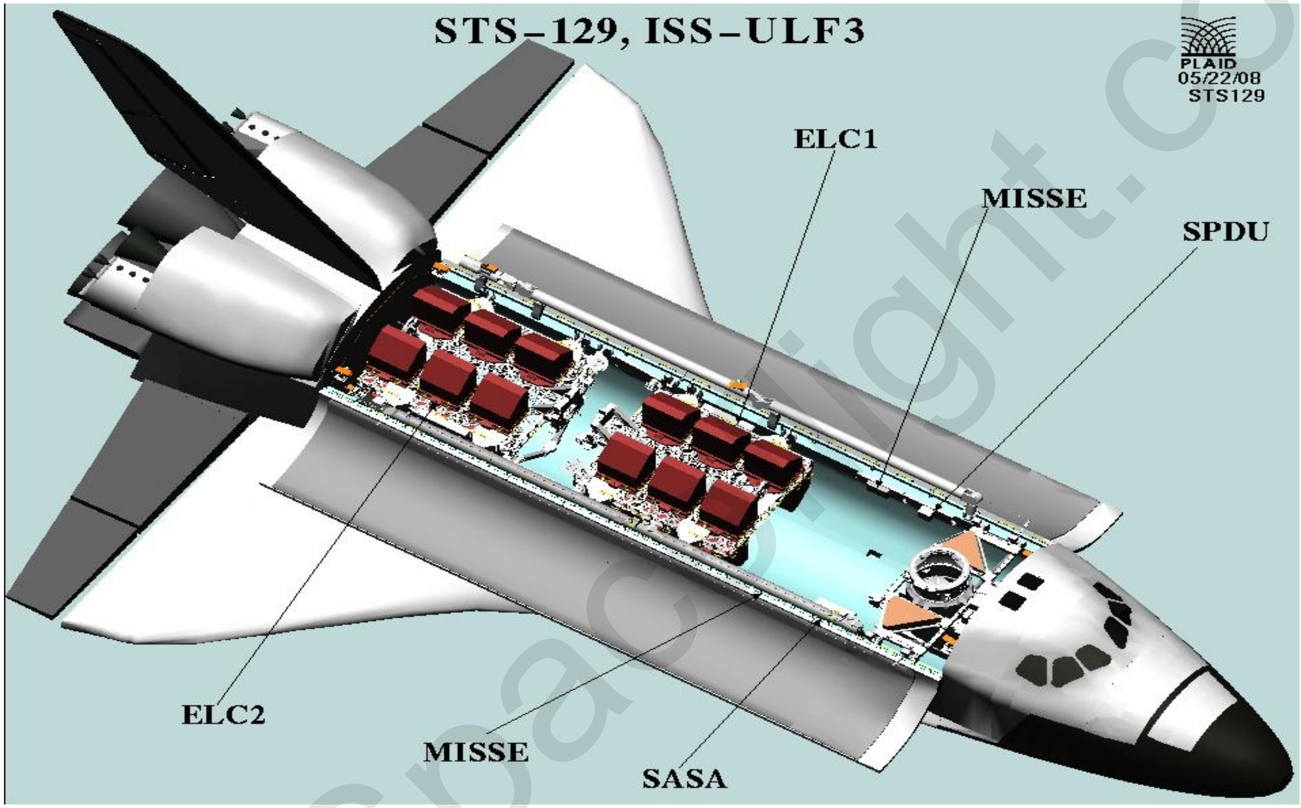
SPACE SHUTTLE PROGRAM

Space Shuttle Flight Management Office

NASA Johnson Space Center, Houston, Texas



SR# 4321

STS-129 (ULF3) Baselined Flight Manifest

October 9, 2008

PRCB

MO3/Michael Darnell
Mission Integration Manager

Agenda

- Purpose of SR#4321
- FDRD Flight Manifest
- STS-129 Cargo Bay Arrangement Drawing
- Ascent Performance/Flight Design
- Documentation Status
- ISS-ULF 3 Mission Manifest
  - ELC 1, ELC 2, MISSE 7A, MISSE 7B, SASA, ISS Middeck (powered payloads)
- Mission Objectives
- Backup Charts
  - Preliminary Overview Timeline with EVA 1 on FD4
  - Preliminary Overview Timeline with EVA 1 on FD5
  - ISS Cargo Element Manifest Overview
  - Personnel Assignments

Purpose of SR 4321	Presenter MO3/Michael Darnell	
	Date Oct. 2008	Page 3

Purpose:

Informational presentation to the PRCB on the mission content and orbiter configuration required for the STS-129 / ISS-ULF3 mission.

- CR# S072129, to baseline STS-129 into the FDRD and initiate the flight production process was reviewed by the FOICB on 9/22/08 with recommendation for OSB approval due to PRCB schedule conflicts.
- Flight Production process in place to support a target launch date of October 15, 2009.

STS-129 (ULF3) Baselined Flight Manifest

This CR Request is to: Add a column in NSTS 07700 Volume III FDRD, Table 4.1 as follows:

ACTIVITY TARGET LAUNCH DATE	STS-129 10-15-09
CONFIGURATION	
–ORB (FLT NO)	OV-103 (37)
–ET	ET-133
–SRB'S	BI-140
–RSRM	RSRM-108
–SSME SETTING	104.5/104.5%
–POSITION 1	TBD
–POSITION 2	TBD
–POSITION 3	TBD
–SOFTWARE REL	OI-34
–CRYO TANK SETS	5
–GN2 TANKS	6
–MISC RQMTS	SRMS, OBSS, ODS, SSPTS

P/L MANIFEST	
–PAYLOAD BAY	ISS ULF 3 (ELC1, ELC 2, MISSE 7A, MISSE 7B, SASA)
–MIDDECK	ISS ULF 3, MAUI [(a)], SEITE [(a)], SIMPLEX [(a)]
OPERATIONS	
–PAD/MLP	A/TBD
–INCLINATION	51.6 DEG
–INSERTION ALT	122 NM
–MECO TGT	DIR INSERTION
–TAL SITE	ZARAGOZA
–FLT DURATION	15 + 1 DAYS
–EVA's	4+ 1
–CREW SIZE	6 Up / 7 Down [(b)]
–LANDING SITE	KSC
INSTRUMENTATION	Rescue Flight for STS-128
REMARKS	[(a)] Payload of Opportunity [(b)] One Crew Return

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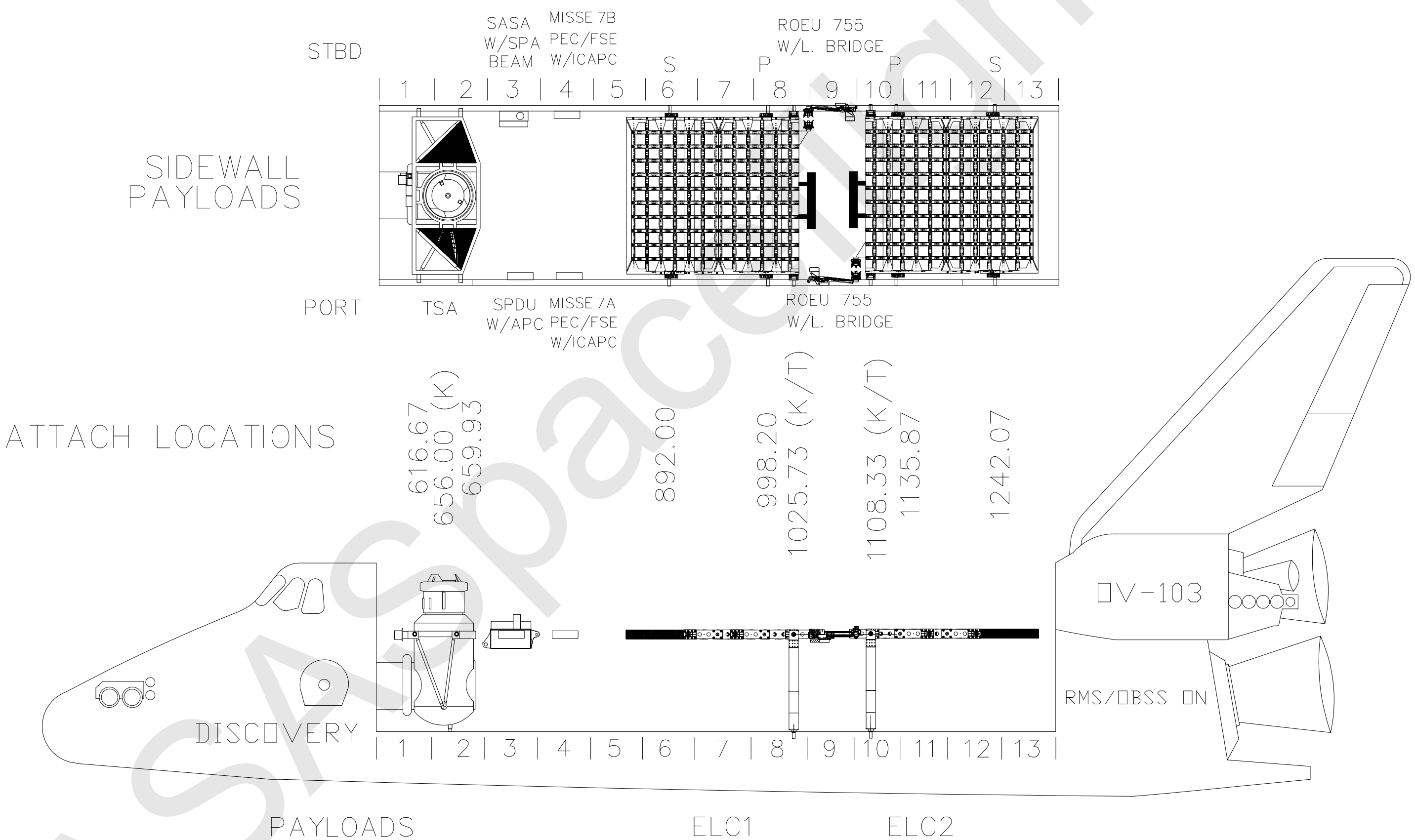
STS-129 Cargo Arrangement SR#4321	Presenter MO3/Michael Darnell	
	Date Oct. 2008	Page 5



