Troy, NY

- **National Lab Pathfinder - Cells - 4 (NLP-Cells-4)** is a commercial payload serving as a pathfinder for the use of the ISS as a National Lab. It will assess the effects of microgravity on cells of the *Jatropha curcas* plant on improving characteristics such as cell structure, growth and development and accelerating the breeding process of new cultivars of *J. curcas* for commercial use. Accelerated breeding could allow *J. curcas* to be used as an alternative energy crop (or biofuel). Wagner Vendrame, Ph.D., University of Florida, Homestead, FL

- **National Lab Pathfinder - Vaccine - 9 (NLP-Vaccine-9)** is a commercial payload serving as a pathfinder for the use of the ISS as a National Lab. It contains several different pathogenic (disease causing) organisms. This research is investigating the use of space flight to develop potential vaccines for the prevention of different infections caused by these pathogens on Earth and in microgravity. Timothy Hammond, M.B.B.S., Durham Veterans Affairs Medical Center, Durham, NC

Human Research

- **Sleep-Wake Actigraphy and Light Exposure During Spaceflight - Short (Sleep-Short)** will examine the effects of space flight on the sleep of the astronauts during Shuttle missions. Advancing state-of-the-art technology for monitoring, diagnosing and assessing treatment of sleep patterns is vital to treating insomnia on Earth and in space. Charles A. Czeisler, M.D., Ph.D., Brigham and Women's Hospital, Harvard Medical School, Boston, MA

Astronaut Behnken works with the NLP-Vaccine experiment.

Jatropha fruit used in NPL-Cells- 4 experiment.

Short-Duration Experiments to be Performed on STS-132/ULF4

Technology

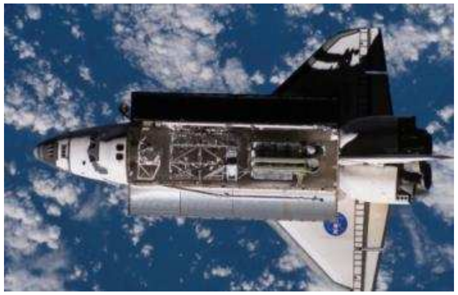
- **Maui Analysis of Upper Atmospheric Injections (MAUI),** a Department of Defense experiment, observes the Space Shuttle engine exhaust plumes from the Maui Space Surveillance Site in Hawaii when the Space Shuttle fires its engines at night or twilight. A telescope and all-sky imagers will take images and data while the Space Shuttle flies over the Maui site. The images are analyzed to better understand the interaction between the spacecraft plume and the upper atmosphere of Earth. Rainer A. Dressler, Ph.D., Hanscom Air Force Base, Lexington, MA

- **Ram Burn Observations (RAMBO),** a Department of Defense experiment, uses a satellite to observe Space Shuttle orbital maneuvering system engine burns. Its purpose is to improve plume models which predict the direction the plume, or rising column of exhaust, will move as the shuttle maneuvers on orbit. Understanding the direction in which the spacecraft engine plume, or exhaust flows could be significant to the safe arrival and departure of spacecraft on current and future exploration missions. William L. Dimpfl, Ph.D., Aerospace Corporation, Los Angeles, CA

- **Shuttle Exhaust Ion Turbulence Experiments (SEITE),** a Department of Defense experiment, uses space-based sensors to detect the ionospheric turbulence inferred from the radar observations from previous Space Shuttle Orbital Maneuvering System (OMS) burn experiments using ground-based radar. Paul A. Bernhardt, Ph.D., Naval Research Laboratory, Washington DC

- **Shuttle Ionospheric Modification with Pulsed Localized Exhaust Experiments (SIMPLEX),** a Department of Defense experiment, investigates plasma turbulence driven by rocket exhaust in the ionosphere using ground-based radars. Paul A. Bernhardt, Ph.D., Naval Research Lab, Washington DC

Engine burns on the Space Shuttle.



Space Shuttle used for MAUI, RAMBO, SEITE, and SIMPLEX experiments.

Experiments to be Delivered to the ISS on STS-132/ULF4

Goldfish used in the Fish Scales experiment.

Plants in the ground based growth chamber.

