



# STS-135 SSP Flight Readiness Review

**MS/Terri Murphy**  
**June 21, 2011**



Pre-decisional. Internal Use Only.



Pre-decisional. Internal Use Only.

## 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

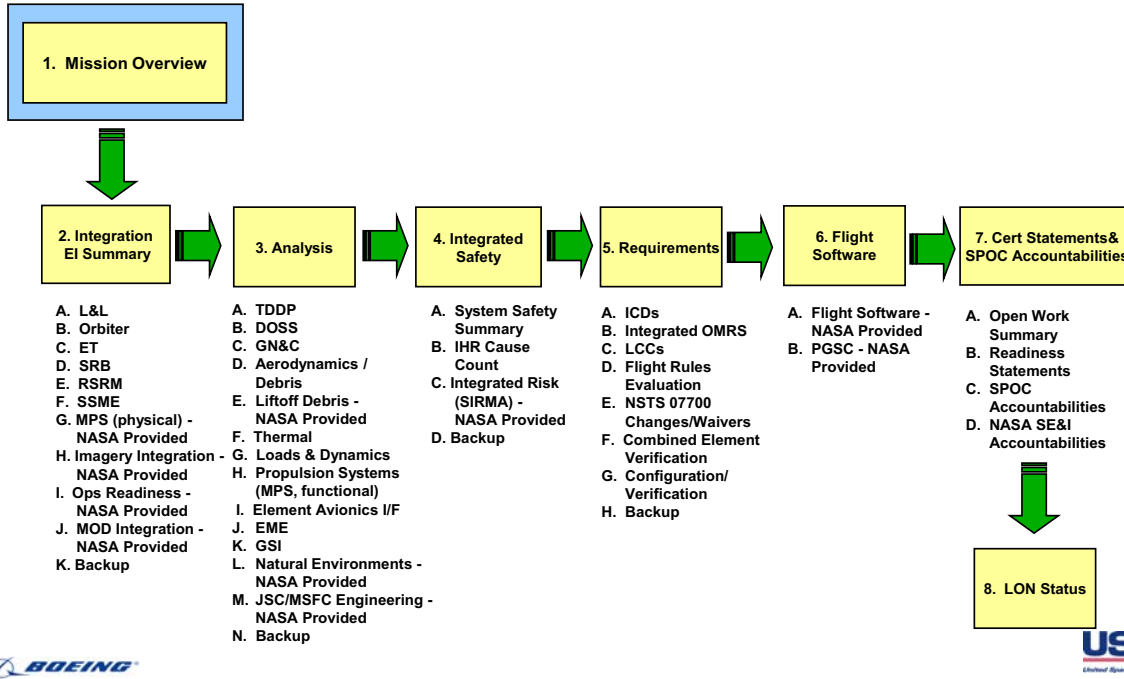




## SE&I FRR Roadmap

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



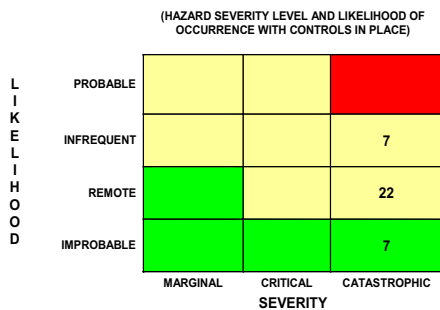
<b>STS-135 SSP FRR</b>		Presenter	<b>MS/ Doug Drewry</b>
		Date	<b>6/21/11</b>

# STS-135 Debris Risk Summary

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



<b>STS-135 Debris Risk Assessment Summary</b>		Presenter	<b>MS/ Doug Drewry</b>
		Date	<b>6/21/11</b>



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

**Debris Risk Assessment, 6/2011**

**IDBR-01 debris risks remain Infrequent/Catastrophic**

- **Liftoff Debris** is expected to remain at this risk level for the life of the Program due to the diversity of potential Debris sources although rigorous controls have been implemented 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, forward work may be used to reduce the likelihood to “Remote”.
- **T-0 Umbilical Ice**: Accepted Risk; NSTS 08303 Updated to include 0.1 lbm allowable external ice
- **LOX IFR**: Implemented NDE of all IFR ramps to screen for large voids
- **ET Intertank Foam Loss**: Changed to Infrequent Catastrophic for STS-128
  - Continued Tensile Testing of ET high risk debris areas to mitigate risk
- **RCC Capability /ICE**: SIRMA Risk 2691 elevated to Infrequent for STS134 & 135