STS-129 Flight Design and APM

Flight Design:

Ref. SPICE Baselined Data Package 9/10/08

Ascent performance margin (APM): 1198 lbp

Ascent Design	Ops Hi Q
Cryo Tanks:	5 Full
Forward RCS:	1912 lbs/offload
GN2 Tanks:	6 Full
Water	Standard offload (180 lbs)
Ballast aft:	854 lbs total
SSME's:	Block II
EVAs:	4 + 1
Rendezvous Altitude	195 nmi
ELC 1:	14,100 lbs
ELC 2:	13,527 lbs
SASA w/FSE/SPA Beam	600 lbs
MISSE 7A PEC w/ICAPC	216 lbs
MISSE 7B PEC w/ICAPC	216 lbs
Middeck:	8,600 lbs (969 lbs ISSP mission unique items)

STS-129 Flight Design and APM (Cont'd)

- **Downweights and X-cg: C.G.'s within limits for all Abort cases and NEOM.**
  - **NEOM** 205,768 @ 1081.5 in cg (Cg Limit: 1075.2 to 1109.0 in.)
  - **RTLS** 241,557 @ 1079.8 in cg (Cg Limit: 1076.7 to 1109.0 in.)
  - **TAL** 239,485 @ 1080.9 in cg (Cg Limit: 1076.7 to 1109.0 in.)
  - **AOA** 233,271 @ 1075.7 in cg (Cg Limit: 1075.2 to 1109.0 in.)
  - **NO DOCK PLS BLST** 233,124 @ 1075.7 in cg (Cg Limit: 1075.2 to 1109.0 in.)

  - **Worst Case FWD CG (217,276 @ 1071.6 in cg) results if the ELC-2 pallet (aft payload bay installed pallet) is deployed first.**
    - **To protect for this ops scenario would require additional orbiter lead ballast (~2,000 lbs) and a decrease in ISS upmass carrying capability (2-3 ORUs).**
    - **This worst case configuration scenario can be precluded if the ELC-1 pallet is deployed first.**
      - **Requires a mission operational crew timeline constraint to remove ELC-1 first**
      - **Mission operational constraint approved by both the FOICB (7/9/07) and JMICB (7/11/07).**
    - **Successful deployment of ELC-1 first protects for forward cg margin and provides acceptable X-cg for an anytime de-orbit.**

STS-129 Documentation Status

Documentation	ECD/Date
MIP – NSTS 21546 Basic (Dated 7/08/08)	
CR-0003 Update MIP Control Weights Table 4-1 a&b (Out for Evaluation)	08 Oct 08
PIP-MAUI, NSTS 21530, Basic, Chg 1 (3/29/06)	
No open CRs	
SEITE PIP – NSTS 21542	
No open CRs	
SIMPLEX PIP – NSTS 21327	
No open CRs	
FRD-NSTS 17462-129	
CR-0001: Baseline STS-129 Flight Requirements Document	18 Sept 08
PIP – MISSE 7A and7B, NSTS 21537, Basic, Chg 1-3 (01/24/08)	None Pending
ICD-A-21545 ELC 1 (Baselined)	12 August 08
ICD-A-21545 ELC 2 (Baselined)	7 August 08

ISS ULF 3 Mission Manifest*:

- ELC1 (Battery Charge/Discharge Unit (BCDU), Plasma Contactor Unit (PCU), Latching End Effector (LEE), Control Moment Gyro (CMG), Nitrogen Tank Assembly (NTA), Ammonia Tank Assembly (ATA), Pump Module (PM), 2 empty P/L Passive Flight Releasable Attachment Mechanism (PFRAM))
- ELC2 (High Pressure Gas Tank (HPGT), Cargo Transport Container (CTC), Control Moment Gyro (CMG), Pump Module (PM), NTA, Mobile Transporter/Trailing Umbilical System (MT/TUS), Materials on International Space Station Experiment (MISSE)-7 Flight Support Equipment (FSE), 1 empty PFRAM, & 1 empty P/L PFRAM)*
- 3 Sidewalls (SASA, MISSE-7A PEC, MISSE-7B PEC)*
- Shuttle Integration H/W

*As documented in Mission Integrated Manifest (MIM) Rev J, approved 6/20/08

Materials on International Space Station Experiment (MISSE)

Utilization:

- MISSE-7A & 7B Passive Experiment Containers (PECs) — Payload in development

Sidewall Carriers:

Pre-Positioned Spare:

- S-Band Antenna Sub-Assembly (SASA) — Repaired from 10A return

Middeck Payloads:

1 Powered Payload

- General Laboratory Active Cryogenic ISS Equipment Refrigerator (GLACIER) (2 MLE) – Rear Breather

STS-129 Mission Objectives

Mission Objectives

- **Return one ISS crewmember (Expedition 20 Flight Engineer 4)**
- **Deliver and install 2 ELCs with pre-positioned spares and utilization**
- **Deliver MISSE-7 PECs and install to ELC2**
- **Deliver spare SASA and transfer to stowage location on Z1**
- **Remove spare HPGT from ELC2 and install to ISS Airlock**

Backup Charts

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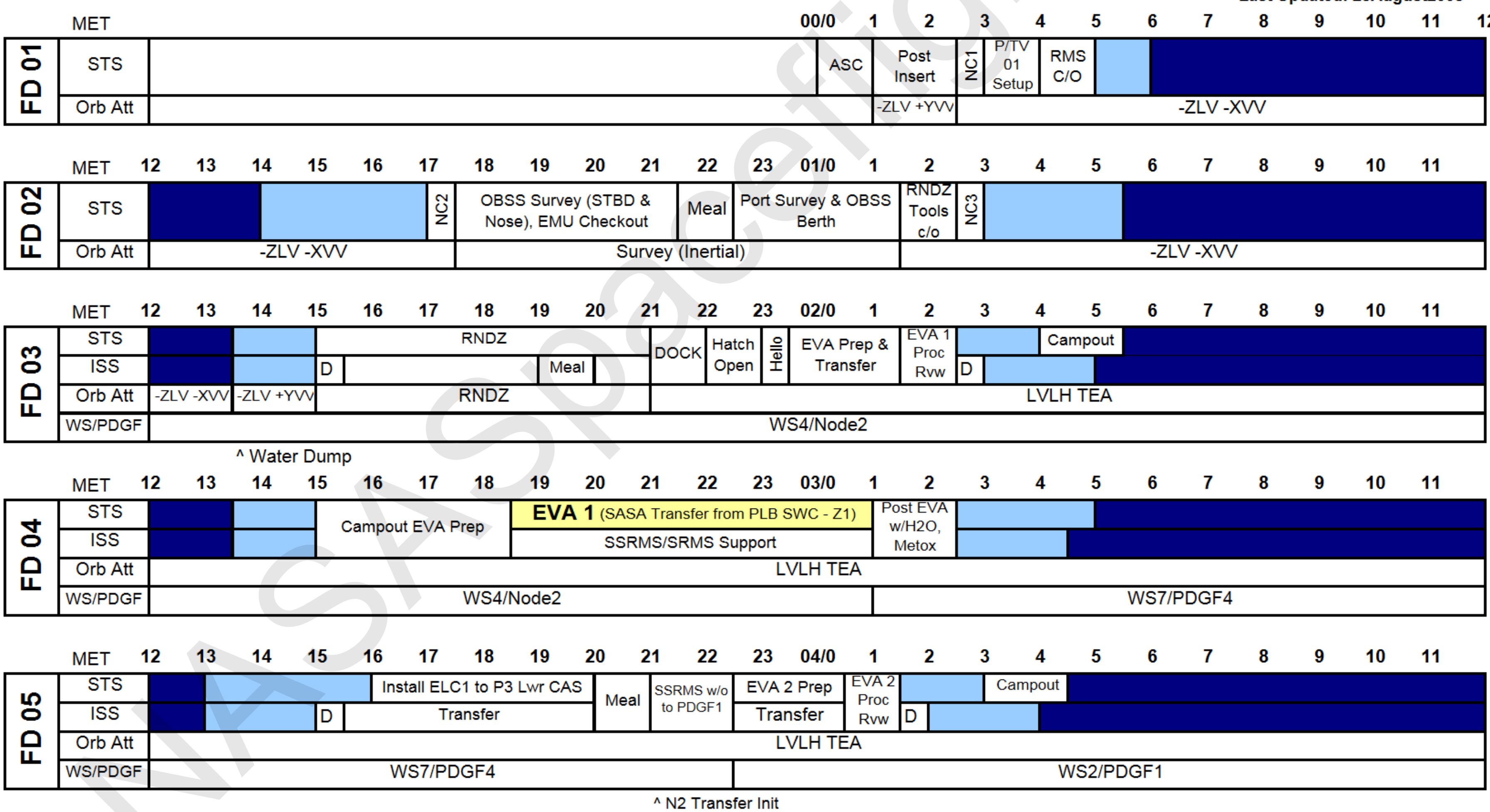
Preliminary STS-129 (ULF3) Timeline EVA 1 on FD4	Presenter MO3/Michael Darnell	
	Date Oct. 2008	Page 12

STS-129/ULF3 Overview Timeline (15+1+2)

Last Updated: 25August2008



Preliminary STS-129 (ULF3) Timeline EVA 1 on FD4 (Cont'd)

Presenter MO3/Michael Darnell
Date Oct. 2008

MET 12 13 14 15 16 17 18 19 20 21 22 23 05/0 1 2 3 4 5 6 7 8 9 10 11

FD 06	
STS	Campout EVA Prep; **EVA 2** (Install MISSE-7 PECs to ELC2); Post EVA w/H2O, Metox
ISS	Install ELC2 to S3 Upper CAS; Transfer; Meal; Transfer; Post EVA w/H2O, Metox; D
Orb Att	LVLH TEA
WS/PDGF	WS2/PDGF1

^ Water Dump
*Is a MT Translate/SSRMS Walkoff Req'd to support Focused Inspection???

