



STS-133 SSP Flight Readiness Review

MS/Terri Murphy
October 6, 2010



Pre-decisional. Internal Use Only.



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Agenda

Presenter	MS/Terri Murphy	
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- **Systems Engineering & Integration**
 - SE&I FRR Roadmap
 - Flight Preparation Readiness
 - Integrated Debris Risk Summary
 - Integrated Hazard Report Summary
 - Integrated In-flight Anomalies (IFAs)
 - Imagery Status
 - Radar Status
 - 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)

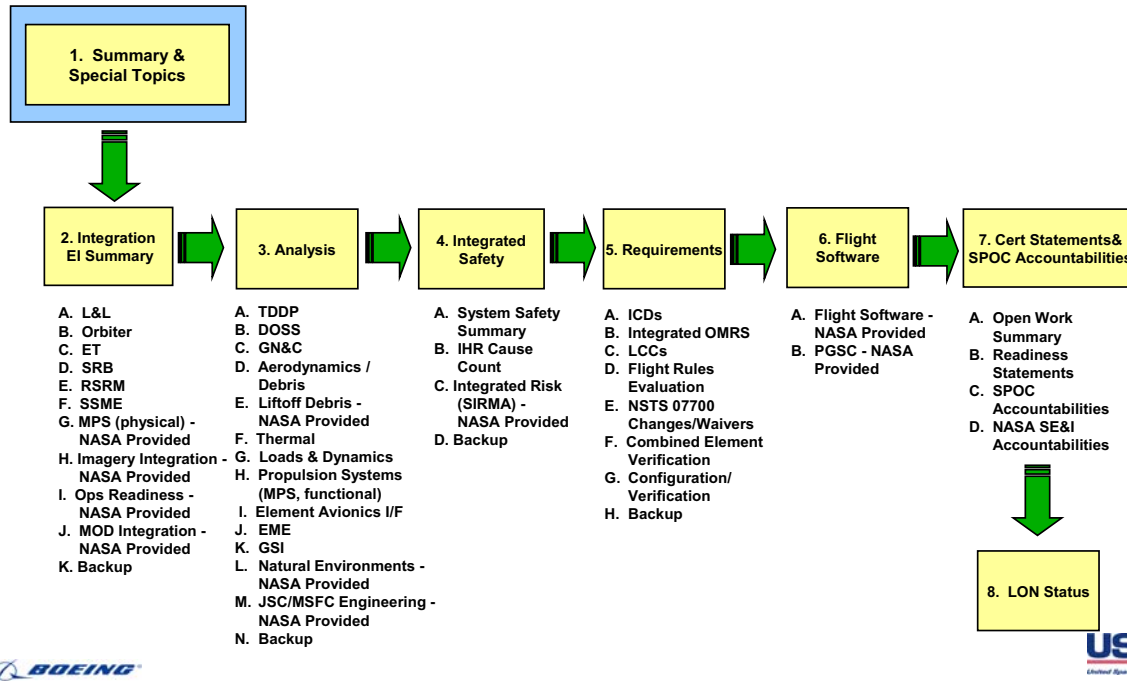




SE&I FRR Roadmap

Presenter MS/Terri Murphy

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Flight Preparation Readiness

Presenter MS/Terri Murphy

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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





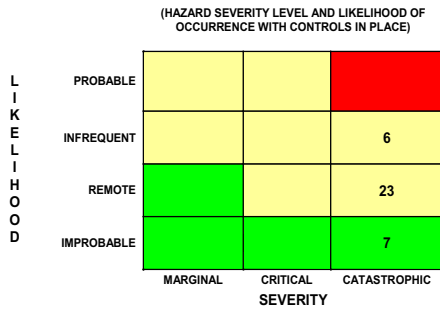
STS-133 SSP FRR	Presenter	MS/ Doug Drewry
	Date	10/6/10

STS-133 Debris Risk Summary

Doug Drewry, MS2
 Systems Engineering & Integration Office
 Space Shuttle Program Office



STS-133 Debris Risk Assessment Summary	Presenter	MS/ Doug Drewry
	Date	10/6/10



- 6 Infrequent Causes:
- Liftoff Debris (AD)
 - ET Umbilical Ice (V)
 - Orbiter Putty Repair (AK)
 - T-0 Umbilical Ice (AO)
 - LO2 IFR (I)
 - Intertank acreage (G)

Debris Risk Assessment, 10/2010

Six IDBR-01 debris risks remain Infrequent/Catastrophic

- **Liftoff Debris:** Accepted Risk; Rigorous controls in place and continuous vigilance is policy.
- **ET Umbilical Ice:** Accepted Risk; Closely monitored during pre-launch
- **Putty Repair:** Windows zero impact allowable keeps any impact in the "catastrophic" category
- **T-0 Umbilical Ice:** Accepted Risk
- **LOX IFR:** NDE of IFR ramps revealed no large voids
- **ET Intertank Foam Loss:** Continue Tensile Testing of ET high risk debris areas to mitigate risk