**Issues & Integrated In Flight Anomalies**

Presenter	MS/ Doug Drewry	
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**•STS-133-I-002 ET Intertank Stringer Cracks:**

- CLOSED for STS-134 at 3/22/11 SICB
- 6/15/11 STS-135/ET-138 Tanking Test
- Reviewed at Special SICB on 6/17/11 and Closure pending NDE results from Test

**•STS-134-I-001 Unexpected Debris/Expected Debris Exceeding Mass Allowable Prior to PAD Clearance (Liftoff Debris):**

- Reviewed at 6/6/11 DIG
- CLOSED at 6/14/11 SICB

**•STS-134-I-002 Cylindrical Object Observed Near +Y Thrust Panel During SRB Separation**

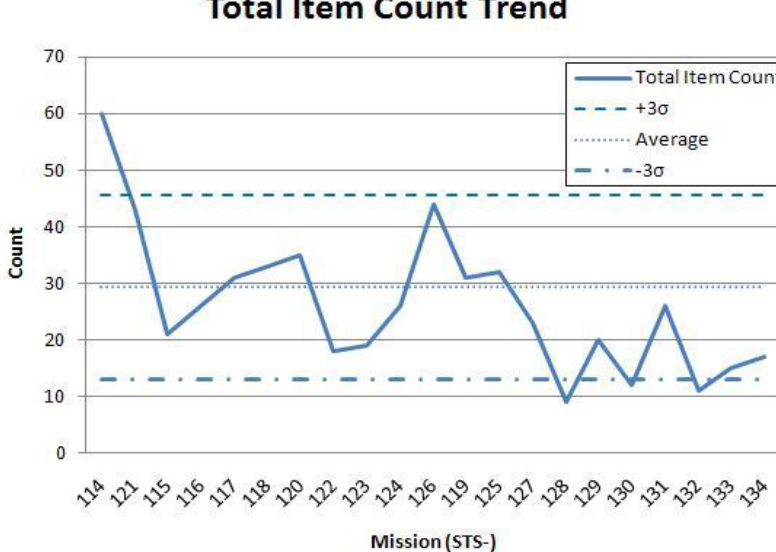
- Investigation team led by Sam Stephens/MP-71
- Presented to 6/17/11 SICB for closure as UA



**STS-114 through STS-134:  
 Debris Instance Chronology**

Presenter	MS/ Doug Drewry	
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**Total Item Count Trend**



	Total
+3σ	45.65
μ	29.38
-3σ	13.12
STS-134	14

Baseline established with data from STS-114 through STS-127.