MET 12 13 14 15 16 17 18 19 20 21 22 23 06/0 1 2 3 4 5 6 7 8 9 10 11

FD 07	
STS	SSRMS Grpl OBSS & H/O to SRMS; Focused Inspection; SRMS H/O OBSS to SSMRS, OBSS Berth; EVA 3 Proc Rvw; Campout
ISS	D; SSRMS Grpl OBSS & H/O to SRMS; Meal; EVA 3 Prep; SRMS H/O OBSS to SSMRS, OBSS Berth; EVA 3 Proc Rvw; D
Orb Att	LVLH TEA
WS/PDGF	WS2/PDGF1

MET 12 13 14 15 16 17 18 19 20 21 22 23 07/0 1 2 3 4 5 6 7 8 9 10 11

FD 08	
STS	Campout EVA Prep; **EVA 3** (HPGT Xfer from ELC2 to ISS A/L); Post EVA w/H2O, Metox
ISS	Campout EVA Prep; SSRMS/SRMS Support; Post EVA w/H2O, Metox; D
Orb Att	LVLH TEA
WS/PDGF	WS2/PDGF1; WS4/PDGF4

MET 12 13 14 15 16 17 18 19 20 21 22 23 08/0 1 2 3 4 5 6 7 8 9 10 11

FD 09	
STS	EVA 4 Prep; Meal; Off Duty (4 hrs); EVA 4 Proc Rvw; Campout
ISS	D; Transfer; Meal; Off Duty (4 hrs); EVA 4 Proc Rvw; D
Orb Att	LVLH TEA
WS/PDGF	WS4/PDGF4

MET 12 13 14 15 16 17 18 19 20 21 22 23 09/0 1 2 3 4 5 6 7 8 9 10 11

FD 10	
STS	Campout EVA Prep; **EVA 4** (TBD); Post EVA w/H2O, Metox
ISS	Campout EVA Prep; SSRMS/SRMS Support TBD; Post EVA w/H2O, Metox; D
Orb Att	LVLH TEA

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Preliminary STS-129 (ULF3) Timeline EVA 1 on FD4 (Cont'd)

Presenter: MO3/Michael Darnell
Date: Oct. 2008
Page: 14

MET: 12 13 14 15 16 17 18 19 20 21 22 23 10/0 1 2 3 4 5 6 7 8 9 10 11

FD 11	
STS	Transfer; D, Transfer; Crew Conf; Meal; Off Duty (4 hrs); D
Orb Att	LVLH TEA
WS/PDGF	WS4/PDGF4

^ Water Dump

MET: 12 13 14 15 16 17 18 19 20 21 22 23 11/0 1 2 3 4 5 6 7 8 9 10 11

FD 12	
STS	Transfer; D, Transfer; Meal; EVA Xfer/Tool Stow; Transfer; D
Orb Att	LVLH TEA
WS/PDGF	WS4/PDGF4

MET: 12 13 14 15 16 17 18 19 20 21 22 23 12/0 1 2 3 4 5 6 7 8 9 10 11

FD 13	
STS	Transfer; D, Transfer; Meal; Off Duty (1 hr); RNDZ Tools c/o; O2 Xfer T/D; Hatch Close
Orb Att	LVLH TEA
WS/PDGF	WS4/PDGF4

^ O2/N2 Transfer Term

MET: 12 13 14 15 16 17 18 19 20 21 22 23 13/0 1 2 3 4 5 6 7 8 9 10 11

FD 14	
STS	Un-dock; Flyaround and Sep; Meal; OBSS; Late Inspection; OBSS
ISS	
Orb Att	TEA; Undock/Flyaround; -ZLV +YVV; Survey (Inertial); -ZLV -XVV
WS/PDGF	WS4/PDGF4

^ Water Dump

MET: 12 13 14 15 16 17 18 19 20 21 22 23 14/0 1 2 3 4 5 6 7 8 9 10 11

FD 15	
STS	FCS C/O & RCS Hot Fire; Pilot Ops; Cabin Stow; Brief; Meal; PAO; Cabin Stow; KU Stow
Orb Att	-ZLV -XVV

Preliminary STS-129 (ULF3) Timeline EVA 1 on FD4 (Cont'd)

Presenter MO3/Michael Darnell

Date Oct. 2008

	MET	12	13	14	15	16	17	18	19	20	21	22	23	15/0	1	2	3	4	5	6	7	8	9	10	11
FD 16	STS		IMU Align & Verif	Deorbit Prep				Entry																	
	Orb Att	-XVV	IMU	-XSI		Comm		Entry																	

Assumptions:
- Timeline layout doesn't assume actual mission trajectory.
- Robotic support during EVA 4 is still TBD.

STS-129/ULF3 Overview Timeline (15+1+2)

EVA1 on FD5

Last Updated: 23September2008

FD 01

MET: 00/0 1 2 3 4 5 6 7 8 9 10 11 12

STS	ASC; Post Insert; NC1; P/TV 01 Setup; RMS C/O
Orb Att	-ZLV +YVV; -ZLV -XVV

FD 02

MET: 12 13 14 15 16 17 18 19 20 21 22 23 01/0 1 2 3 4 5 6 7 8 9 10 11

STS	NC2; OBSS Survey (STBD & Nose), EMU Checkout; Meal; Port Survey & OBSS Berth; RNDZ Tools c/o; NC3
Orb Att	-ZLV -XVV; Survey (Inertial); -ZLV -XVV

FD 03

MET: 12 13 14 15 16 17 18 19 20 21 22 23 02/0 1 2 3 4 5 6 7 8 9 10 11

STS	RNDZ; DOCK; Hatch Open; Hello; EVA Prep & Transfer
ISS	D; Meal; DOCK; Hatch Open; Hello; EVA Prep & Transfer; D
Orb Att	-ZLV -XVV; -ZLV +YVV; RNDZ; LVLH TEA
WS/PDGF	WS7/PDGF4

^ Water Dump

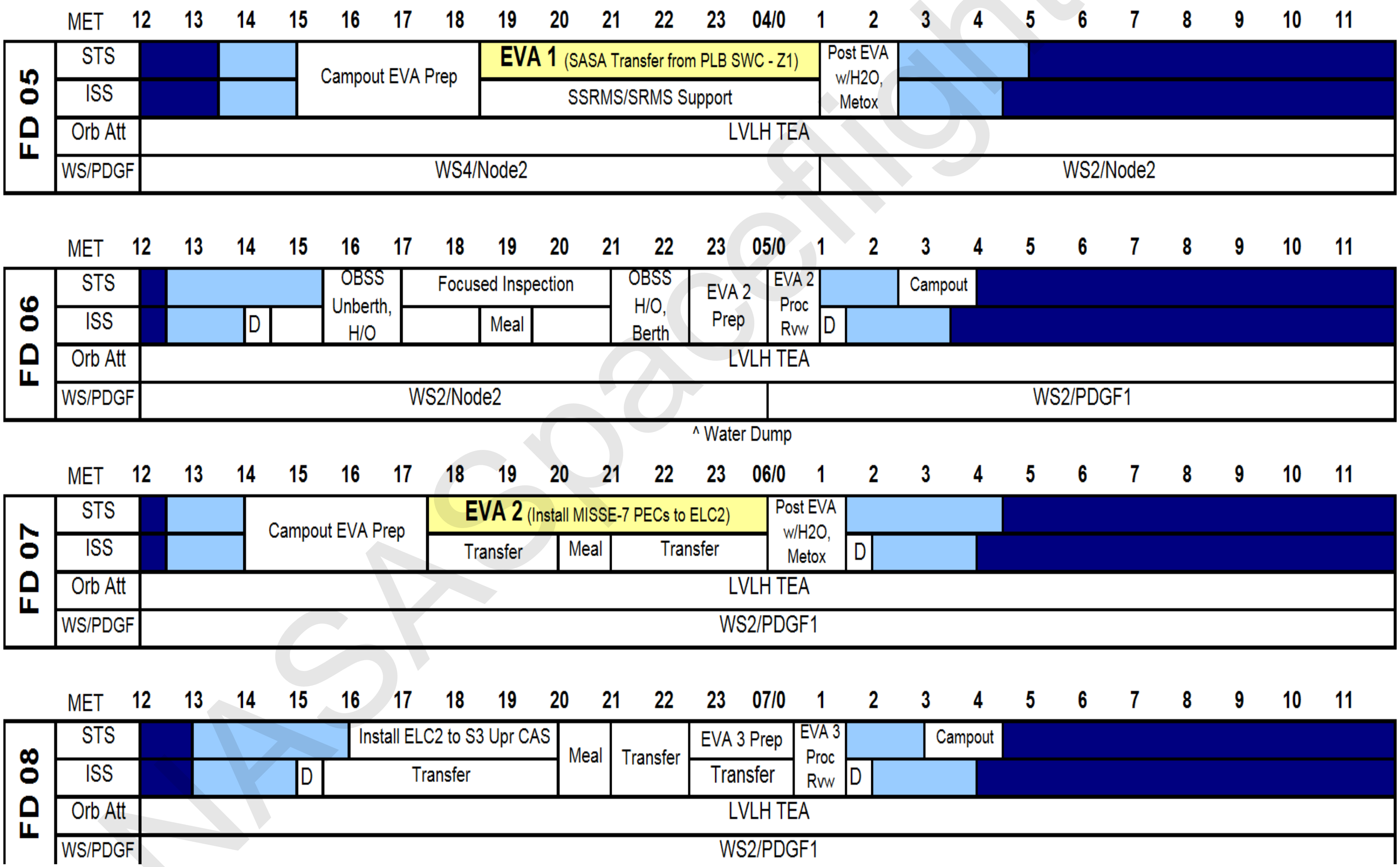
FD 04

MET: 12 13 14 15 16 17 18 19 20 21 22 23 03/0 1 2 3 4 5 6 7 8 9 10 11

STS	Install ELC1 to P3 Lwr CAS; Meal; SSRMS w/o; EVA 1 Prep; EVA 1 Proc Rvw; Campout
ISS	D; Transfer; Meal; SSRMS w/o; Transfer; EVA 1 Proc Rvw; D

Overview Timelime (15+1+2) (Cont'd) EVA1 on FD5

Presenter MO3/Michael Darnell
Date Oct. 2008



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Overview Timelime (15+1+2) (Cont'd) EVA1 on FD5