Biology and Biotechnology

- **Gravity Related Genes in *Arabidopsis* - A (Genara-A)** investigates the effects of microgravity induced altered molecular activities which will help find plant systems that compensate the negative impact on plant growth in space. Eugenie Carnero-Diaz, Ph.D., Universite Pierre et Marie Curie, Paris, France

- **Regulation by Gravity of Ferulate Formation in Cell Walls of Rice Seedlings (Ferulate**) tests the hypothesis that microgravity modifies ferulic acid thereby decreasing the mechanical strength of cell walls. Kazuyuki Wakabayashi, Ph.D., Osaka City University, Osaka, Japan

- **Investigation of the Osteoclastic and Osteoblastic Responses to Microgravity Using Goldfish Scales (Fish Scales)** will examine regenerating scales collected from anesthetized goldfish in microgravity and compare the results with ground controls. Nobuo Suzuki, Ph.D., Kanazawa University, Kanazawa, Ishikawa, Japan

- **Hydrotropism and Auxin-Inducible Gene expression in Roots Grown Under Microgravity Conditions (HydroTropi)** determines whether hydrotropic response can be used for the control of cucumber, *Cucumis sativus* root growth orientation in microgravity. Hideyuki Takahashi, Ph.D., Tohoku University, Sendai, Japan

- **Microbial Dynamics in International Space Station (Microbe-II)** experiment monitors microbes on board the ISS which may affect the health of crewmembers. Koichi Makimura, M.D., Ph.D., Teikyo University, Otsuka, Hachioji, Japan

Experiments to be Delivered to the ISS on STS-132/ULF4

Educational Activities

- **Cube Lab** is a low-cost 1 kilogram platform which provides a generic “cubesat” like capability for small researchers to interface with ISS support systems. A fully integrated Cube Lab platform can accommodate 16 small (100mm with a mass of no more than 1g) experiments in one EXPRESS Rack locker. This capability is available to any researcher, but is targeted as a low-cost opportunity for educational projects to allow students to participate in ISS research. Nanoracks, LLC, Lexington, KY

- **Japan Aerospace Exploration Agency - Education Payload Observation (JAXA-EPO)** activities demonstrate educational events and artistic activities on board the ISS to enlighten the general public about microgravity research and human space flight. Naoko Matsuo, Japan Aerospace Exploration Agency, Tsukuba, Japan

JAXA Astronaut Takao Doi in the JAXA lab.

Technology

- **Japan Aerospace Exploration Agency - Commercial Payload Program (JAXA-Commercial Payload Program)** consists of commercial items sponsored by JAXA sent to the ISS to experience the microgravity environment. Japan Aerospace Exploration Agency (JAXA)

Physical and Materials Sciences

- **Smoke and Aerosol Measurement Experiment (SAME)** will measure the smoke properties, or particle size distribution, of typical particles from spacecraft fire smokes to provide data to support requirements for smoke detection in space and identify ways to improve smoke detectors on future spacecraft. David Urban, Ph.D., Glenn Research Center, Cleveland, OH

A candle flame in Earth's gravity (left) and microgravity (right) showing the difference in the processes of combustion in microgravity.

Samples/Experiments to be Returned on STS-132/ULF4

Biology and Biotechnology

- **Cambium** investigates the effect of gravity on cambial cells (cells located under the inner bark where secondary growth occurs) in willow. *Salix babylonica*. Rodney Savidge, Ph.D., University of New Brunswick, Fredericton, NB, Canada

- **Investigation of the Osteoclastic and Osteoblastic Responses to Microgravity Using Goldfish Scales (Fish Scales)** will examine regenerating scales collected from anesthetized goldfish in microgravity and compare the results with ground controls. Nobuo Suzuki, Ph.D., Kanazawa University, Kanazawa, Ishikawa, Japan

- **Biomedical Analyses of Human Hair Exposed to a Long-term Space Flight (Hair)** examines the effect of long-duration space flight on gene expression and trace element metabolism in human body. Chiaki Mukai, M.D., Ph.D., Japan Aerospace Exploration Agency, Tsukuba, Japan