**STS-133 debris count is below the baseline average and within family of the last several flights.**



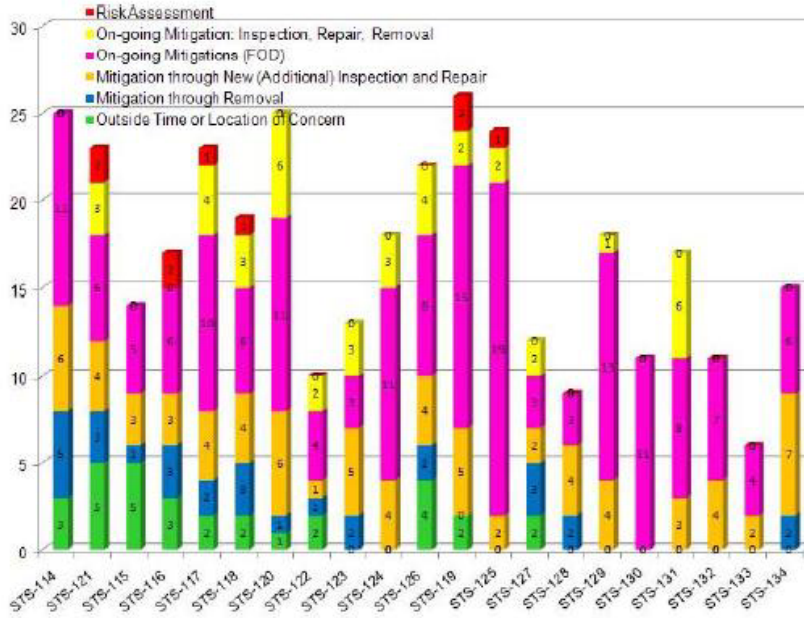


**Summary of Lift Off Debris Categories  
 RTF - STS-134**

Presenter **MS/ Doug Drewry**

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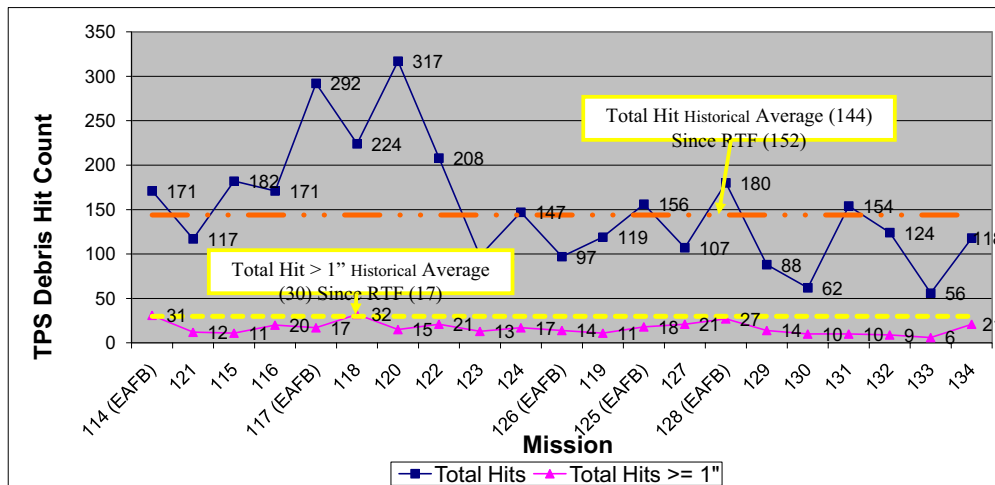
**Orbiter Debris Impact summary  
 RTF Summary thru STS-134, OV-105**

Presenter **MS/ Doug Drewry**

Date **6/21/11**

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- Total # of TPS Hits = 118 / TPS Hits w/damage > 1" = 21
- Prior to RTF Average for >1" = 30.5 per flight / Average Since RTF = 17 per flight



- STS-134 elliptical volume Hits>1" = 9.421 in<sup>3</sup> / RTF Average = 2.536 in<sup>3</sup>
- STS-134 Total elliptical volume ALL Hits = 10.065 in<sup>3</sup> / RTF Average = 3.515 in<sup>3</sup>

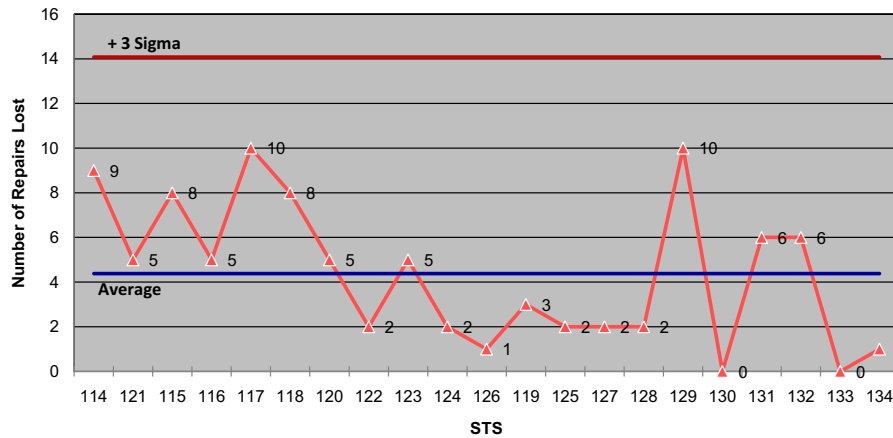




<b>Putty Repair Debris Summary</b>		Presenter <b>MS/ Doug Drewry</b>
<b>RTF- STS-134</b>		Date <b>6/21/11</b> Page <b>11</b>

- 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
- One (1) loss experienced during STS-134

### Missing Putty Repairs Since RTF



<b>SPACE SHUTTLE PROGRAM</b>		Presenter <b>Doug Drewry/MS</b>
<b>Propulsion SE&amp;I Office</b>		Date <b>6/21/11</b> Page <b>12</b>

## IIFA STS-134-I-002 Cylindrical Object Observed Near +Y Thrust Panel During SRB Separation

**SR4933**

**Sam Stephens, MP71**

**6/17/11**





**Cylindrical Object Observed Near +Y Thrust Panel  
 During SRB Separation**

Presenter	Doug Drewry/MS	
Date	6/21/11	Page 13

- Right SRB ET Observation Camera (SRF110) recorded imagery of cylindrical object downstream of ET/SRB forward attach point.
  - Object not observed in any other camera view
  - Point of origin outside field of view
  - Observed in 7 frames approximately 0.4 sec after SRB separation (~125 sec MET)
  - Appears to be metallic with range of size from 0.25 to 2.78 in length with length to diameter aspect ratio between 2 – 5+. Maximum initial velocity ~ 33 ft/sec.
  - Object is tumbling end over end at approx. 900 rpm
- Large uncertainty on size, velocity, and direction due to large depth of field of camera and due to fact that both object and reference points on tank are moving relative to camera and each other.
- Potential correlation with debris radar
  - Object with Ballistic number (BN) of 3.9 psf is observed at ~125 sec in forward third of vehicle.
- Potential correlation to WLEIDS on panel 12R at approx 126.6 sec (2 Grms trigger)
  - No damage observed from postflight inspections