Presenter MO3/Michael Darnell

Date Oct. 2008

MET 12 13 14 15 16 17 18 19 20 21 22 23 08/0 1 2 3 4 5 6 7 8 9 10 11

FD 09	
STS	Campout EVA Prep; **EVA 3** (HPGT Xfer from ELC2 to ISS A/L); Post EVA w/H2O, Metox
ISS	Campout EVA Prep; SSRMS/SRMS Support; Post EVA w/H2O, Metox; D
Orb Att	LVLH TEA
WS/PDGF	WS2/PDGF1; WS4/PDGF4

MET 12 13 14 15 16 17 18 19 20 21 22 23 09/0 1 2 3 4 5 6 7 8 9 10 11

FD 10	
STS	EVA 4 Prep; Meal; Off Duty (4 hrs); EVA 4 Proc Rvw; Campout
ISS	D; Transfer; Meal; Off Duty (4 hrs); EVA 4 Proc Rvw; D
Orb Att	LVLH TEA
WS/PDGF	WS4/PDGF4

MET 12 13 14 15 16 17 18 19 20 21 22 23 10/0 1 2 3 4 5 6 7 8 9 10 11

FD 11	
STS	Campout EVA Prep; **EVA 4** (TBD); Post EVA w/H2O, Metox
ISS	Campout EVA Prep; SSRMS/SRMS Support TBD; Post EVA w/H2O, Metox; D
Orb Att	LVLH TEA
WS/PDGF	WS4/PDGF4

^ O2 Transfer Init

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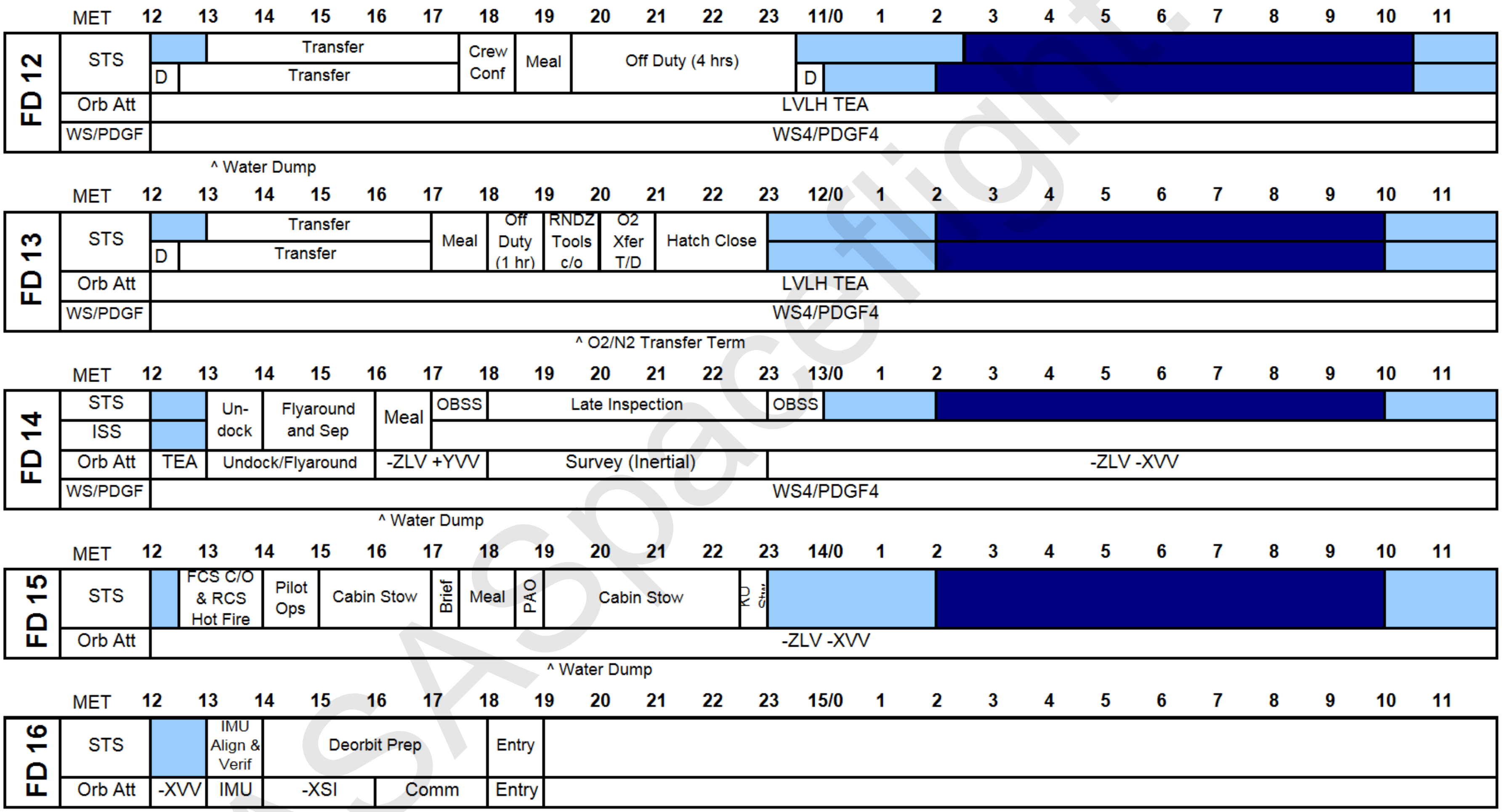
Overview Timelime (15+1+2) (Cont'd) EVA1 on FD5

Presenter MO3/Michael Darnell

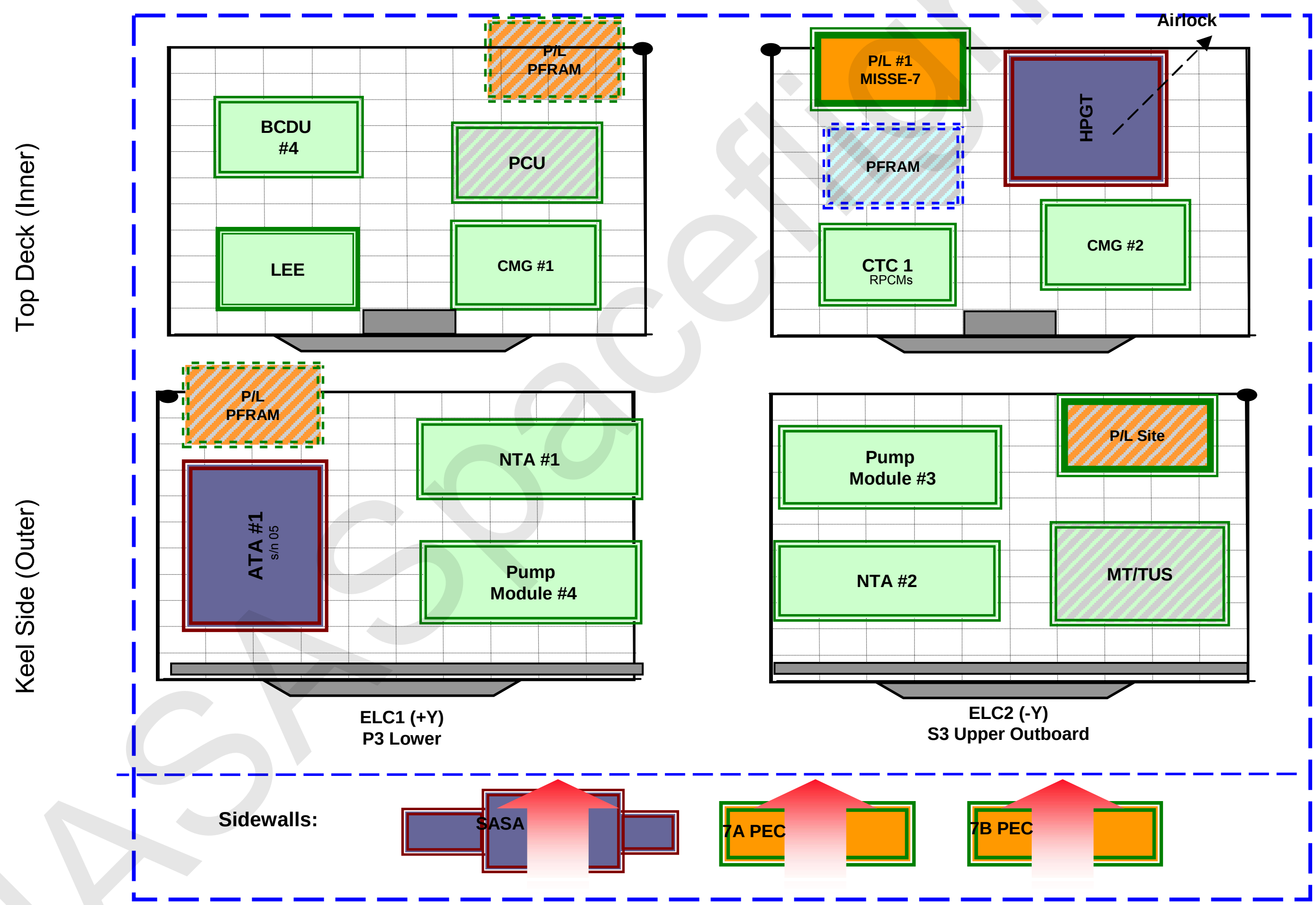
Date Oct. 2008



Assumptions:
- Timeline layout doesn't assume actual mission trajectory.
- Robotic support during EVA 4 is still TBD.
- All robotic activities and WS/PDGF positions are under review. Activities may change based on review.