Issues & Integrated In Flight Anomalies

Presenter **MS/ Doug Drewry**

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- **STS-132-I-001 (Liftoff Debris):** Reviewed STS-132 LOD & No increase in Risk - **CLOSED 6/15/10**
- **STS-132-I-002 (Intertank TPS Loss):** Loss assessment discussed at the 6/9/10 DIG, found to be consistent with current analysis assumptions. **CLOSED 7/21/10**
- **STS-132-I-003 (LH2 T-0 Umbilical Internal Ice):** Inspection of hardware and water intrusion test showed leak path leading to location where internal ice was seen; procedures have been modified to improve RTV application to eliminate the open flow path into the seal cavity. **CLOSED 08/18/10**
- **STS-132-I-004 (Frustum UR BSM RTV-133 Missing with Darkened Substrate):** Element analysis and testing complete, determined Loss was not during ascent. Remains Unexpected Debris for ascent. **CLOSED 9/23/10**
- **STS-131-I-002 (Rudder Speed Brake TPS Liberation):** Chit J6625 measures the gaps across the RSB interface and the tile alignment with the RSB structure. Inspection procedures implemented on all vehicles (OV-103 work is complete). Remains Unexpected Debris. **CLOSED 08/19/10**
- **STS-131-I-003 (Ceramic Insert Plugs):** Ceramic plugs modified using alternate cordage that was shown to improve the running torque and thus decrease the likelihood of liberation. STS-132 performance was improved with no loss of plugs. **CLOSED 08/19/10**
- **STS-131-I-004 (Base Heat Shield TPS Liberation):** OPO/TPS reviewed updated MEI Acoustics – No impacts. **CLOSED 10/1/10**

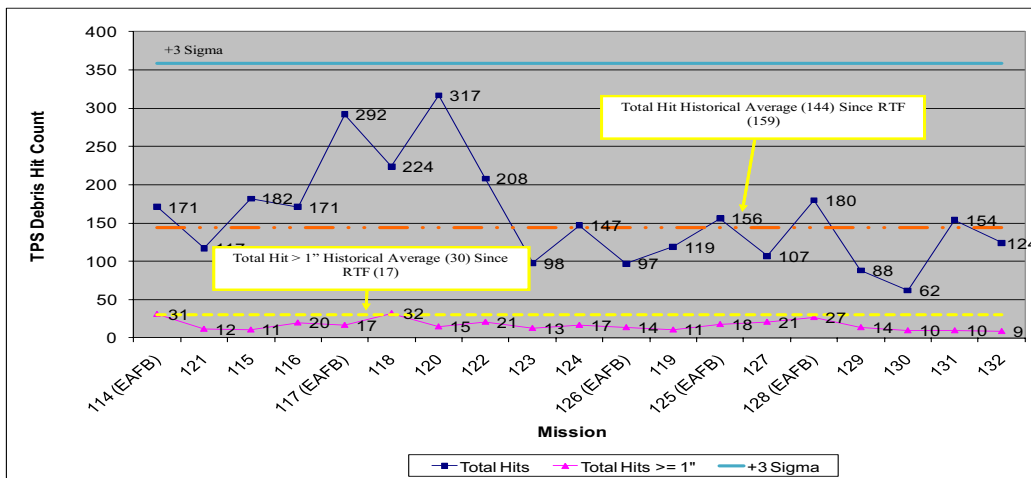


Orbiter Debris Impact summary STS-132, OV-104

Presenter **MS/ Doug Drewry**

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- **Total # of TPS Hits = 124 / TPS Hits w/damage > 1" = 9** (4 lower surface, 4 L OMS, 1 R OMS, 0 windows)
- **Prior to RTF Average for >1" = 30.5 per flight / Average Since RTF = 17 per flight**



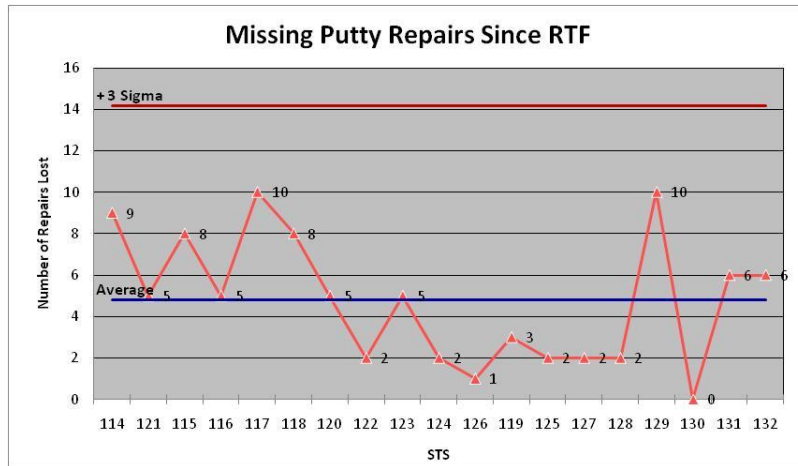
- **STS-132 elliptical volume Hits>1" = 0.608 in³ / RTF Average = 2.294 in³**
- **STS-132 Total elliptical volume ALL Hits = 0.984 in³ / RTF Average = 3.330 in³**