- **Molecular Mechanism of Microgravity-Induced Skeletal Muscle Atrophy - Physiological Relevance of Cbl-b Ubiquitin Ligase (MyoLab)** studies a rat muscle gene modified cell line to determine the effects of microgravity. Takeshi Nikawa, M.D., Ph.D., The University of Tokushima, Tokoshima, Japan

- **Waving and Coiling of Arabidopsis Roots at Different g-levels (WAICO)** studies the interaction of circumnutation (the successive bowing or bending in different directions of the growing tip of the stems and roots) and gravitropism (a tendency to grow toward or away from gravity) in microgravity and 1-g of *Arabidopsis thaliana*. Guenther Scherer, Ph.D., Leibniz Universitat Hannover, Hannover, Germany

Astronaut Williams works with the Cambium experiment in the JAXA lab.

Image of Arabidopsis thaliana plant used in several plant investigations on board the ISS.

Samples/Experiments to be Returned on STS-132/ULF4

Biology and Biotechnology

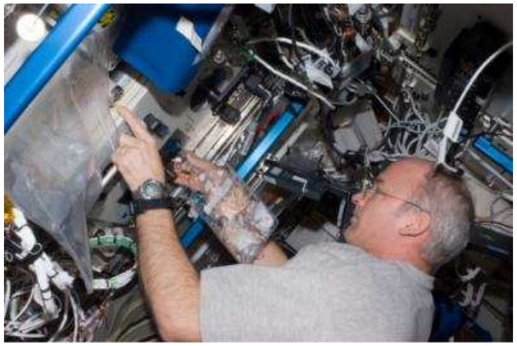
- **A Comprehensive Characterization of Microorganisms and Allergens in Spacecraft (SWAB)** uses advanced molecular techniques to comprehensively evaluate microbes on board the ISS, including pathogens (organisms that may cause disease). It also will track changes in the microbial community as spacecraft visit the ISS and new modules are added. This study allows an assessment of the risk of microbes to the crew and the spacecraft. Duane L. Pierson, Ph.D., Johnson Space Center, Houston, TX

- **Biological Effects of Space Radiation and Microgravity on Mammalian Cells (NeuroRad)** studies the effects of space radiation on the human neuroblastoma cell (nerve cell containing a tumor) line in microgravity. Hideyuki Majima, Kagoshima University, Kagoshima, Japan

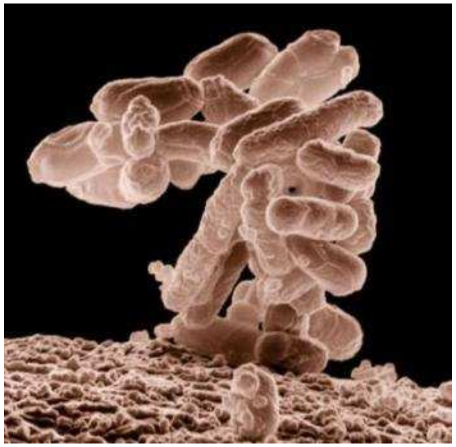
Human Research

- **Mental Representation of Spatial Cues During Space Flight (3D-Space)** investigates the effects of exposure to microgravity on the mental representation of spatial cues by astronauts during and after space flight. The absence of the gravitational frame of reference during space flight could be responsible for disturbances in the mental representation of spatial cues, Gilles Clement, Ph.D., Centre National de la Recherche Scientifique, Toulouse, France

- **Mycological Evaluation of Crew Exposure to ISS Ambient Air - 2 (Myco-2)** evaluates the risk of microorganisms via inhalation and adhesion to the skin to determine which fungi act as allergens on the ISS. Chiaki Mukai, M.D., Ph.D., JAXA, Tsukuba, Japan



Astronaut Williams samples water for the SWAB experiment in the US lab.



Electron micrograph image of Escheria coli, a common pathogenic microbe, magnified 10,000 times.

Samples/Experiments to be Returned on STS-132/ULF4

JAXA Astronaut Wakata works with a human research experiment.

IVGEN will be used to demonstrate water purification on the ISS.

