



STS-127 SSP Flight Readiness Review

MS/Donald W. Totton
May 27, 2009



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Agenda

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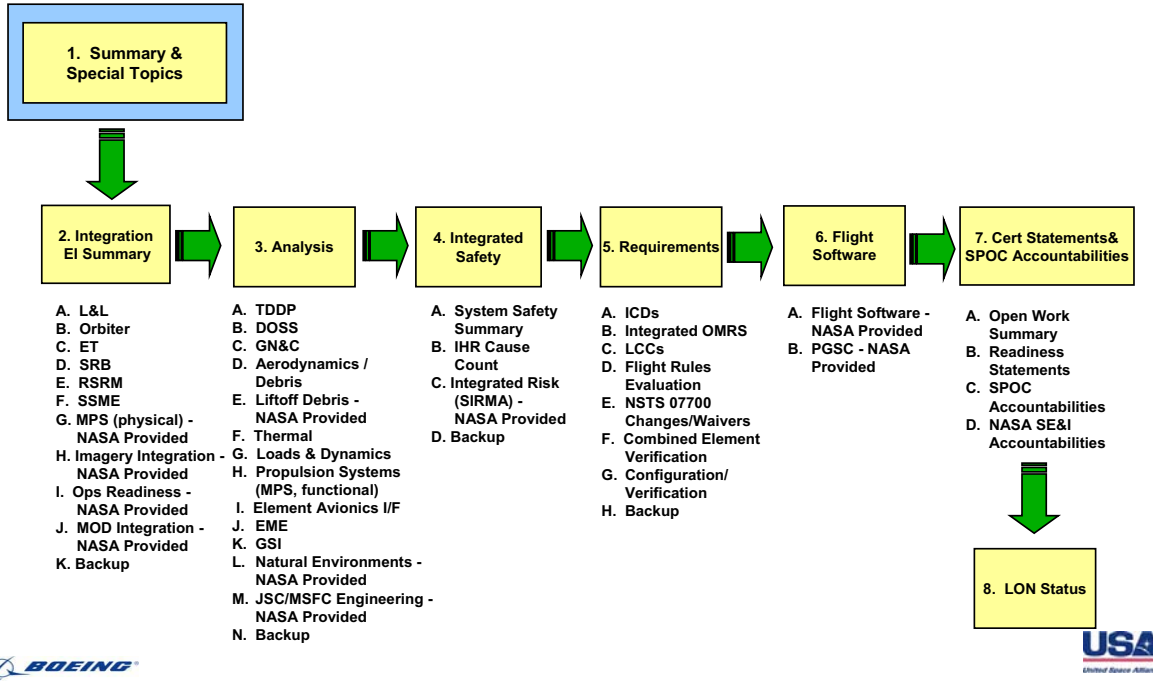
- **Systems Engineering & Integration**
 - SE&I FRR Roadmap
 - Flight Preparation Readiness
 - Integrated Debris Risk Summary
 - 104 Second Debris Event
 - T-0 Ice
 - MPS Inventory Update/CMR Change
 - Integrated In-flight Anomalies (IFAs)
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 - Payload and General Support Computer Readiness
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 - Certificate of Flight Readiness
 - Launch On Need (LON)





SE&I FRR Roadmap

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Flight Preparation Readiness

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- **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





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STS-127 SSP Flight Readiness Review Integrated Debris Risk Summary



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Special Topic: 104 Second Debris Event





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Special Topic: T-0 Ice



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MPS Inventory Update/CMR Change