STS-132 Putty Repair Debris Summary		Presenter	MS/ Doug Drewry
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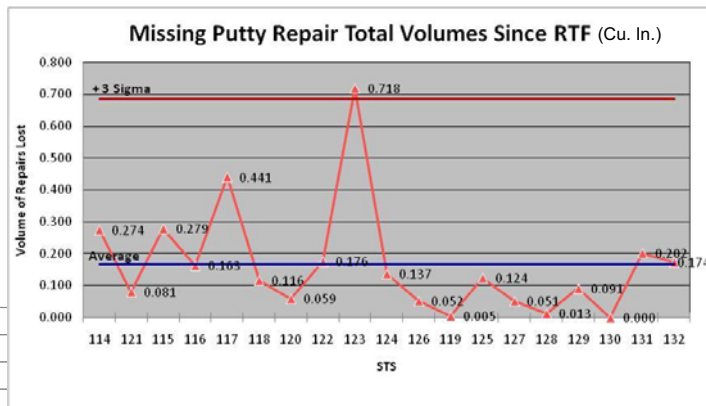
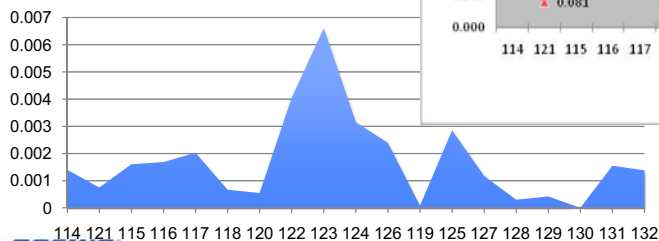
- TPS putty repairs are listed as expected debris in NSTS 60559
- Putty Repair loss is listed in IDBR-01 as cause AK and carried as an Infrequent/Catastrophic Risk primarily because Windows have zero capability for impacts
 - Since RTF, 3 losses have had transport to windows – largest mass was 0.0009 lbs
 - No losses w/transport to windows on STS-132
- Six losses experienced during STS-132
 - Limited to small masses, consistent with historical distribution in NSTS 60559



STS-132 Putty Repair Debris Summary		Presenter	MS/ Doug Drewry
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- OPO/TPS PRT continues risk reduction steps
- Inspection/repair procedures strengthened to identify suspect repairs
 - Areas with transport to windows/RCC undergo tactile evaluation
 - Where repairs have transport to Windows or RCC tighter restrictions limit masses
 - Tiles with large repairs are being removed in critical areas FWD of the RCC and windows per CHIT

Average Loss Mass / Flt (lbm)





STS-133 SSP Flight Readiness Review

Integrated Hazard Report and Integrated In-flight Anomalies Summary

MS3/JJ Hill
 October 6, 2010



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Integrated Hazard Report Changes Since STS-132

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- IMPS-03 “Improper IMPS configuration during SSME Operation” was updated to document an increase in risk associated with the LH2 inboard fill and drain valve (PV12) relief valve (RV).
 - CR S050425KA was approved with mods at the 9/23 PRCB.
 - New fault tree developed to cover improper propellant supply due to off-nominal propellant properties, including propellant purity and quality
 - Poor Propellant Purity and Poor Propellant Quality (Temp, Pressure) blocks added as causes that could lead to off-nominal propellant properties
 - Undeveloped Events rationale updated for Fault Tree Blocks deemed non-credible
- IMPS-03 Cause W updated to document off-nominal propellant properties
 - Cause W increase in risk to Remote Catastrophic (was IMPROBABLE)
 - REMOTE based on minor uncertainties in the controls against operational fluids/gases contaminating the propellant supply
- Background Section updated with PV12 IIFA and hazard analysis discussion
- Change Flight Effectivity to STS-133 through STS-999
- No change to overall IMPS-03 Classification of ACCEPTED RISK





**Integrated In-Flight Anomalies (IIFAs)
 Summary**

Presenter	MS3/J. Hill	
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- STS-132-I-001 - Unexpected Debris/Expected Debris Exceeding Mass Allowable Prior to Pad Clearance (Liftoff Debris)
 - Status – Closed
- STS-132-I-002 - Missing ET TPS on Intertank Stringer Outboard of Port Bipod
 - Status – Closed
- STS-132-I-003 - Ice Observed on the T-0 Umbilical at Retraction
 - Status – Closed
- STS-132-I-004 - RTV-133 Partially Missing with Darkened Substrate from Forward Booster Separation Motor (BSM)
 - Status – Closed
- STS-132-I-005 – Multiple Streaks Observed in SSME Plumes
 - Status – Closed
- STS-131-I-002 - Rudder Speedbrake TPS Liberation
 - Status – Closed
- STS-131-I-003 - Windows 5, 6 Missing/Protruding Ceramic Plugs
 - Status – Closed
- STS-131-I-004 - Tile Repair Loss on Base Heat Shield
 - Status – Closed
- STS-130-I-005 - SSME #2 Nozzle Heating Indications
 - Status – Closed



Integrated In Flight Anomalies (IIFAs)