ISS ULF 3 Manifest
SR 4321

ULF3 – Oct 2009



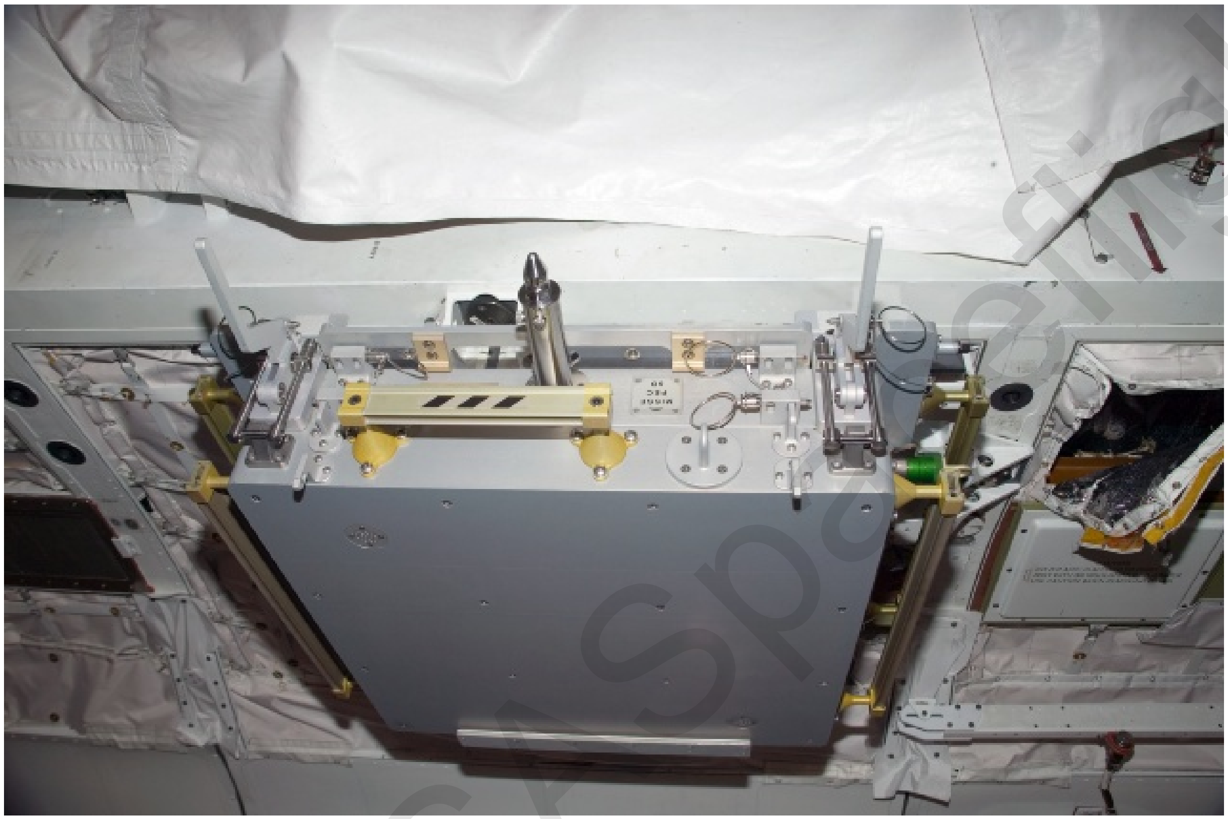
General Laboratory Active Cryogenic ISS Equipment Refrigerator (GLACIER)

SASA

SASA is an assembly that includes the S–band RF Group (RFG) and a standard support structure. The S–band RF Group (RFG) consists of three units: a Transmit/Receive Amplifier (TRA), a High Gain Antenna (HGA) and a Low Gain Antenna (LGA). The TRA contains the transmit and receive sections, power supplies and an antenna controller. The HGA is a horn and gimbal assembly mounted on a pedestal. The LGA is a fixed omnidirectional antenna. The TRA serves as a structural platform for the antennas. The support structure consists of a mast, a mounting surface for the RFG and a baseplate fitting. The baseplate fitting is the structural interface between the SASA and the primary structure. The support structure routes and supports a single harness terminating in three connectors at the connector panel for operational and heater power, command and status signals and RF transmit and receive signals.

Photo from 5A

MISSE PEC Sidewall



The Materials International Space Station Experiment-7 (MISSE-7) is a test bed for materials and coatings attached to the outside of the International Space Station (ISS) being evaluated for the effects of atomic oxygen, ultraviolet, direct sunlight, radiation, and extremes of heat and cold. This experiment allows the development and testing of new materials to better withstand the rigors of space environments. Results will provide a better understanding of the durability of various materials when they are exposed to the space environment with applications in the design of future spacecraft. (MISSE-6 shown)

Photo of MISSE-6 from 1JA

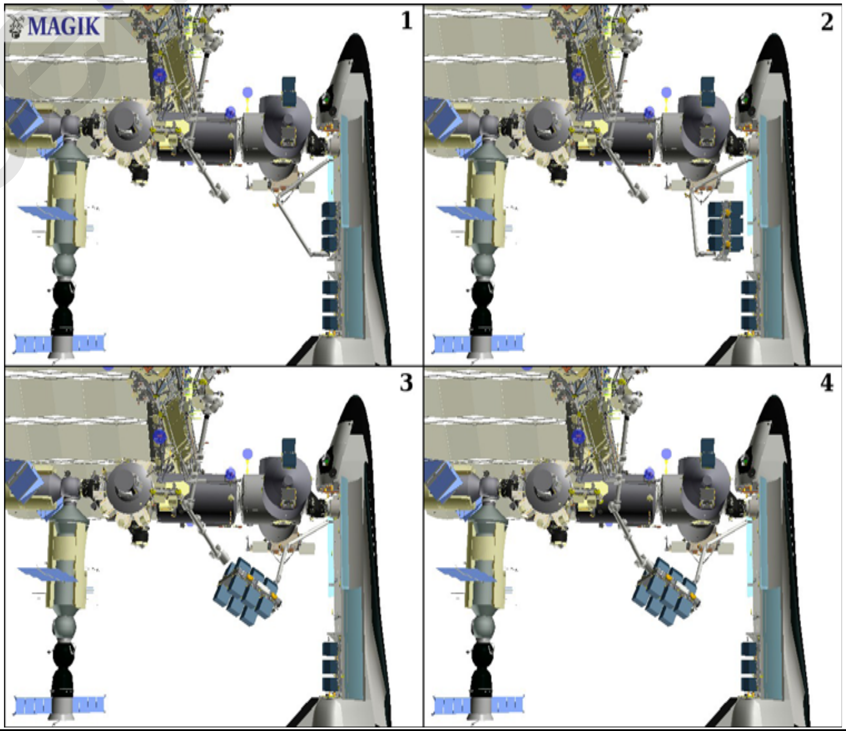
Robotics Tasks

Activity:

- **ELC1 installation to P3 Lower (UCCAS #2)**
  - **SRMS unberth carrier from PLB and handoff to SSRMS**

- **ELC2 installation to S3 Upper Outboard (PAS #1)**
  - **SRMS unberth carrier from PLB and handoff to SSRMS**

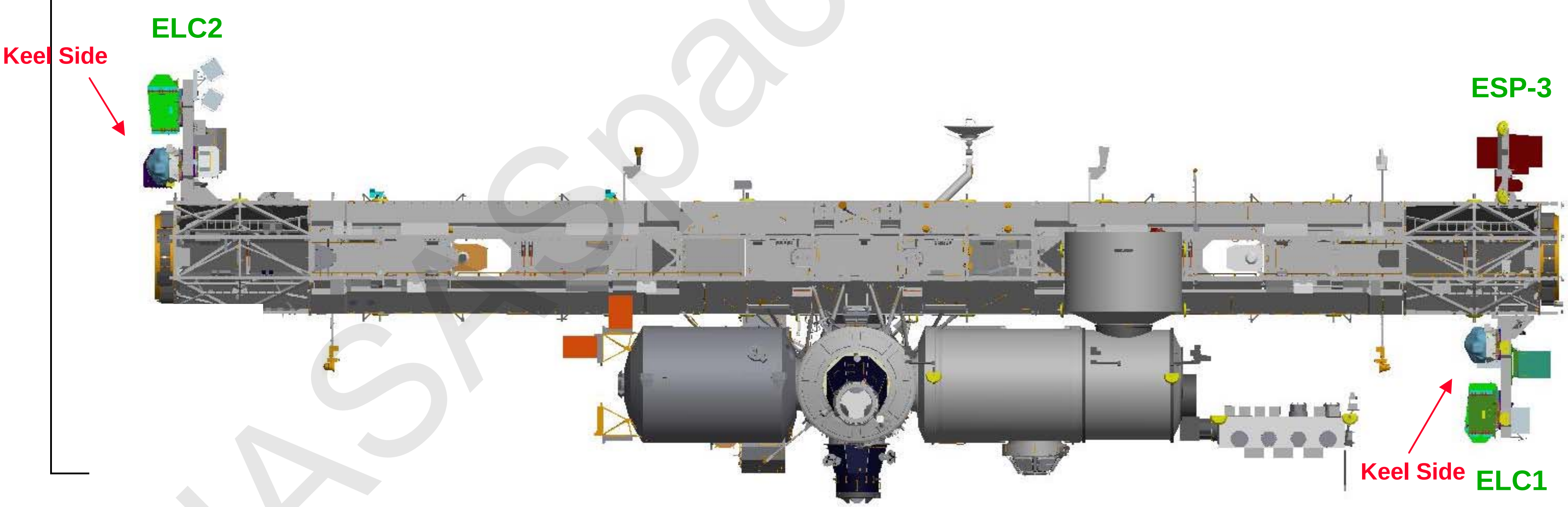
- **Note: Order of carrier deployment depends which ELC is manifested forward in the PLB. The ULF3 ballast scenario requires that the forward ELC be deployed first.**



Robotics Tasks, cont'd

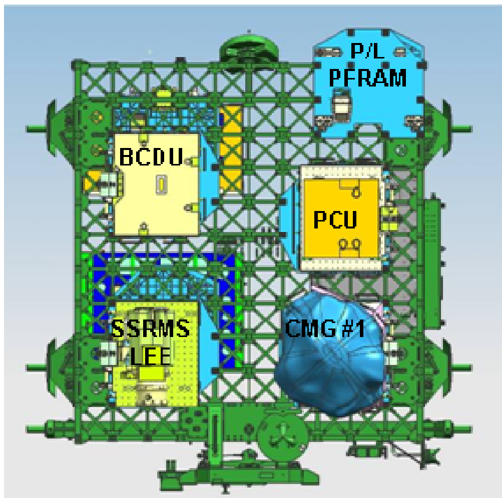
Rationale for Designated CAS Sites:

