



STS-125 SSP Flight Readiness Review

MS/Donald S. Noah
September 11, 2008



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Agenda

Presenter	MS/D. S. Noah	
Date	09/11/08	Page 2

- **Systems Engineering & Integration**
 - SE&I FRR Roadmap
 - Flight Preparation Readiness
 - Special Topics
 - Overboard Mixture Ratio
 - DOLILU/Due East Certification for Roll Maneuver
 - Integrated Hazard Report Changes Summary
 - Integrated In-flight Anomalies (IFAs)
 - Integrated Debris Risk Assessment
 - Imagery/Debris Radar
 - Flight Software Readiness
 - Payload and General Support Computer Readiness
 - Non-Standard Open Work Summary
 - Alternate/Dissenting Opinions
 - Certificate of Flight Readiness
 - Launch On Need (LON)

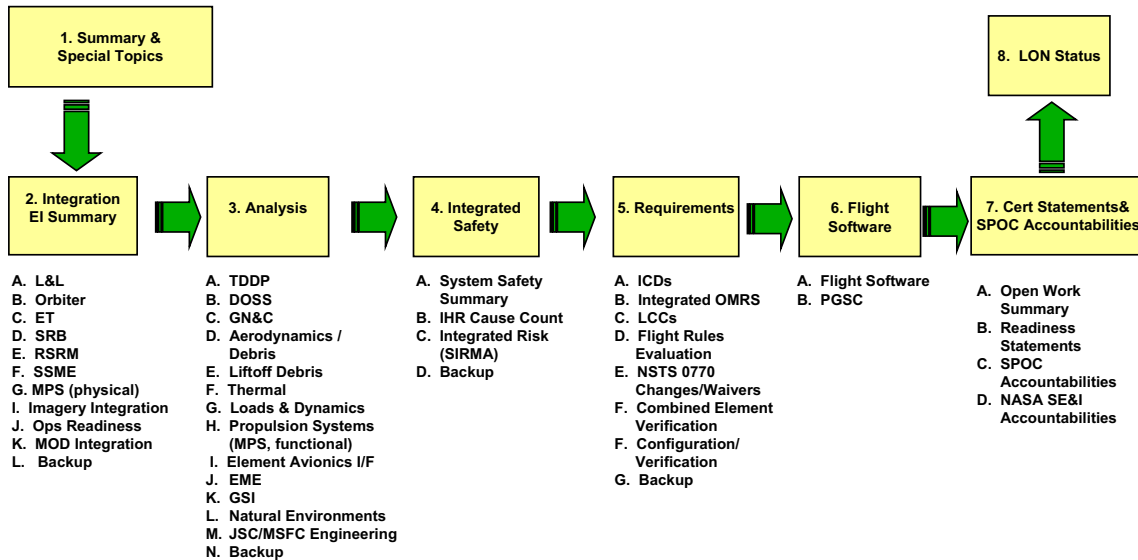




SE&I FRR Roadmap

Presenter MS/D. S. Noah

Date 09/11/08 Page 3



Flight Preparation Readiness

Presenter MS/D. S. Noah

Date 09/11/08 Page 4

- **All standard Systems Engineering and Integration flight preparation activities have been completed or are planned. Non-standard open work will be addressed.**
 - System requirements verification
 - Design requirements and induced environment updates; verification of element incorporation
 - Integrated vehicle performance evaluation
 - Real-time mission support preparation and certification of personnel as applicable
 - Review and disposition of waivers, deviations, and exceptions
 - Updates to Integrated Hazards baseline
 - Flight Software verification/Payload and General Support Computer (PGSC) Readiness
 - Review of element requirements changes and verifications for integration impacts





Special Topic	Presenter MS2/E. M. Burns
	Date 09/11/08 Page 5

Low Over-Board Mixture Ratio Trend and MPS Inventory Plan for STS-125/-400



Special Topic – MPS Low Over-Board Mixture Ratio Trend	Presenter MS2/E. M. Burns
	Date 09/11/08 Page 6