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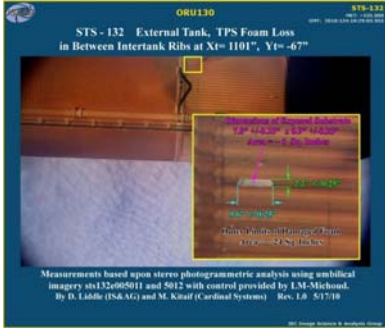
IFA Number : Title Description	STS-133 Status and Rationale
<p>• STS-132-I-001: Unexpected Debris/Expected Debris Exceeding Mass Allowable Prior to Pad Clearance (Liftoff Debris)</p> <p>• Multiple pieces of debris were found on pad post-launch that include liberated pad hardware, and foreign object debris.</p>	<ul style="list-style-type: none"> • Risk Assessment indicates that given the proposed mitigations, observed debris poses no appreciable increase in risk. • Liftoff debris risk is currently characterized as infrequent, catastrophic due to significant uncertainties in controls and significant limitations in analysis. • Debris release has been mitigated for identified potential sources of critical debris by performing repairs and adding inspections for system-level components. Ongoing mitigations include FOD awareness, attrition-based hardware removal, routine inspections and monitoring for facility corrosion. <p>• Status – Closed</p>





Integrated In-Flight Anomalies (IIFAs)


Presenter	MS3/J. Hill
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IFA Number : Title Description	STS-133 Status and Rationale
<p>•STS-132-I-002: Missing ET TPS on Intertank Stringer Outboard of Port Bipod</p> <p>•ET TPS loss on intertank stringer outboard of port bipod strut at ~ MET-129 sec.</p> <p>•Mass of loss exceeds the NSTS-60559 risk assessment mass for Void delta P.</p> 	<ul style="list-style-type: none"> •The failure mode was most likely poor TPS bond adhesion •While many previous ET foam losses appeared to correlate with the location of the cleaning platforms, ET-136 (STS-132) did not. •In the absence of a root cause or a conclusive correlation to tank processing, the ET will need to be cleared for each flight based on the bond adhesion tests conducted. •A special TIM was held at MAF 3/4/10 to determine the approach for developing a PRA to quantify the risk to Special Tile & RCC. •The PRA indicates a probability of the IT foam exceeding the damage capability of tile to be 1 in 700. •The documented risk posture remains unchanged and no constraints for STS-133. <p>•Status – Closed</p>



Integrated In-Flight Anomalies (IIFAs)

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IFA Number : Title Description	STS-133 Status and Rationale
<p>•STS-132-I-003: Ice Observed on the T-0 Umbilical at Retraction</p> <p>•Ice visible on the Orbiter at two locations after LH2 T-0 umbilical retraction. Size of ice - external to seal ~5.5 x 1.9 x 0.2 in (left), internal to seal ~6.2 x 1.4 x 0.3 in (right)</p> 	<ul style="list-style-type: none"> •Ice/Frost build-up inside and outside the peripheral seal on the LH2 T-0 umbilical has been observed on previous flights. •Mitigation from previous flights was an enhanced installation and verification process. •For STS-132, gray RTV was applied per drawing to seal the peripheral seal splice joints without contacting the DAPCO 235 seal. •However, this application process left a leak path between the DAPCO 235 and the gray RTV. •Drawing and OMI were updated to improve the gray RTV application process by applying the RTV along the sides of the peripheral seal upper splice plate and abutting to the DAPCO 235 seal thereby eliminating the open flow path into the seal cavity. •T-0 internal ice remains unexpected debris; no changes will be required to IDBR-01. <p>•Status – Closed</p>





Integrated In-Flight Anomalies (IIFAs)

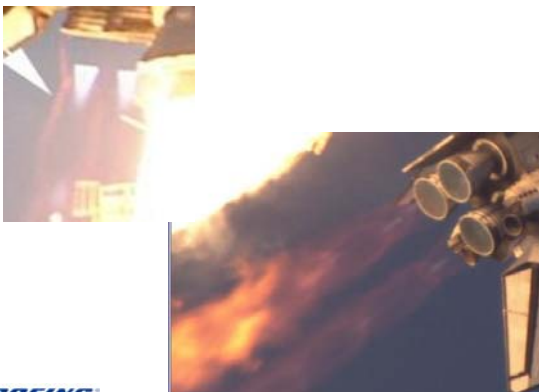
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IFA Number : Title Description	STS-133 Status and Rationale
<p>▪STS-132-I-004: RTV-133 Partially Missing with Darkened Substrate from Forward Booster Separation Motor (BSM)</p> <p>•During RSRB Post-flight assessment, a piece of RTV-133 was discovered missing from the forward left-hand upper-right Booster Separation Motor (BSM) exit cone location.</p> <p>•The missing piece of RTV was approximately ¼” x ¼” x 5” long with an estimated mass of 0.01 lbm.</p> 	<ul style="list-style-type: none"> •For the subject observation, the region on the closure plate exposed by the missing RTV was reported to have sooting and heating effects. •RTV can be concluded to not liberate during ascent, the cause of the observed sooted substrate condition was determined to not occur earlier than two minutes past SRB separation. •The discoloration on the BSM closure plates supports the possibility of late descent environments causing closure plate de-bonds. •There is no expected increase in risk of debris liberation on ascent. •RTV-133 remains unexpected debris; no changes will be required to IDBR-01 <p>Status – Closed</p>