- A preferred attach site exists for each ELC based its ORU/Payload complement
  - Desire to place spare ORUs in close proximity to future R&R locations
  - Desire that certain ORUs be evenly distributed between port and starboard sides of ISS (i.e., NTA, ATA, Pump Module on both P1 & S1)
  - Payload viewing requirements (zenith vs. nadir)



ULF-3 ELC 1 Configuration

Top



Pre-Positioned Spares:

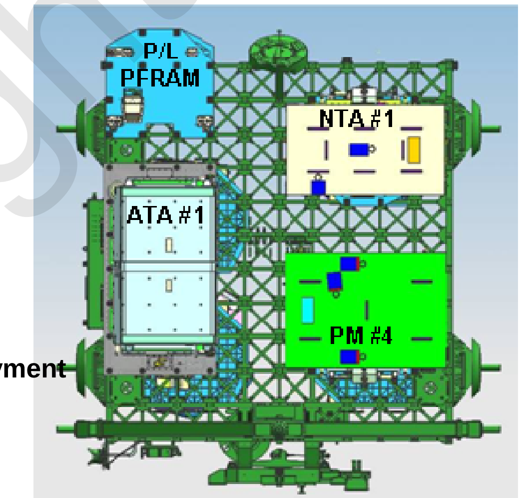
1 Battery Charge/Discharge Unit (BCDU)
1 Control Moment Gyro (CMG)
1 Nitrogen Tank Assembly (NTA)
1 Pump Module (PM)
1 Ammonia Tank Assembly (ATA)
1 Plasma Contactor Unit (PCU)
1 Latching End Effector (LEE)

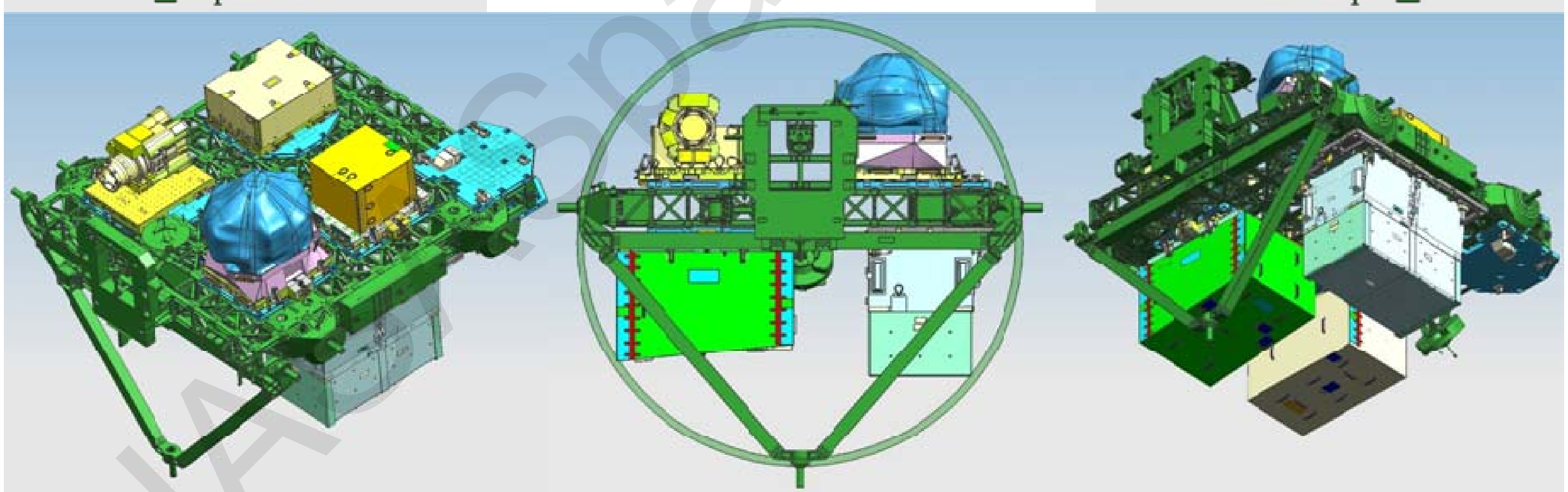
Utilization:

2 empty P/L PFRAMs for future payload use

<u>Note:</u> Keel remains in Orbiter upon ELC deployment

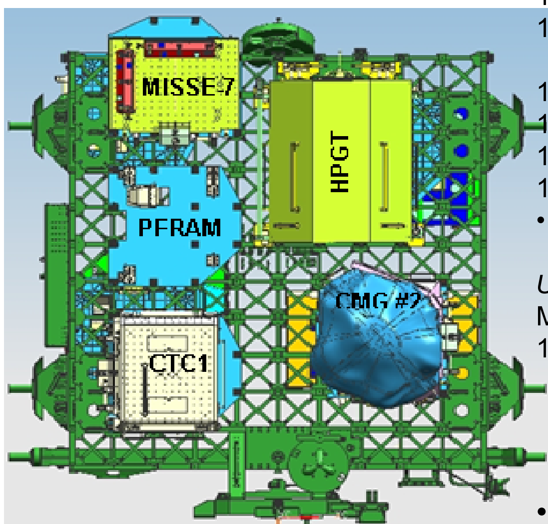
Bottom





ULF-3 ELC 2 Updated Configuration

Top



Pre-Positioned Spares:

1 Control Moment Gyro (CMG)
1 Nitrogen Tank Assembly (NTA)

1 Pump Module
1 High Pressure Gas Tank (HPGT)
1 MT/TUS Reel Assembly
1 Cargo Transport Container (CTC)

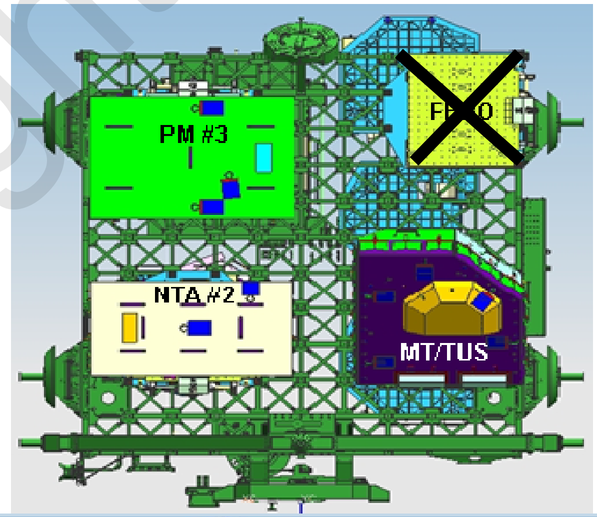
- Contains 7 Type V RPCMs, 1 Type II RPCM 1 CRPCM, & 1 empty RPCM OAK

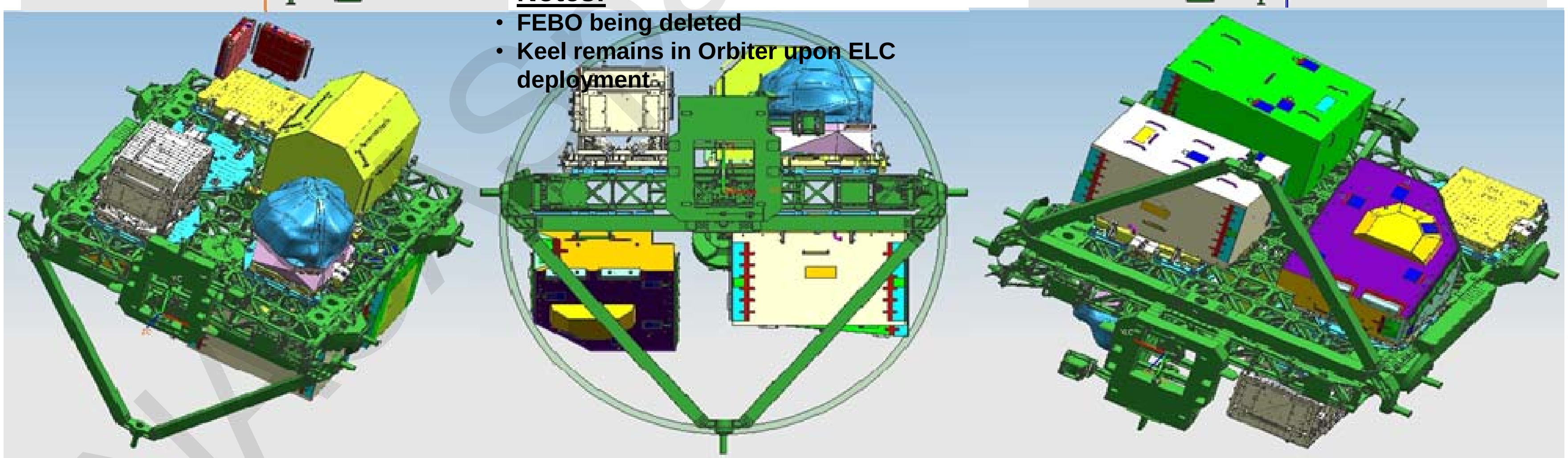
Utilization:

MISSE-7 Attach Hardware / Adapter Plates
1 empty PFRAM & 1 empty P/L PFRAM
FEBO has indicated a desire to have the forward RAM P/L PFRAM location reserved for a future flight

- **Notes:**
- **FEBO being deleted**
- **Keel remains in Orbiter upon ELC deployment**

Bottom





Battery Charge/Discarge Unit (BCDU)

- Serves a dual function of charging the batteries during insolation periods, and providing conditioned battery power to the primary power buses during eclipse periods
- BCDU initial start-up includes activation of the DC/DC power converter, Local Data Interface (LDI), and control and monitoring circuitry
- Includes provisions for battery status monitoring and protection from power circuit faults
- Commanded and monitored by a 1553 data bus.