Human Research

- **Validation of Procedures for Monitoring Crew Member Immune Function (Integrated Immune)** will assess the clinical risks resulting from the adverse effects of space flight on the human immune system and validate a flight-compatible immune monitoring strategy. Researchers will collect and analyze blood, urine and saliva samples from crewmembers before, during and after space flight to monitor changes in the immune system. Changes in the immune system will be monitored by collecting and analyzing blood and saliva samples from crewmembers during flight and blood, urine, and saliva samples before and after space flight. Clarence Sams, Ph.D, Johnson Space Center, Houston, TX

- **IntraVenous Fluid GENeration for Exploration Missions (IVGEN)** is a hardware development and demonstration effort which will demonstrate the capability to purify water to the standards required for intravenous administration, then mix the water with salt crystals to produce normal saline. This hardware is a prototype that will allow flight surgeons more options to treat ill or injured crewmembers during future long-duration exploration missions. John McQuillen, Glenn Research Center, Cleveland, OH (Hardware Project Scientist)

- **Bisphosphonates as a Countermeasure to Space Flight Induced Bone Loss (Bisphosphonates)** examines whether antiresorptive agents which help reduce bone loss, in conjunction with the routine in-flight exercise program, will protect ISS crewmembers from the regional decreases in bone mineral density. Adrian LeBlanc, Ph.D., Division of Space Life Sciences, Universities Space Research Association, Houston TX; Toshio Matsumoto, M.D., Ph.D., University of Tokushima, Kuramoto, Japan

Samples/Experiments to be Returned on STS-132/ULF4

Human Research

- **Nutritional Status Assessment (Nutrition)** is the most comprehensive in-flight study done by NASA to date of human physiologic changes during long-duration space flight. This study includes measures of bone metabolism, oxidative damage, nutritional assessments, and hormonal changes. This study will impact both the definition of nutritional requirements and development of food systems for future space exploration missions. This experiment will also help to understand the impact of countermeasures (exercise and pharmaceuticals) on nutritional status and nutrient requirements for astronauts. Scott M. Smith, Ph.D., Johnson Space Center, Houston, TX

- **The Dietary Intake Can Predict and Protect Against Changes in Bone Metabolism during Spaceflight and Recovery (Pro K)** investigation is NASA's first evaluation of a dietary countermeasure to lessen bone loss of astronauts. Pro K proposes that a flight diet with a decreased ratio of animal protein to potassium will lead to decreased loss of bone mineral. Pro K will have an impact on the definition of nutritional requirements and development of food systems for future exploration missions, and could yield a method of counteracting bone loss that would have virtually no risk of side effects. Scott M. Smith, Ph.D., Johnson Space Center, Houston, TX

- **National Aeronautics and Space Administration Biological Specimen Repository (Repository)** is a storage bank that is used to maintain biological specimens over extended periods of time and under well-controlled conditions. Biological samples, including blood and urine, are collected, processed and archived during the preflight, in-flight and postflight phases of ISS missions. Kathleen A. McMonigal, M.D. (Curator), Johnson Space Center, Houston, TX

Astronaut Barratt performs the BISE experiment in the US lab.

Astronaut Williams unpacks food bags and containers in the U.S. Lab.

Samples/Experiments to be Returned on STS-132/ULF4

Physical and Materials Science

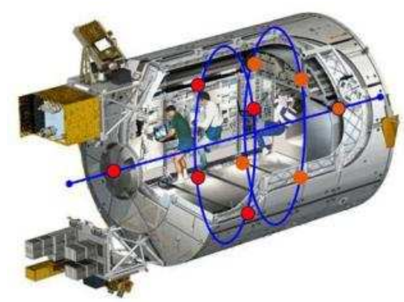
- **Constrained Vapor Bubble (CVB)** operates a miniature wickless heat pipe (heat exchanger) to understand the physics of evaporation and condensation as they affect heat transfer processes in microgravity. Peter C. Wayner, Jr., Ph.D., Rensselaer Polytechnic Institute, Troy, New York

- **The Materials Science Laboratory - Columnar-to-Equiaxed Transition in Solidification Processing and Microstructure Formation in Casting of Technical Alloys under Diffusive and Magnetically Controlled Convective Conditions (MSL-CETSOL and MICAST)** support research into metallurgical solidification, semiconductor crystal growth, and measurement of thermo-physical properties of materials. This is a cooperative investigation between ESA and NASA. Charles-Andre Gandin, Ph.D., Ecole de Mines de Paris, ARMINES-CEMEF, Sophia Antipolis, France (CETSOL) Lorenz Ratke, Prof., German Aerospace Center, Cologne, Germany (MICAST)

Astronaut De Winne commissioning the Materials Science Laboratory (MSL) in the US Lab.