Integrated In-Flight Anomalies (IIFAs)

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IFA Number : Title Description	STS-133 Status and Rationale
<p>▪STS-132-I-005: Multiple Streaks Observed in SSME Plumes</p> <p>•STS-132 post launch imagery review of ground based film and high definition cameras identified a greater number of streaks than usual in the Space Shuttle Main Engine (SSME) exhaust plumes at 4.6 sec MET and between 16.1 – 54.4 sec MET.</p> 	<ul style="list-style-type: none"> •Streaks are possible indicators of abnormal events, and have also been attributed to external debris sources (e.g. foam, ice, etc) falling into the plume path which is not an abnormal event. •Streaks were observed in all three SSME plumes, but when streaks were reviewed individually, they weren't unusual compared to past experience. •A single root cause has not been identified; however, the following have been considered as potential sources : degraded Flow Recirculation Inhibitor (SSME2), degraded Dome Heat Shield blanket (SSME1), RCS thruster cover paper, base heat shield tile damages/dings, ET TPS, SRB TPS, Viton-Coated Nylon, Ice/Frost, and minor camera configuration setting changes. No vehicle performance or MPS related anomalies or contaminants were identified during investigation. •Although a root cause has not been identified, the risk is considered acceptable because the potential contributors, listed above, are not a safety of flight concern. <p>Status – Closed</p>





Integrated In-Flight Anomalies (IIFAs)

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IFA Number : Title Description	STS-133 Status and Rationale
<p>▪STS-131-I-002: Rudder Speedbrake TPS Liberation</p> <p>▪A single piece of debris was observed near the vertical stabilizer, aft of the trailing edge of the port speed brake.</p> <p>▪Debris was confirmed to be tile from the RPM Imagery. No impacting debris was identified in this area. No out-of-experience motion from the Speed Brake or Vertical Stabilizer was identified.</p> <p>▪Post-flight imagery confirmed partial tile released.</p> 	<ul style="list-style-type: none"> •The analysis of the exposed internal structures for both ascent and entry showed that a partial tile loss will result in local temperature exceedances during ascent only; however the structural integrity will not be compromised. •The effect of the resulting OML change to the RSB performance has also been assessed and does not pose a risk to controllability. •A Debris Transport Analysis (DTA) was also completed. The results showed that a partial RSB tile loss can only impact Orbiter structures. •Based on assessment, RSB tile liberation remains unexpected and thus there is no impact to IDBR-01. •No constraints for STS-133 and Subs. •Status – Closed



Integrated In-Flight Anomalies (IIFAs)

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IFA Number : Title Description	STS-133 Status and Rationale
<p>▪STS-131-I-003: Windows 5, 6 Missing/Protruding Ceramic Plugs</p> <p>•During post-landing inspection, several ceramic plugs were found protruding or missing.</p> <ul style="list-style-type: none"> •Protruding ceramic plugs at Window 5 (~ 7mm) and at Window 6 (~ 245mm) •Missing ceramic plug at Window 6. Re-review of RPM imagery showed this plug was installed and visible. 	<ul style="list-style-type: none"> •The STS-131 plug design is dependent on braided cord to supply the “locking feature” between insert and plug threads. •Test team found that by substituting the type of braided cord a consistent torque was achieved without damaging the plugs. •Plug replacements were performed and Orbiter CAR modified the type of braided cord used. •A Debris Transport Analysis (DTA) was also completed. The results showed that a loss from a ceramic plug on the FWD windows or from ceramic inserts on the payload bay door hinge had potential to impact the Orbiter OMS pod, vertical tail, rudder speedbrake, and SSME. •STS-132 performance of modified plugs was nominal. •Remains unexpected debris; no changes will be required to IDBR-01. •Status – Closed





Integrated In-Flight Anomalies (IIFAs)

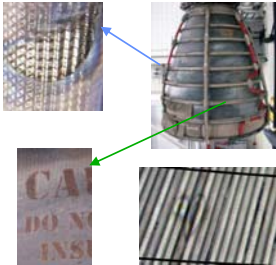
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IFA Number : Title Description	STS-133 Status and Rationale
<p>▪STS-131-I-004: Tile Repair Loss on Base Heat Shield</p> <p>▪A small piece of debris was observed falling inboard of the right OMS pod stinger after Main Engine Ignition (MEI) at -3.364 MET during STS-131.</p> <p>▪Post flight investigation revealed it was an RTV repair that liberated and likely took some additional tile material along with it.</p> 	<ul style="list-style-type: none"> • Liftoff Debris evaluated this loss and determined there was no LOD liftoff debris concern. •The impact energy from a liberated tile fragment at the time and size observed is bounded by an impact from an allowable ice loss (0.333 lbm) from the TSM umbilical interface. • The TPS PRT has not determined a root cause, but the leading suspect cause is the MEI environment, based on when the failure occurred. •The OPO/TPS PRT assessment is complete and no corrective action was deemed necessary. •The MEI Acoustic environment update was presented and approved at the Sept 30, 2010 PRCB. •Remains unexpected debris; no changes will be required to IDBR-01. •Status – Closed