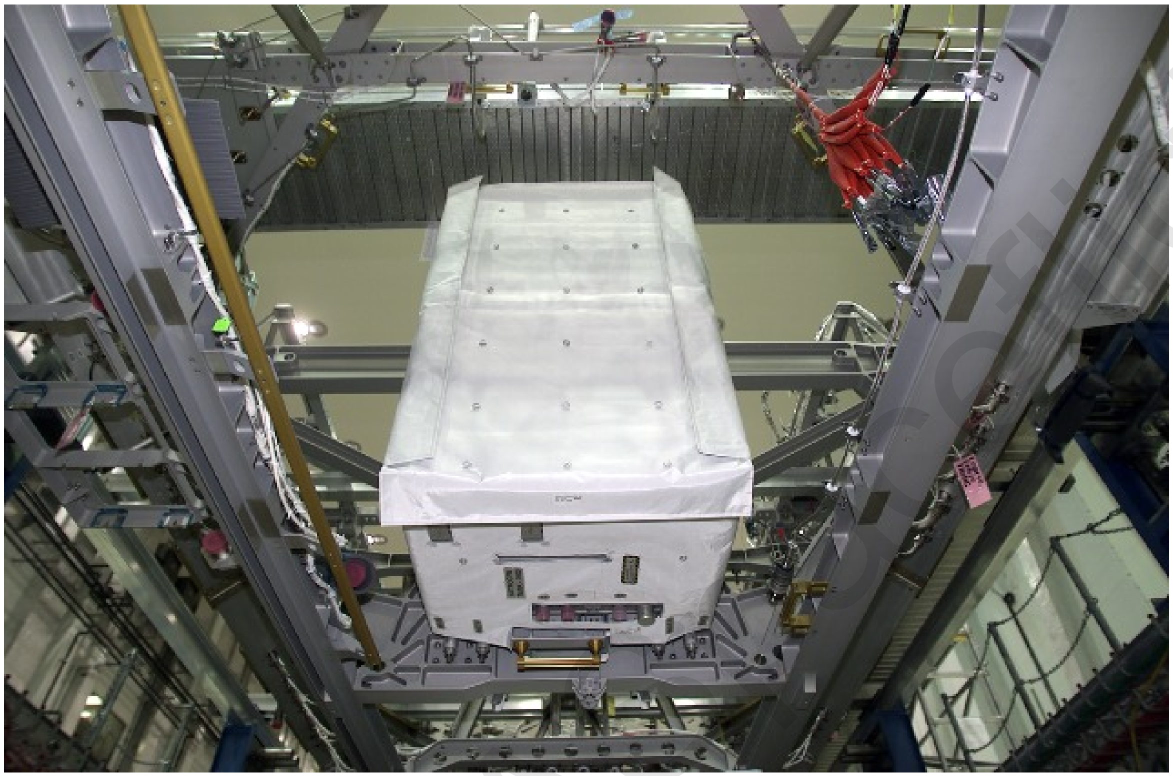
PUMP MODULE (PM)

The Pump Module (PM) is the primary ETCS heat transportation component. There are two PM ORUs, one located on the S1 (Loop A) Truss and the other on the P1 (Loop B) Truss. The Pump Module ORU circulates liquid ammonia at a constant flowrate to a network of coldplates and heat exchangers located on the external trusses and USOS modules, respectively. The major components in the PM include a Pump and Control Valve Package (PCVP), an accumulator, isolation and relief valves, and various temperature, flow, and pressure sensors.

AMMONIA TANK ASSEMBLY (ATA)

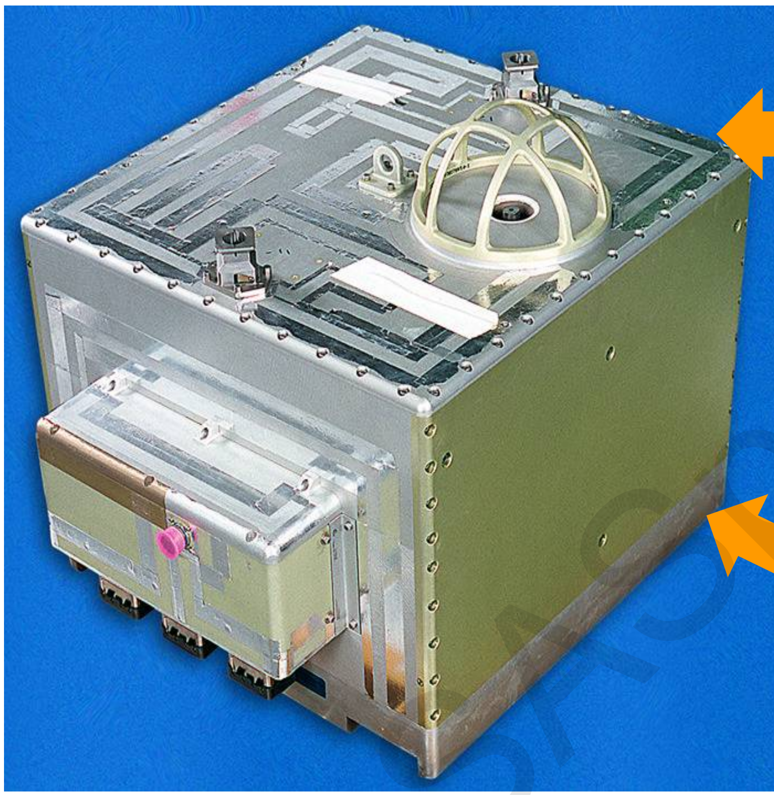
The primary function of the ATA is to store the ammonia used by the ETCS. The major components in the ATA include two ammonia storage tanks, isolation valves, heaters, and various temperature, pressure, and quantity sensors. Each ATA will be used to fill their respective ETCS loop on startup (loops are launched with nitrogen in the lines) and to supply makeup fluid to that loop. It also assists the PM accumulator with ammonia inventory management, and provides the capability to vent the PM and ATA by connection to an external nonpropulsive vent panel. If required, it can be used to replenish the PVTCS fluid lines.

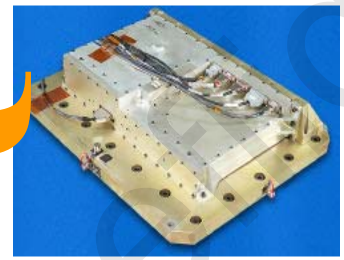
NITROGEN TANK Assembly (NTA)



The primary function of the NTA is to store the high pressure nitrogen that is used to control the pressurization of the ammonia tanks in the ATA. The NTA mounts to the S1 (Loop A) and P1 (Loop B) truss segments and is connected to the ATA by self-sealing QDs. The major components in the NTA include a nitrogen tank, a Gas Pressure Regulator Valve (GPRV), isolation and vent valves, heaters, and various temperature and pressure sensors. The GPRV provides high-pressure control as well as high-pressure nitrogen isolation and overpressure protection of downstream components.

Plasma Contactor Unit (PCU)





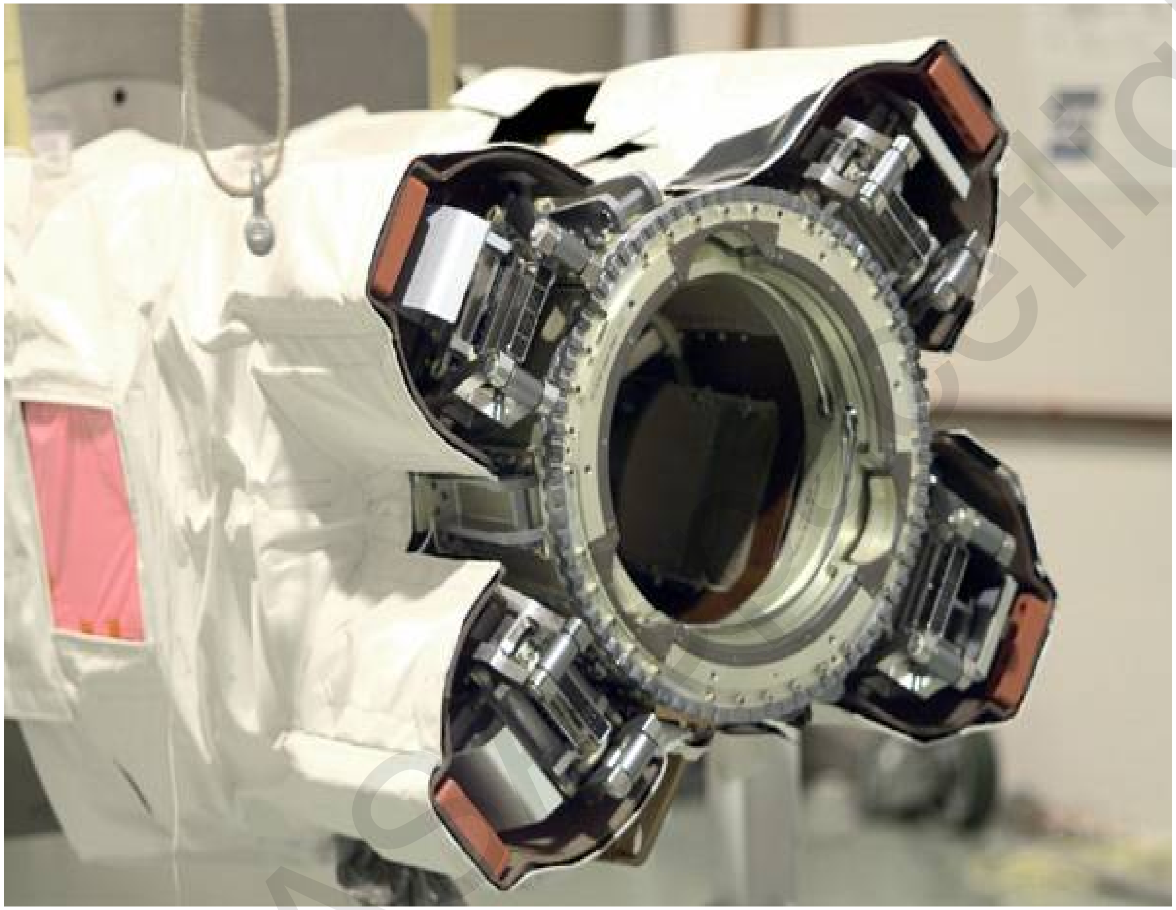
Power Electronics Unit (PEU)

Gas Feed System (GFS)

The Plasma Contactor Unit ORU is an integral element of the Station grounding design. Two PCUs are mounted on the Z1 truss. Used to keep the electrical potential between the surrounding space plasma and the station structure from reaching damaging potentials (maintain ±40 Vdc). To minimize this potential difference, Plasma Contactor Units (PCUs) located on the Z1 truss (one operational and one backup) generate plasma from xenon gas and emit a stream of electrons into space. This electron emission results in a “grounding-strap” that effectively grounds the ISS to the space environment, minimizing the potential difference as well as related hazards to the ISS and crew.