- **STS-123 Post Flight Reconstruction showed lowest OBMR since RTF (-2.7 sigma)**
 - All available Fuel Bias was consumed (~1200 lbs), NOT at risk of a LLCO since there was positive APM on that mission
- **Review of previous flight data indicated a decreasing trend in OBMR beginning about STS-114 (RTF)**
- **“Low OBMR Trend” TIM held in Houston, July 15-16, 2008**
 - Low OBMR trend confirmed by TIM participants
- **MPS inventory (FPR, FB, OBMR) is being updated per normal reconstruction processes – in work for STS-119 and subsequent FLTs**
- **STS-125/400 will perform at a lower OBMR than the current MPS inventory.**





**Special Topic – MPS Low Over-Board
 Mixture Ratio Trend**

Presenter	MS2/E. M. Burns	
Date	09/11/08	Page 7

- **STS-125/-400 MPS Inventory Plan**
 - Use 6.023 OBM R Inventory and accept 1100 lbm DOL APM impact (complete)
 - Generate flight-specific inventory for L-30 TDDP (complete)
 - Adjust launch window to allow for performance gain, if needed (JSC-MOD)
 - SICB approval of CR for new MPS inventory ECD: 09/26/08



Special Topic - DOLILU Changes for STS-125

Presenter	MS2/E. M. Burns	
Date	09/11/08	Page 8

- **DOLILU updates for RTF did not include 28.45° inclination missions**
 - Roll maneuver (RM) Q-planes and dispersions were developed for 51.6° inclination and did not cover 28.45° (due East) inclination flights
 - Existing (51.6° inclination) RM q-planes showed unacceptable launch probability for STS-125 and -400 in November (<90%)
 - Updated RM q-planes provide launch probability of 94% for November
 - Alpha/beta systems dispersions were expanded to cover due east trajectories
 - Roll maneuver wind persistence increments were updated for due east trajectories and the updated day-of-launch wind pairs database
 - Roll Maneuver Q-plane constraints and DOLILU dispersion updates to cover due East trajectories were approved at the SICB 08/19/08
 - Wind change redline updates to protect for DOL wind changes that might invalidate the DOL I-Loads were updated to protect for due East missions were approved at the SICB 8/29/08
- **DOLILU software updates and input data changes for STS-125 were incorporated in Block Update 2008.2 (approved at the SICB 08/29/08)**





**Integrated Hazard Report Changes
 Since STS-124**

Presenter	MS3/B. J. Eliason	
Date	09/11/08	Page 9

- **IMPS-03, “Improper IMPS configuration during SSME Operation”**
 - Downgraded cause X, “Improper Propellant Supply due to Combined Sources,” from Infrequent/Catastrophic to Remote/Catastrophic
 - Result of increased confidence in LLCO sensor system with feed-through connector modification
 - Downgraded cause AR, “Improper MPS Configuration during SSME Operation due to Improper Helium Bubbling System Configuration,” from Remote/Catastrophic to Improbable/Catastrophic
 - Result of Pad A Helium bubbling system no longer using HIM cards
 - Risk Classification unchanged – Accepted Risk
 - Flight Effectivity Update for STS-119 & STS-125 through STS-999
 - CR directive in signature cycle
 - ECD: 09/11/08



**Integrated In Flight Anomalies
 Closed for STS-125**

Presenter	MS3/B. J. Eliason	
Date	09/11/08	Page 10

- **STS-122-I-001, Stinger tile observed falling after SSME startup**
- **STS-123-I-002, Stub Tile Damage During SSME Ignition**
- **STS-124-I-001, Unexpected Debris/Expected Debris Exceeding Mass Allowable Prior to Pad Clearance (Liftoff Debris)**
- **STS-124-I-002, Liberated Refractory Brick, NE Flame Trench Wall Pad A**
- **STS-124-I-003, Late Tyvek Partial Cover Releases**
- **STS-124-I-004, Roll Moment During SRB Tail off**
- **STS-124-I-005, ET TPS Loss at ~Xt 1129, near LO2 Feedline Bracket**