STS-127 MPS Inventory Update/CMR Change

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• Background

- **STS-123 Post Flight Reconstruction showed lowest Over Board Mixture Ratio (OBMR) since RTF (-2.7 sigma, -0.4%)**
 - All available Fuel Bias was consumed (~1200 lbs), NOT at risk of a LLCO since there was positive Ascent Performance Margin (APM) on that mission
- **Review of previous flight data indicated a decreasing trend in OBMR beginning about STS-114 (RTF) – Could result in loss of performance (payload capability)**
 - **“Low OBMR Trend” TIM held in Houston, July 15-16, 2008**
 - Low OBMR trend confirmed by TIM participants
- **Lower than predicted OBMR likely due, in part, to a facility fuel flowmeter temperature bias at SSC which was identified by SSME Project during the OBMR investigation**
- **Interim mitigation against lower than predicted OBMR was implemented through an increase in the Controller Mixture Ratio (CMR) to 6.049**
 - **MPS inventory was not changed for STS-119, -125, and -126**
- **STS-127 will be the first flight of SSME controller constant updates, an updated MPS propellant inventory, and an updated CMR**



STS-127 Inventory Update/CMR Change

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- **First Flight Changes for STS-127**
 - **SSME Element calculated biases for each engine acceptance test and corrected flight engines accordingly**
 - **The corrections reduce variability in active engines to the point where a single inventory can reasonably account for the performance variations**
 - **The Flight-derived Dispersion Database (FDD) was updated to include flights up to STS-124 and the MPS inventory was updated**
 - **CMR has been updated to 6.043 based on the new MPS inventory**
 - **New FPR performance curve results in -175 lbm impact to APM**





STS-127 SSP Flight Readiness Review Integrated In-flight Anomalies Summary

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INTEGRATED IN-FLIGHT ANOMALIES

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- STS-119-I-004 “PARTIAL F4D TYVEK RELEASE”
 - Status – OPEN
- STS-125-I-001 “LIFTOFF DEBRIS”
 - Status – OPEN
- STS-125-I-002 “ICE INTERNAL AND EXTERNAL TO LH2 T-0 UMBILICAL”
 - Status – OPEN
- STS-125-I-003 “AEROSURFACE SERVO AMPLIFIER 1 POWER LOSS”
 - Status – OPEN
- STS-125-I-004 “MISSING STIFFENER RING FOAM”
 - Status – OPEN
- STS-125-I-005 “DEBRIS EVENT AT MET 104 SECONDS”
 - Status – OPEN





<h1>Integrated Hazard Risk matrix</h1>		Presenter	MS/JJ HILL	
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Likelihood	Probable			
	Infrequent	2		11
	Remote	2	2	133
	Improbable	11	11	268
		Marginal	Critical	Catastrophic
		Severity		

Risk Summary
 21 of 38 IHR's are classified as Controlled Risk
 17 of 38 IHR's are classified as Accepted Risk
 * Previous Flight

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Hazard Report #	Integrated Hazard Titles	Controlled				Accepted Risk								
		Controlled Risk	remote-marginal	improbable-marginal	improbable-critical	Accepted Risk	probable-marginal	infrequent-marginal	remote-critical	remote-catastrophic	probable-critical	infrequent-critical	infrequent-catastrophic	probable-catastrophic
"Accepted Risk" Hazard Reports														
IDBR-01	Ascent Debris Impact to SSV	7		7	28						24			4
ICOM-01	Adverse Effects due to Intentional RF Environment	2		2	1						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		2							1			1
IMPS-02	Contamination in the Integrated MPS O2 System	0		1							1			1
IMPS-03	Improper IMPS configuration during SSME Operation	11		11	3						3			
IMPS-04	Off-Nominal Purges	11		11	1						1			
IMPS-05	Over pressurization of the Integrated MPS H2 System	7		7	1						1			
IMPS-09	Hazardous Environment due to H2 External to SSV	4		4	6						6			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)				148	0	2	2	133	0	0	11	0



<h1>Integrated Hazard Risk Matrix</h1>		Presenter	MS/JJ HILL	
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"Controlled Risk" Hazard Reports															
IARO-01	Aerodynamics Environment not per Specified Design	1			1	0									
IEPD-01	Inability to Power Critical Functions	8		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	0									
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-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	40	5	6	29	0									
IVLD-02	System Instability Results In Structural Failure of SSV	13			13	0									
Controlled Risk Distribution Totals		292	2	11	11	268	148	0	2	2	133	0	0	11	0