Integrated In Flight Anomalies (IIFAs)

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IFA Number : Title Description	STS-133 Status and Rationale
<p>▪STS-130-I-005: SSME #2 Nozzle Heating Indications</p> <p>•TPS Discoloration , Aft Manifold Discoloration , and Paint Discoloration were observed on previous flights.</p> <p>•Damaged TPS screen, Hotwall discoloration/bluing, and One-flight paint color change.</p> 	<ul style="list-style-type: none"> •Paint Discoloration was more noticeable. •The Orbiter Reaction Control System (RCS) vernier thruster L5D was determined to impinge on the nozzle in the area of concern. •SSME Project does not consider the discolored paint to be an anomalous condition. •After investigation, the only possible cause for Hotwall Bluing was due to re-entry heating. •No safety of flight issues have been identified for the hotwall bluing observations. •The most probable cause of the melted screen was determined to be the brief, ~0.5 sec., firing of the primary reaction control system (RCS) thrusters L2D and L3D just after main engine cut off (MECO). •No safety of flight concerns were identified due to the melted TPS screen. •Status – Closed





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Integrated Hazard Risk Matrix

Likelihood	Probable			
	Infrequent	2		12
	Remote	2	2	132(131)
	Improbable	11	11	267(268)
		Marginal	Critical	Catastrophic

Risk Summary
 22 of 38 IHR's are classified as Controlled Risk
 16 of 38 IHR's are classified as Accepted Risk
 * Previous Flight

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	29					23			6
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				1				1				
IMPS-02	Contamination in the Integrated MPS O2 System	0				1				1				
IMPS-03	Improper IMPS configuration during SSME Operation	10			10	4				4				
IMPS-04	Off-Nominal Purges	11			11	1								
IMPS-09	Hazardous Environment due to H2 External to SSV	4				4							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				
MLD-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	132	0	0	12	0



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Integrated Hazard Risk Matrix

"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	0								
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-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	40		5	6	29	0								
MLD-02	System Instability Results In Structural Failure of SSV	13				13	0								
Controlled Risk Distribution Totals		291	2	11	11	267	148	0	2	2	132	0	0	12	0





Integrated Hazard Risk Matrix Count Changes

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•Infrequent Catastrophic

None

•Remote Catastrophic

•IMPS-03-W Improper Propellant Supply due to Off-Nominal Propellant Properties

•Cause W increase in risk to Remote Catastrophic per CR S050425KA

•Improbable Catastrophic

•IMPS-03-W Improper Propellant Supply due to Off-Nominal Propellant Properties

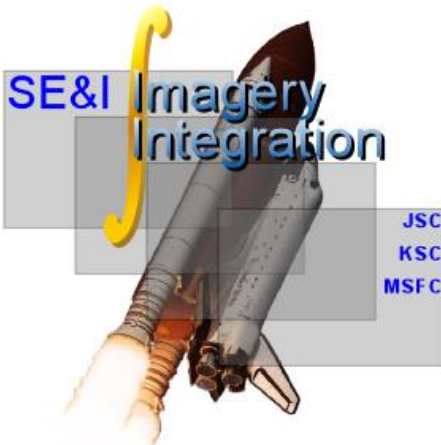
•REMOTE based on minor uncertainties in the controls against operational fluids/gases contaminating the propellant supply

•No change in hazard report overall risk classification of Accepted Risk



**STS-133
 SSP Flight Readiness Review**

October 6, 2010



MS3/David Melendrez





Imagery Hardware
ELVIS

Presenter	MS3/David Melendrez	
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ET LO2 Feedline Camera (ET-137)

- Camera system installed and on schedule with nominal checkouts
- **Ready to support.**

Ground Network & TV

- Nominal ground network and TV truck status
- **Ready to support.**

SRB Cameras (BI-144)

- Hardware installation and closeouts on schedule with nominal checkouts
- Monitoring Hangar AF Wharf booster slip cracks: Any delay to booster recovery would result in delay of video retrieval
- **Ready to support.**

Digital ET Thermal Protection System (DETTPS)

- Camera configured for **Daylight** settings through Nov 26th
- Camera and flash functional test in VAB on Sept. 14th successful
- Investigating image overexposure issue from STS-132
 - No data lost, but it remains uncertain why unprocessed images were so washed-out
 - Camera from STS-132 retired from service, OPO GFE checking to make sure there is no systemic issue with other (2) DETTPS cameras
 - All preflight test images for STS-133 appeared ok (dark scene in VAB notwithstanding)
- **Ready to support.**

DETTPS Camera Settings	
• Daylight:	• f/8, ISO 100, 1/250
	• Bracketing: 0EV=f/8, +1EV= f/5.6
• Night	• f/2.8, ISO 200, 1/250
	• Bracketing 0EV=f/2.8, +1EV= f/2.0