No new causes or increase in risk to existing causes

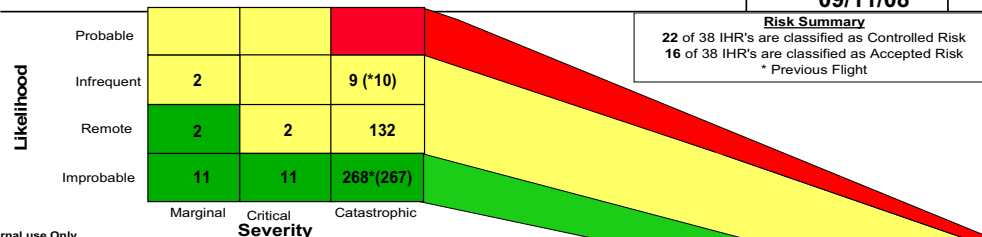




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Integrated Hazard Risk Matrix

Presenter **MS3/B. J. Eliason**
 Date **09/11/08** Page **11**



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Hazard Report #	Integrated Hazard Titles	Controlled				Accepted Risk				Total				
		Controlled Risk	remote-marginal	improbable-marginal	improbable-critical	Accepted Risk	probable-marginal	infrequent-marginal	remote-catastrophic					
"Accepted Risk" Hazard Reports														
IDBR-01	Ascent Debris Impact to SSV	7			7	27			24	3				
ICOM-01	Adverse Effects due to Intentional RF Environment				2				1					
IEME-01	Adverse Electromagnetic Effects (EME)	0				18			18					
IGNC-01	Ascent Trajectory Event Anomaly	13			13	1				1				
IMEO-01	Hazardous Environment in the Aft Compartment	0				4			1	3				
IMPS-01	Contamination in the Integrated MPS H2 System	0				1			1					
IMPS-02	Contamination in the Integrated MPS O2 System	0				1			1					
IMPS-03	Improper IMPS configuration during SSME Operation	11			11	3			3					
IMPS-04	Off-Nominal Purges	11			11	1			1					
IMPS-09	Hazardous Environment due to H2 External to SSV	4			4	6			5	1				
INEV-01	Exposure to Natural Environment Exceeds Capability of the Space Shuttle SSV Elements	17	1	1	15	45	1	1	42	1				
ISPR-04	SRB Hold Down Post (HDP) System Malfunction	1			1	1			1					
ISPR-05	SRB Umbilical System Malfunction	3			3	1			1					
ITHM-01	Exposure to Thermal Environment Exceed Capability of SSV	15	1	5	2	7	3	1	1	1				
IVLD-01	Exposure to Induced Environments Exceed Structural Capability of SSV	22			22	26			26					
ILIT-01	Adverse Effects of Lightning	0				6			6					
Accepted Risk Distribution Totals		(see next page)				145	0	2	2	132	0	0	9	0



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Integrated Hazard Risk Matrix