Technology

- **Dose Distribution Inside ISS - Dosimetry for Biological Experiments in Space (DOSIS)** documents the actual nature and distribution of the radiation field inside the ISS and develops a standard method to measure the absorbed doses in biological samples on board the ISS. Guenther Reitz, Ph.D., German Aerospace Center, Cologne, Germany



Locations of the radiation measurement devices used for DOSIS-DOBIES.

Educational Activities

- **Cube Lab** is a low-cost 1 kilogram platform for educational projects on the ISS. Nanoracks, LLC, Lexington, KY

BACKUP

Additional Space Operations Mishap Information

Trans-Oceanic Abort Landing (TAL) Sites

Emergency Landing Sites (ELS)

Roles and Responsibilities

Associate Administrator for Mission Support

To ensure that financial and procurement management controls are an integral part the NASA accident investigation board, the Associate Administrator for Mission Support will identify an administrative structure and staff that will establish all necessary financial and procurement controls when an accident investigation board is initiated, with emphasis on the following control procedures:

1. Before certifying invoices for payment, ensure that services are performed and supplies are received. Before entering into any obligating agreement, procurement actions must meet the needs of the requesting customers.
2. Only General Services Administration (GSA) labor rates are paid to Federal Supply Schedule contractors and overhead rates are properly applied. If labor rates in excess of the negotiated GSA rates are required, contractors must first receive approval from GSA.
3. Appropriate charge codes are used and the Core Financial Module is used as the system of record for documenting and reporting purposes. Travelers, travel voucher preparers, and travel voucher approvers receive the proper training to know:
    1. Which expenses are prudent, reasonable, and necessary for travel;
    2. How to properly complete travel vouchers;
    3. How to properly review travel vouchers; and
    4. How to properly authorize travel.
4. Any individual authorized to approve travel must obtain approvals in writing, as required, and written approval must be obtained before travel vouchers are approved for payment. An appropriate level of review for authorized travel must be performed before extended travel begins. For example, if it appears that the travel may be for an extended period of time, perform a comparison of the local lodging rate to that of long-term lodging accommodations and determine which is the most cost effective.

Roles and Responsibilities

Agency Chief Health and Medical Officer

The Agency Chief Health and Medical Officer is responsible for directing, overseeing, and administering the health and medical aspects of mishap and close-call reporting, investigating, and recordkeeping.

Roles and Responsibilities

Center Directors

Center Directors having institutional support responsibilities for SOMD programs will be asked to provide the following HCAT support during an SO-related mishap and/or SO contingency. Center Directors:

1. Notify the AA/SO, or designated representative, within 60 minutes of SO-related mishaps that occur at their Centers, with their contractors, or during activities for which their Centers are responsible.
2. Notify the Chief Safety and Mission Assurance Officer of any Type A or B mishap, any mission failure or high visibility close call.
3. Take immediate action to limit further damage or injury following a mishap.
4. Respond to, support, and/or investigate SO-related mishaps, mission failures, or close calls, as directed by the AA/SO.
5. Initiate the mishap response telephone conference when directed to do so by the AA/SO.
6. Appoints an investigation board for Type B mishaps, incidents, or Type A mishaps as delegated by the Administrator or the AA/SO in coordination with the Chief Safety and Mission Assurance Officer.
7. Support program or institutional contingency simulations that demonstrate the Center's capability to support SOMD-related contingencies.
8. Provide casualty notification and support of next of kin of NASA employees.
9. Establish working groups appropriate to the Center's areas of responsibility and maintain lists of working group members. The working group lists will name acting chairpersons and specialists qualified to participate in contingency investigations. The lists will be provided by the Field Centers to the Board Chairperson upon board activation.
10. Submit to the AAA for Space Shuttle the name of the Center points of contact to be notified when the CAP is to be implemented.