Integrated Hazard Risk Matrix Reduction Count		Presenter	MS/JJ HILL
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- **Infrequent Catastrophic**
 - None
- **Remote Catastrophic**
 - None
- **Improbable Catastrophic**
 - None



STS-127 SSP Flight Readiness Review Imagery Status

MS3/David Melendrez



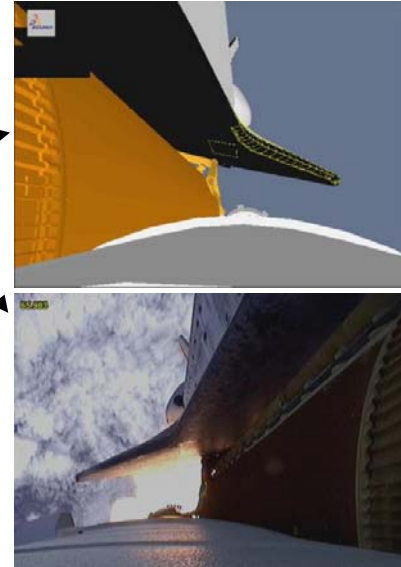


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Imagery

Enhanced Launch Vehicle Imaging System (ELVIS)

- ET LO2 Feedline Camera, SRB cameras, crew handheld cameras, ground network, configured and on track with nominal checkouts. Only two changes from STS-125:
 - LH SRB Fwd Skirt camera will have new repointed configuration to match RH SRB. Repointed configuration is baseline for both boosters for remaining flights.
 - Reminder: ISS orbit inclination will again allow live downlink of ET LO2 Feedline Camera video through MECO and ET Sep.
- Orbiter DETTIPS (umb well) still camera R&R will occur after vehicle arrives at Pad A. Expected to resolve "no-flash" and memory buffer problems experienced during pre-flight testing.



Ground Cameras

- One change from STS-125: long range tracker to be moved back from CB to Ponce Inlet.
- No current plans to monitor SRB flame trench.

Pending ELVIS DETTIPS camera R&R, Imagery team is ready to support.



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Lighting Predicts, June 13 – July 31

Launch

- June 13 – 14: DAYLIGHT
- June 15: DAYLIGHT, Non-Optimal
- June 16 – 19: DARK
- June 20 - July 10: DARK β
- July 11 – 31: DAYLIGHT

Post ET-Sep Mnvr

- June 13 – 19: Nominal +X, Nominal Pitch
- June 20 – 28: Nominal +X, Nominal Pitch β
- June 29 – July 10: Nominal +X, No Pitch β
- July 11 – 31: Nominal +X, Nominal Pitch

ET Sep Imagery

- June 13 – 19: DAYLIGHT
- June 20 – 21: DAYLIGHT
- June 22: DAYLIGHT, Non-Optimal β
- June 23 – July 9: DARK
- July 10: DAYLIGHT
- July 11 – 31: DAYLIGHT

NOTE: Beta violation June 20 – July 10

Handheld ET (post-pitcharound) Imagery

- June 13 – 19: DAYLIGHT
- June 20 – 25: DAYLIGHT
- June 26 – 28: DAYLIGHT, Non-Optimal β
- June 29 – July 10: DARK
- July 11 – 31: DAYLIGHT

MOD. SE&I Agreements for Crew HH ET Photography

- Pitch mnvr for handheld ET photography will not be attempted if nominal photography time is dark.
- Pitch mnvr will not be performed "late"
- Pitch mnvr and ET handheld photography will not be attempted on LON mission



Debris Radar Configuration for STS-127:

Presented by	MS3/J.A. Hamilton	
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- **STS-127 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)
- 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
- System configuration will be the same as STS-125.
- Mission plan will be similar to STS-119 with minor updates.
- Coordinating with FDO for NDR support during planned on-orbit debris release events.
- NDR STS-127 CoFR is scheduled for 5/22/09.