Presenter **MS3/B. J. Eliason**
 Date **09/11/08** Page **12**

"Controlled Risk" Hazard Reports															
Hazard Report #	Integrated Hazard Titles	Controlled Risk	remote-marginal	improbable-marginal	improbable-critical	Accepted Risk	probable-marginal	infrequent-marginal	remote-catastrophic	Total					
IARO-01	Aerodynamics Environment not per Specified Design	1			1	0									
IEPD-01	Inability to Power Critical Functions			3	5										
IFSI-01	ET/SRB System Interface Failure	6			6	0									
IFSI-02	ET/Orbiter System Interface Failure	10			10	0									
IFSI-03	SSME/Orbiter System Interface Failure	14			14	0									
IFSI-04	Outer Mold Line Configuration Error	3			3	0									
IFSW-01	Flight Software Generic Problems can cause loss of vehicle command and control	1			1	0									
IFSW-02	Erroneous Inputs to Flight Software can cause loss of vehicle command and control	9			9										
IMEO-02	Malfunction of Integrated Hydraulic System (Systems 1, 2 and 3)	4			4	0									
IMEO-03	SSME Nozzle/OMS Pod/ Body Flap Interference	2			2	0									
IMPS-05	Over pressurization of the Integrated MPS H2 System	7			7	0									
IMPS-06	Under pressurization of the Integrated MPS H2 System	7			7	0									
IMPS-07	Over pressurization of the Integrated MPS O2 System	7			7	0									
IMPS-08	Under pressurization of the Integrated MPS O2 System	7			7	0									
IMPS-12	Excessive O2 from ET/Orbiter/SSME External to SSV	7			7	0									
IMPS-15	LO2 Geyser Event during Cryo Loading	8			8	0									
IMPS-16	Loss of MPS He System	4			4	0									
IMPS-17	Inadvertent SSME Shutdown	3			3	0									
IPYR-01	Pyrotechnic System Malfunction	11			11	0									
ISPR-02	ET Vent Arm System (ETVAS) Umbilical System Malfunction	14			14	0									
ISPR-03	Tail Service Mast (TSM) T-0 Umbilical System Malfunction	11		5	6	29									
IVLD-02	System Instability Results In Structural Failure of SSV	13			13	0									
Controlled Risk Distribution Totals		242	2	11	11	268	145	0	2	2	132	0	0	9	0





STS-125 Hubble Debris Risk Assessment Summary

Presenter	MS/D. S. Noah	
Date	09/11/08	Page 13

(HAZARD SEVERITY LEVEL AND LIKELIHOOD OF OCCURRENCE WITH CONTROLS IN PLACE)

L I K E L I H O O D	PROBABLE			
	INFREQUENT			3
	REMOTE			24
	IMPROBABLE			7
		MARGINAL	CRITICAL	CATASTROPHIC

SEVERITY

3 Infrequent Causes:
 •Liftoff Debris (AD)
 •Umbilical Ice (V)
 •Orbiter Putty Repair (AK)

**IDBR-01 (STS-125) Hubble
 Debris Risk Assessment, 9/2008**

- **The debris environment for the Hubble servicing mission has been reduced to minimize the debris threat to the vehicle**
 - This is reflected in the significant reduction of “Infrequent/Catastrophic” debris causes
 - ET redesigns and process-oriented debris mitigations since the original Hubble risk assessment have significantly reduced the risk to the vehicle
 - Debris model updates since RTF have also improved the ability to characterize the debris risk



Debris Radar Configuration for STS-125:

Presenter	MS/A. D. Griffith	
Date	09/02/08	Page 14

- **STS-125 NDR Configuration:**
 - 1 MCR C-band radar (NDR-C1)
 - 2 NASA X-band radars
 - NASA #1 on SRB vessel *Liberty Star* (NDR-X3)
 - NASA #2 on *Runnymede-Class* ARMY LCU (NDR-X4)
- **STS-125 is first flight with entire NDR system in permanent configuration (new building for full support, C-bd tuned for 16 bit ADC)**
- **Operational SRB tracking, following ASTT, by both X-bd radars**
 - Plan is for X4 to track the boosters from 150-310 MET, and X3 from 270-420 MET
- **No line of sight available for pad debris from X4 for due east trajectory**
- **Mission plan is updated for due east trajectory**
- **In cooperation with the DIG, an updated material ID card will be used during STS-125. This update reflects recent ground truth measurements at AFRL**
- **NIRD reporting process is continuing to be improved**
 - Reportable item criteria updated to reflect ops improvements





Imagery Hardware - ELVIS & Ground

Presenter	MS3/D. Melendrez	
Date	09/11/08	Page 15

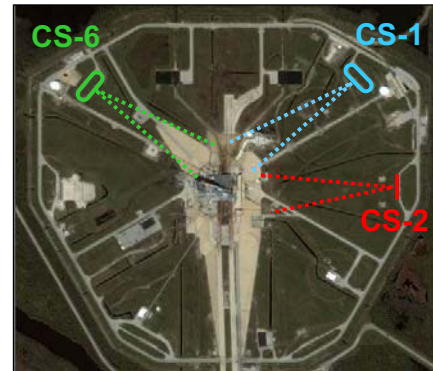
ET LO2 Feedline Camera Signal & Video Downlink Plan

- 28.5° orbit inclination will affect ground station AOS/LOS times.
- Expected loss of downlink and live feed to NASA TV at ~400 seconds MET.