Crew Handheld Digital Still and HD Video Cameras

- **Ready to support.**



Imagery Hardware
non-ELVIS

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Orbiter MiniCam

- STS-131: Video very dark (night launch)
- STS-132
 - Video dark (day launch)
 - First flight of 12mm lens to optimize view of ET and Orbiter (not a significant contributor to dark video)
- STS-133:
 - Still using 12mm lens and shutter speed of 1/1000
 - New exposure settings:
 - Aperture: f/8 (was f/5.6) – smaller aperture improves depth of field
 - White balance: DAYLIGHT (was AUTO) – to improve color balance
 - Auto gain: ON (was MANUAL) – to improve overall scene brightness
 - New settings are intended for all remaining flights
 - Same exposure settings used day or night
 - STS-133 FRD includes requirement for crew downlink as time allows
- **Ready to support.**



Airborne Cameras

- HYTHIRM/Cast Glance scheduled to support entry BLT DTO (0.5" protuberance height)
- **Ready to support.**





Imagery Hardware
Ground

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Ground Cameras

- Cameras configured nominally per Launch & Landing PRD
- Camera E040 remains in new position (first moved on STS-132, only by a couple of feet) to accommodate placement of experimental cameras on FSS 275 ft level.
 - E040 will remain in new position for all future flights
 - New position is no impact to analysis
- Experimental cameras are being placed on FSS 275 ft level and at CS2 to investigate new stereoscopic, dynamic range, and infrared techniques. Not for operational use or analysis.
- MLP and FSS photo targets performed as expected following STS-132. All 19 have been inspected with some replaced as required.
- **Ready to support.**



FSS FE04 – not replaced



FSS FE05 – replaced



Lighting Predictions, November 1 – 30

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Nov 8-22 Beta Cutout

Launch

- Nov 1 – Nov 22: **DAYLIGHT**
- Nov 23: **DAYLIGHT, Non-Optimal**
- Nov 24 – Nov 30: **DARK**

Post ET-Sep Mnvr

- Nov 1 – Nov 29: Nominal +X, Nominal Pitch
- Nov 30: Nominal +X**, No Pitch

ET Sep Imagery

- Nov 1 – Nov 26: **DAYLIGHT**
- Nov 27 – Nov 30: **DARK****

**For launch on Nov 30th: MOD may execute modified +X (20 sec) vs. the nominal (11 sec) burn

Handheld ET (post-pitcharound) Imagery

- Nov 1: **DAYLIGHT, Non-Optimal**
- Nov 2 – Nov 28: **DAYLIGHT**
- Nov 29 **DAYLIGHT, Non-Optimal**
- Nov 30: **DARK**

MOD, SE&I Agreements for Crew HH ET Photography

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





CoFR Products & Readiness

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- All 27 NIRD Reportables have been Closed with supporting rationale
- STS-133 Imagery Readiness Review was held with the IATs and hardware teams on 9/13/10

Area of Responsibility	Statement	Status
Operations Integration Plan	NSTS 60540, Operations Integration Plan, Rev B approved at 06/27/06 SICB. End-to-end readiness level of hardware, procedures, tools, and facilities have been assessed to ensure Open Work and issues will be resolved prior to flight.	Ready
Engineering Image Analysis Products, Training, and Staffing	Imagery engineering analysis, and "I-Squared" SE&I personnel and tools are ready to support STS-133.	Ready
Imagery Laboratory Readiness	Imagery labs at JSC, KSC, and MSFC have the required capabilities and configurations to support anticipated and unexpected analysis.	Ready
Camera Hardware Readiness	All ground and vehicle requirements for imagery and other data collection assets have been implemented for flight and associated operational readiness has been demonstrated.	Ready



**STS-133
 SSP Flight Readiness Review
 Radar Status**

MS/Joe Hamilton





Debris Radar Configuration for STS-133:

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• STS-133 NDR Configuration:

- 1 MCR C-band radar
 - New Klystron (high power transmitter)
 - New real-time display computers
 - Repaired Low Noise Amplifiers (LNA's)
- 2 NASA X-band radars
 - NASA #1 on SRB vessel *Liberty Star*
 - NASA #2 on *Runnymede-Class* ARMY LCU
- Operational SRB tracking, following ASTT, by both X-bd radars
- NDR Readiness will be reviewed on 10/08/10.



NDR Issues During STS-132:

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NDR-C1 Radar:

Problem: Intermittent track. Unable to establish and maintain track on the Shuttle.

Resolution: A comprehensive evaluation of the radar system was conducted. The klystron was replaced and the new LNA's were sent back to the vender for repair. Procedures were modified to increase the probability of collecting data. Optimized track filter settings.

Problem: Minor noise problem prevented the use of Phase Compensation Tables (PCTs) which are intended to improve data quality (Same status since STS-125).

Resolution: PCT's tested successfully on Atlas V mission in August.

NDRX-3 Radar:

Problem: Coolant leak prior to leaving port was not completely repaired until after mission. Radar was operational with time restrictions to prevent overheat.

Resolution: Repaired and tested.

Problem: Interference from ship equipment. Procedural error was detected late due to distraction from coolant leak work-around.

Resolution: Emphasis training.

NDRX-4 Radar:

Problem: None.