Composed of 3 subsystems:
GFS: Gas Feed System
HCA: Hollow Cathode Assembly
PEU: Power Electronic Unit

Space Station Remote Manipulator System – Latching End Effector (SSRMS LEE)

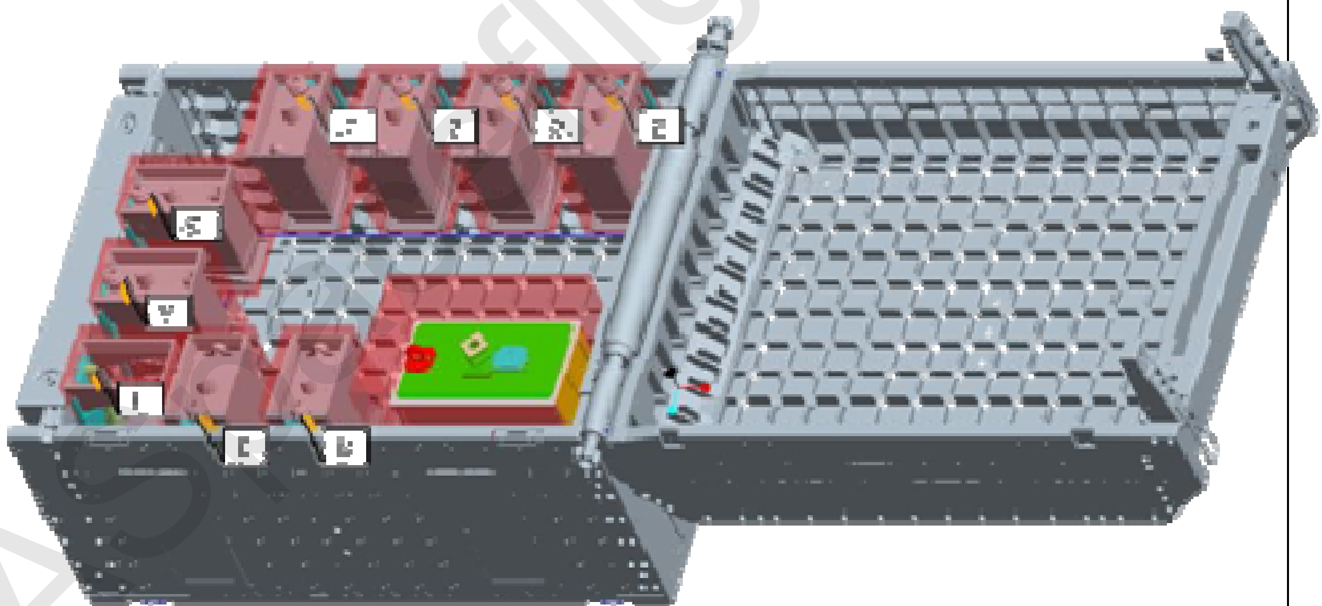


The Space Station Remote Manipulator System (SSRMS) is equipped with two Latching End Effectors (LEEs). Either LEE can be used as the arm's base, while the other is used to grasp payloads or new base locations. To grasp a Grapple Fixture (GF), the arm is first maneuvered to position the tip of the LEE over the Grapple Fixture (GF). A series of mechanisms is then actuated to rigidly attach the LEE to the GF. The LEE grapples PDGFs to act as a base or to provide connectivity to powered payloads or the Special Purpose Dexterous Manipulator (SPDM). PDGFs are equipped with electrical connections for the arm and an interface to which the LEE can be latched. The LEE is composed of the following components:

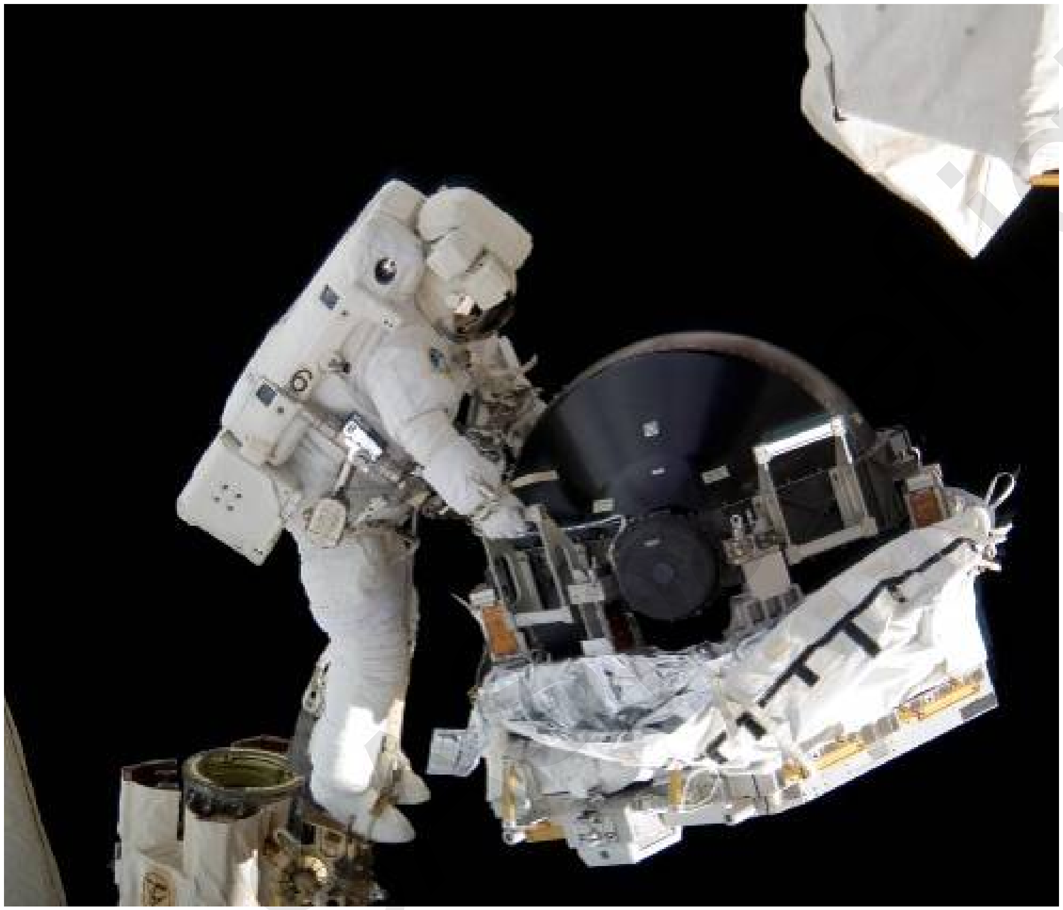
- **Snare Mechanism - (Three cables each connecting two rings that rotate with respect to each other.)**
- **Snare Rings - (rings are mounted on a retractable carriage)**
- **Snare Motor Module (SMM) - (Rotates rings causing the cables to close like the iris of a camera, wrapping around a shaft on the GF).**

CTC1 Layout

- CTC 1
  - (9) RPCM OAKs
    - (7) Type V RPCMs
    - (1) Type II RPCM
    - (1) empty OAK
  - (1) CRPCM OAK



Control Moment Gyroscope (CMG)



The CMG is a gyroscopic device consisting of a motor-driven constant-speed momentum wheel mounted in gimbals that provide two degrees of freedom for the rotor spin axis. The constant-speed wheel is held in an inner gimbal, which is coupled, to an outer gimbal through a pivot, perpendicular to the wheel spin axis. The outer gimbal, in turn, is coupled to the base through a pivot, perpendicular to the inner gimbal axis. Each gimbal pivot contains a geared torquer and a resolver used together for momentum vector control and management. This momentum exchange device is used to apply reaction torque to the Space Station for attitude control.

Photo from 13A.1

Mobil Transporter/Trailing Umbilical System (MT/TUS)

The MT IMCAs receive power and communication via the TUS. Any MSS equipment attached to the MT also transmits and receives communication via the TUS. The TUS is analogous to an extension cord for the MT. It comprises a Reel assembly and the TUS cable itself. There are two TUSs for the MT, one on the zenith side of the MT and one on the nadir side of the MT. The TUS reels are located on the S0 truss and have the capability to extend and retract the TUS cable as required by MT translations. The TUS operates via the use of a swing arm. As the TUS cable becomes slack, the swing arm lowers. Once the arm has lowered far enough, magnetic switches on the arm trip and the IMCA is commanded to retract the cable. The cable is retracted until the swingarm returns to its nominal position. As the TUS cable becomes taught, the swingarm raises and the IMCA is commanded to extend to TUS cable.

Photo from STS-121 / ULF1.1

STS-129/ULF 3 Personnel Assignments

- Flight Mgr: Mary Anne Plaza
- ISS LPM: Hubert Brasseaux
- MIM: Michael Darnell
- EVA Project Marc Ciupitu
- SSP Flight Director: Michael Sarafin
- ISS Flight Director: Brian Smith
- Lead ACO: Robert Napp
- Lead FAO: Telisha Harris
- USA Flight Mgr: Robert Reynolds
- Flight Design Mgr: Jared Renshaw
- Training Mgr: Stephanie Turner
- USA/Cargo Mission Manager: Yvette Carmona
- Crew Compartment Engineer: Tracy Hunt
- MOD/USA Flt Prod. Manager: Linda K. Grubbs
- KSC/Orbiter Manager: Joe Deen
- KSC/Shuttle Payload Proj. Mgr: Debbie Hahn
- CDR Charlie Hobaugh