Ground Cameras

- Procurement in work for 4 new IR cameras (2 cooled, 2 uncooled) for monitoring flame trench liftoff debris: Camera Site (CS)-1 and 6 will each receive 1 cooled and 1 uncooled IR camera.
 - Existing IR camera will be used at CS-2
 - KSC imagery team assessing:
 - Availability of visible-range film cameras to be placed at CS-1 and 6 to provide additional data for flame trench liftoff debris
 - Feasibility of installing high powered flood lights to help illuminate the exit of the SRB flame trench for the visible light cameras.



STS-125 FLIGHT SOFTWARE SUMMARY

Presenter	USA/John Magley	
Date	09/11/08	Page 16

- **Fifth flight of Primary Avionics Software System (PASS) and Backup Flight System (BFS) Operational Increment 32 (OI-32)**
 - No PASS or BFS changes
- **Fifth Flight of MEDS Integrated Display Processor (IDP) / Multifunction Display Unit Function (MDUF) combination (VI 5.00/5.00)**
 - No changes for STS-125
- **Ninth flight of Miniature Airborne Global Positioning System (GPS) Receiver Shuttle - 3 String (MAGRS-3S) Link 7**
 - No changes for STS-125





STS-125 FLIGHT SOFTWARE READINESS SUMMARY

Presenter	USA/John Magley	
Date	09/11/08	Page 17

- **Integrated Avionics Verification (IAV) is complete**
 - A total of 15 test cases were performed in the Shuttle Avionics Integration Laboratory (SAIL) and successfully analyzed in support of STS-125
- **SAIL facility will be in a condition of readiness for mission support**
- **Formal Software Readiness Review (SRR) was conducted on 08/26/08**
 - All actions will be tracked to completion prior to FRR (or applicable post-FRR milestone)
 - Only standard open work expected at FRR
- **With successful completion of Standard Open Work, FSW will be ready to support STS-125**

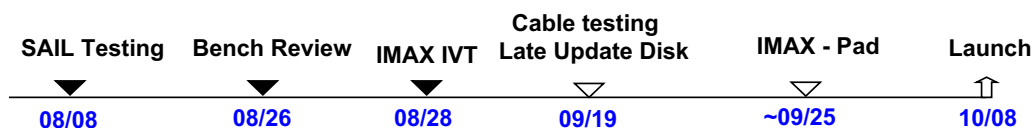


Payload and General Support Computer Readiness – STS-125

Presenter	MS4/E. Jones	
Date	09/11/08	Page 18

- **Hardware and Software Summary**
 - The Payload and General Support Computers (PGSC) were developed to enhance crew situational awareness.
 - STS-125 will be the eleventh flight of the IBM ThinkPad A31p PGSC
 - Fifth flight of the A31p Docking Station
 - Third flight of Netgear Wireless Access Point.
 - Note: No network issues observed during STS-124
 - IBM 760XD being flown as backup for IMAX and OCA (S-band)

• **PGSC Milestones**





STS-124 Lessons Learned

Presenter	MS4/E. Jones
Date	09/11/08
Page	19

- **Successful PGSC network operations were attributed to three primary factors:**
 - Testing at USA FCE (discovered problem with camera used for video conferences)
 - Testing at SAIL (discovered problem with Wireless network card)
 - Network hardware Upgrade (Wireless Access Point simplified network)
- **Incorrect RPOP I-Loads – FIAR JSCMS0001F**
 - Problem discovered during post-dock data analysis
 - Correct files up-linked prior to separation and successfully used on board
 - Flight Build Process Improvement implemented for STS-125
 - Verification of PGSC flight software performed by application owner (required)
 - Flight Readiness Statement signature requirement for all application owners
 - PGSC Engineer Work Instructions updated to enhance Peer Review process