Readiness for STS-133:

Presenter MS/J.A. Hamilton

Date 10/06/10

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- **Team Readiness**
 - Complete, both ascent and analysis teams ready
 - Training new team members for transition
- **Facility Readiness**
 - Complete
- **Radar Readiness**
 - NDR-C1 – GREEN
 - NDR-X3 - GREEN
 - NDR-X4 - GREEN



STS-133 SE&IO Pre-Flight Readiness Review Flight Software



STS-133 FLIGHT SOFTWARE SUMMARY

Presenter	USA/John Magley	
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- **Sixth flight of PASS and BFS Operational Increment 34 (OI-34)**
 - No logic changes from the STS-132 software systems

- **Sixth flight of MEDS Multifunction Display Unit Function (MDUF) VI 6.00 and fourth flight of MEDS Integrated Display Processor (IDP) VI 7.01**
 - No changes from STS-132 software

- **Seventh flight of MAGRS-3S Link 613-9966-008 GPS FSW**
 - No changes from STS-132 software



FSW READINESS SUMMARY

Presenter	USA/John Magley	
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- **Integrated Avionics Verification (IAV) is complete**
 - A total of 15 cases were executed and analyzed in support of STS-133
 - Included testing of full flight system (PASS/BFS STS-133/OI-34 with flight-specific I-Loads; MEDS VI 7.01/6.00 (IDP/MDUF); MAGRS-3S Link 8; and SSME AD08/DA05 software)

- **SAIL facility will be in a condition of readiness for mission support**

- **Formal Software Readiness Review (SRR) was conducted on 09/23/10**
 - No known constraints

- **With the completion of planned open work, FSW will be ready to support STS-133 launch**





LAUNCH ON NEED STATUS

Presenter USA/John Magley

Date **10/06/10** Page 39

- In the event of call-up, the STS-134 flight software products would be flown on OV-105
 - OI-34 STS-134 Base Load and associated products
 - Flight specific I-Load patches for STS-134 (full payload bay)
 - OI-34 compatible MEDS IDP and MDUF software (VI 7.01/6.00)
 - MAGRS-3S Link 8
- Completion of the development and verification of flight-specific FSW products for STS-134 will be performed in time to support the 02/26/11 target launch date
- Formal Software Readiness Review to be conducted after call-up



STS-133 FLIGHT SOFTWARE FLIGHT READINESS STATEMENT

Presenter USA/John Magley

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Full compliance with SPOC Flight Software CoFR requirements is documented in the STS-133 Software Readiness Review packages along with signed readiness statements and identification of open work.

Pending completion of standard open work and identified non-standard open work, Flight Software is ready to support flight.

/s/ Patti A. French

9/24/2010

Patti A. French
Associate Program Manager
USA Flight Software

Date





STS-133 SSP Flight Readiness Review PGSC



Pre-decisional. Internal Use Only.



Pre-decisional. Internal Use Only.

Payload and General Support Computer Readiness – STS-133

Presenter	MS4/E. Jones	
Date	10/06/10	Page 42

- **Hardware and Software Summary**
 - STS-133 will be the twentieth flight of the IBM ThinkPad A31p PGSC
 - 6 PGSC units (None currently planned for ISS transfer)
 - Fourteenth flight of the A31p Docking Station (OCA and WinDecom)
 - Twelfth flight of Netgear Wireless Access Point.
 - *Note: No network issues observed during STS-132*
 - New software
 - None
- **IEA Summary**
 1. RPOP PGSC Cracked Screen – laptop screen was closed down on tethered connector cap (*Closed*)
 2. Printing Problem – oversized paper holes created mis-feed of printed documents (*Closed; Paper removed from inventory, inspection process enhanced*)

▪ **PGSC Milestones**



**FD1 Late Update may be performed on ground at an earlier date





PGSC Readiness for Flight	Presenter MS4/E. Jones	
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The Payload and General Support Computer (PGSC) Configurations are in a condition of readiness to support the STS-133 flight.

Original signed by

Errol A. Jones **date**
POCCB Chairperson

Original signed by

Albert Y. Lee **date**
Manager - USA Dept 4244
Flight Laptops and Network Integration

Original signed by

Keith Chuvala **date**
Manager – USA Dept 4245
Space Operations Computing

Original signed by

Scott Q. Hartwig **date**
Associate Program Manager
USA Flight Operations Element

Original signed by

Willard Jones, Jr. **date**
Associate Program Manager
USA Flight Crew Equipment Element



STS-133 Non Standard Open Work	Presenter MS/Terri Murphy	
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	ECD
Systems Safety -Closure of CR S050425KA, IMPS-03 Improper IMPS configuration during SSME Operation	10/08/10





Alternate/Dissenting Opinions		Presenter MS/Terri Murphy
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- **Alternate/dissenting opinions were actively solicited at the SE&I STS-133 Pre-FRR.**
 - No dissenting opinions were identified.



CoFR Endorsement		Presenter MS/Terri Murphy
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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-133, pending completion of open work.

/s/Travis M. Robinson for

Donald S. Noah
 Manager Systems Engineering and Integration Office





LON Status

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- **SE&I has identified no technical or schedule constraints in support of LON requirements for STS-133 using the SSP baseline “Fly the Next Flight” approach**