NDR Readiness:

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- **Team Readiness**
 - Complete, both ascent and analysis teams ready
- **Facility Readiness**
 - Data communication boxes receiving pointing data from the ER sent to vendor for thermal issues.
- **Radar Readiness**
 - NDR-C1 - **YELLOW** - Investigating tracking issue from STS-125.
 - NDR-X3 - **GREEN**
 - NDR-X4 - **GREEN**





STS-127 FLIGHT SOFTWARE SUMMARY

Presenter	USA/John Magley	
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- **Third flight of PASS and BFS Operational Increment 33 (OI-33) and MEDS Integrated Display Processor (IDP) / Multifunction Display Unit Function (MDUF) combination (VI 6.00/5.00)**
 - STS-127 flight system includes a PASS source update to correct a valve command timing issue in the Abort OMS/RCS Interconnect Sequence (SCR 93267A)
 - Update ensures adequate time is allowed for valve closure in the presence of a power failure

- **Eleventh flight of MAGRS-3S Link 613-9966-007 GPS FSW**
 - No changes from STS-119 software



Launch on Need Status

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- **In the event of call-up, the STS-128 flight software products would be flown on OV-103**
 - **First flight of OI-34**
 - No major new capabilities
 - Several maintenance and maintainability updates
 - **STS-128 Base Load and associated products**
 - **Flight specific I-Load patches for STS-128 (full payload bay)**
 - **First flight of new MEDS load**
 - OI-34 compatible MEDS IDP (VI 7.00) and MDUF (VI 6.00) software
 - **MAGRS-3S Link 8 - no changes from STS-125**
- **Completion of the development and verification of flight-specific FSW products for STS-128 will be performed in time to support the 08/06/09 target launch date**
- **Formal Software Readiness Review to be conducted after call-up**





FSW READINESS SUMMARY

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- **Integrated Avionics Verification (IAV) is complete**
 - A total of 16 test cases were performed in the Shuttle Avionics Integration Laboratory (SAIL) and successfully analyzed in support of STS-127
- **SAIL facility will be in a condition of readiness for mission support**
- **Formal Software Readiness Review (SRR) was conducted on 05/07/09**
 - No known constraints
- **With the completion of planned open work, FSW will be ready to support STS-127 launch**



Payload and General Support Computer Readiness – STS-127

Presenter	MS4/E. Jones	
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- **Hardware and Software Summary**
 - **STS-127 will be the fourteenth flight of the IBM ThinkPad A31p PGSC**
 - Seven PGSC units; One PGSC planned for ISS transfer;
 - One PCS unit
 - No new software
 - Eighth flight of the A31p Docking Station
 - Sixth flight of Netgear Wireless Access Point.
 - Note: No network issues observed during STS-119





STS-127 Non-Standard Open Work Summary

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	Completion Date
System Safety	
- STS-119-I-004, Partial F4D tyvek release closure	06/02/09
- STS-125-I-001, Unexpected Debris/Expected Debris Exceeding Mass Allowable Prior to Pad Clearance(Liftoff Debris)	05/26/09
-STS-125-I-002, Ice Internal and External to LH2 T-0 Umbilical	06/09/09
-STS-125-I-003, Aerosurface Servo Amplifier-1 Power Loss	06/09/09
-STS-125-I-004, Missing Stiffener Ring Foam	06/09/09
-STS-125-I-005, Debris Event at MET 104 Seconds	06/09/09



Alternate/Dissenting Opinions

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- **Alternate/dissenting opinions were actively solicited at the SE&I Delta STS-127 Pre-FRR.**
 - No dissenting opinions were identified.





CoFR Endorsement

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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-127, pending completion of open work.

/s/Donald S. Noah

Donald S. Noah
 Manager Systems Engineering and Integration Office



LON Status

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- PI has identified no technical or schedule constraints to the support of LON requirements for STS-127 using the SSP baseline "Fly the Next Flight" approach