STS-125 Non-Standard Open Work Summary

Presenter	MS/D. S. Noah
Date	09/11/08
Page	20

Open Work	Completion Date
Propulsion	
- CR disposition for new MPS inventory	09/26/08
EME	
-- Disposition CR S063936 Shuttle Crew Escape Equipment	09/11/08
Launch Commit Criteria	
- LCN 1269 – MEC Core A Power Indication Failure	09/26/08
Systems ICDs	
- ET LO2 feedline support collar TPS mod	09/10/08
- ET longeron TPS closeout mods	09/10/08
OMRS	
- PCM/PDI table update	09/19/08





Alternate/Dissenting Opinions

Presenter	MS/D. S. Noah	
Date	09/11/08	Page 21

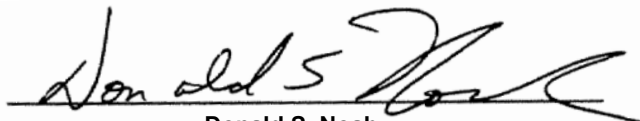
- **Alternate/dissenting opinions were actively solicited at the SE&I STS-125 Pre-FRR.**
 - No dissenting opinions were identified.



CoFR Endorsement

Presenter	MS/D. S. Noah	
Date	09/11/08	Page 22

The Space Shuttle Program, Systems Engineering and Integration Office's Flight Preparation Process Plan, documented in NSTS 08117, Requirements and Procedures for Certification of Flight Readiness have been satisfied. Required products and other responsibilities identified in NSTS 08117, paragraph 8.5.12 and Appendix M, have been or will be scheduled for completion. All technical functions and responsibilities are ready and the Systems Engineering and Integration Office is prepared to sign the Certificate of Flight Readiness for STS-125, pending completion of open work.



Donald S. Noah
 Manager Systems Engineering and Integration Office





STS-400 Agenda

Presenter MS/D. S. Noah

Date 09/11/08 Page 23

- **Systems Engineering & Integration**
 - STS-400 Approach
 - SE&I FRR Roadmap
 - Flight Preparation Readiness
 - Flight Software Readiness/PGSC Readiness
 - Non-Standard Open Work Summary
 - Alternate/Dissenting Opinions
 - Statement of Flight Readiness



STS-400 Approach

Presenter MS/D. S. Noah

Date 09/11/08 Page 24

- **Verified that there were no items of open work that would preclude SE&IO to adhere to a seven day call up.**
- **SE&I reviewed the performance post flight verification process and verified it will support a call up for STS-400.**
- **Certification of Flight Readiness would occur through MMT authorization of launch.**
- **FSW products were created by making modifications to the STS-123 Base Load using the approved set of FSW tools and processes. They have an identical pedigree to other delivered flight systems including STS-125.**

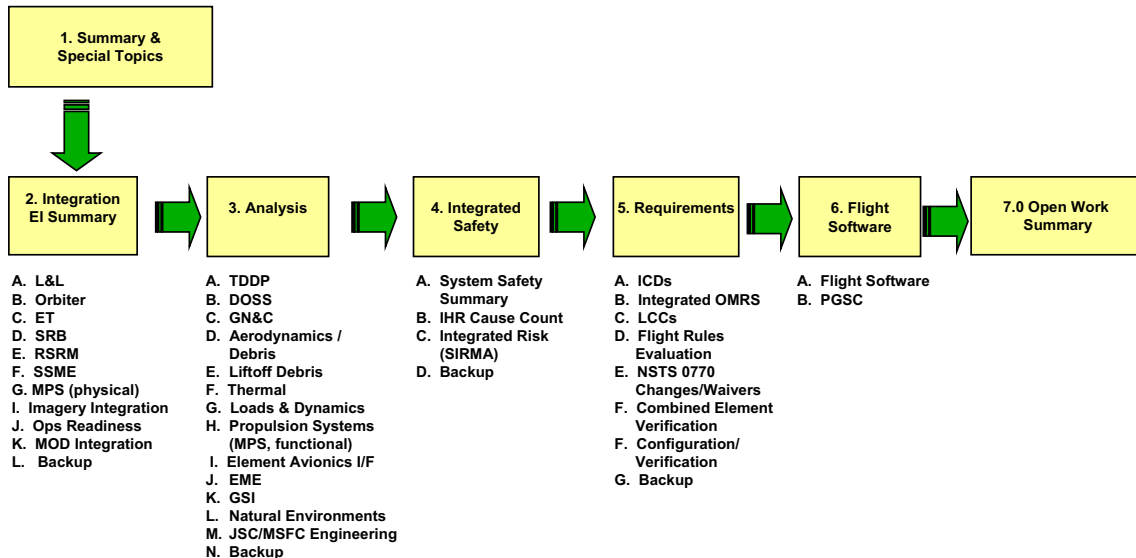




SE&I FRR Roadmap

Presenter MS/D. S. Noah

Date 09/11/08 Page 25



Flight Preparation Readiness

Presenter MS/D. S. Noah

Date 09/11/08 Page 26

- **All standard Systems Engineering and Integration flight preparation activities have been completed or are planned. Non-standard open work will be addressed.**
 - System requirements verification
 - Design requirements and induced environment updates; verification of element incorporation
 - Integrated vehicle performance evaluation
 - Real-time mission support preparation and certification of personnel as applicable
 - Review and disposition of waivers, deviations, and exceptions
 - SE&I performed a review of the disposition of the UA for the ET noise observation and has concurred with flight rationale
 - Updates to Integrated Hazards baseline
 - Flight Software verification/Payload and General Support Computer (PGSC) Readiness
 - Review of element requirements changes and verifications for integration impacts





**STS-400 FLIGHT SOFTWARE / PGSC
 READINESS SUMMARY**

Presenter	USA/J. Magley	
Date	09/11/08	Page 27

• Flight Software

- In the event of call-up by the SSP, STS-400 will be flown on OV-105 using the STS-123 Base Load with STS-400 flight specific I-load patches applied
 - Would be sixth OI-32 based flight
 - All work has been completed Pre call-up
 - I-Load patches were generated and released for STS-400 training
 - Two PASS code patches and one standard GMEM that were originally released for STS-123 were re-released for STS-400
 - One additional PASS code patch was generated and released for STS-400
 - One BFS code patch that was originally released for STS-123 was re-generated for STS-400
 - No changes from STS-125 required for MEDS and MAGRS-3S (GPS)
- SAIL verification complete and facility ready to support STS-400
- Formal Software Readiness Review (SRR) was conducted on 08/26/08
- With successful completion of Standard Open Work, FSW will be ready to support STS-400



**STS-400 FLIGHT SOFTWARE / PGSC
 READINESS SUMMARY**

Presenter	MS4/E. Jones	
Date	09/11/08	Page 28

• Payload and General Support Computers (PGSC)

- STS-400 would be the 12th flight of the IBM ThinkPad A31p PGSC
- STS-400 PGSC hardware configuration is identical to STS-126
 - There will be minor software differences in Rendezvous Proximity Operations Program (RPOP) and Windecom applications
- STS-400 laptops and configuration have been successfully tested in SAIL and, in the event of call-up, will be configured to support the STS-400 flight
- With successful completion of Standard Open Work, PGSCs will be ready to support STS-400





STS-400 Non-Standard Open Work Summary

Presenter **MS/D. S. Noah**

Date **09/11/08**

Page 29

Open Work	Completion Date
Propulsion - CR Disposition for new MPS Inventory OMRS - PCM/PDI table (OS17766-S00)	09/26/08
	09/19/08



Alternate/Dissenting Opinions

Presenter **MS/D. S. Noah**

Date **09/11/08**

Page 30

- **Alternate/dissenting opinions were actively solicited at the SE&I STS-400 Pre-FRR.**
 - No dissenting opinions were identified.





STS-400 Statement of Readiness

Presenter	MS/D. S. Noah	
Date	09/11/08	Page 31

- Pending closure of open work, the Systems Engineering and Integration Office is ready to support the launch of STS-400, if needed.