**Investigation Approach**

Presenter	Doug Drewry/MS	
Date	6/21/11	Page 14

- Integrated logic tree developed with major branches as follows:
  - Foreign Object Debris (FOD)
    - Flight Elements
    - Ground Ops
  - Flight Hardware failure/liberation
    - Orbiter & SSME
      - Eliminated due to object upstream and Orbiter cleared via on orbit inspections
    - ET
    - RSRB
- Extensive reviews by Ground Ops, ET and RSRB of potential FOD and flight hardware sources:
  - Two possible RSRB sources were identified:
    - Ground Strap Coupler
    - Separation Bolt Lock Pin





**RSRB Flight Hardware w/potential**

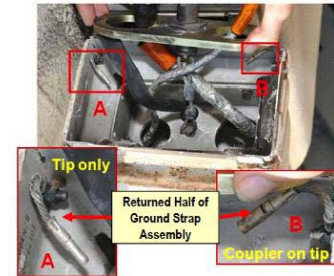
Presenter **Doug Drewry/MS**

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**Ground Strap Coupler**

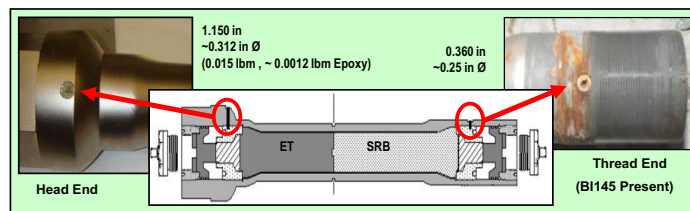
- RSRB Ground strap coupler used in RSS crossover assembly
  - Connects pins on grounding straps at RSRB and ET sides of separation plane
  - Coupler symmetric – can be retained with either pin at separation
    - Is retrieved approx ½ time
    - Remaining times most likely with ET, but could be lost during retrieval, or liberated
- Liberation unexpected but cannot rule out possibility



BI145 RH Fairing Assembly at Postflight

**Separation Bolt Lock Pin**

- Separation bolt lock pin with epoxy located at head end and has never been lost in any ground tests
  - Data review showed thread end lock pin ejected in past
    - Different design
- RSRB characterizes as unexpected
- Dimensions fit with observations
- Calculated BN of 9.3 is higher than radar observation



Separation Bolt Lock Pin Details



**Comparison of Potential Sources to Observations**

Presenter **Doug Drewry/MS**

Date **6/21/11**

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	<u>Observation</u>	<u>Coupler</u>	<u>Lock Pin</u>
<b>Appearance</b>	Metallic Cylinder	Metallic Cylinder	Metallic Cylinder
<b>Length</b> Visible Imagery Radar (BN=3.9 object)	0.25 – 2.84 <1.25 in.	0.625 in	1.15 in
<b>Diameter</b>	.07 – 0.76 in	0.22 – 0.23 in	0.312 in
<b>Aspect Ratio (L/D)</b>	2 - 5+	2.68 – 2.86	3.69
<b>Ballistic Number (Radar)</b>	3.9 +/-1.9 psf	3.3 psf	<b>9.3 psf</b>

- Assessment insufficient to classify either object as most likely or to rule out other possibilities.
- However SRB Ground Strap Coupler debris transport shows potential impacts and damage to RCC, tile and special tile regions.
  - RCC Front side coating damage expected due to the hard/strong nature of the impactor (10 times denser and about 100 times stronger than ice)
  - RCC Punch through failure is possible given Modeling uncertainties
  - Tile damage would require assessment during mission

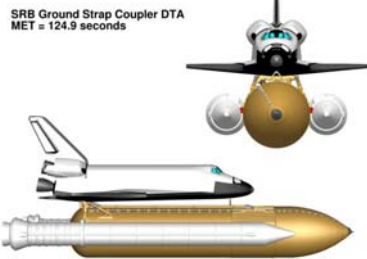




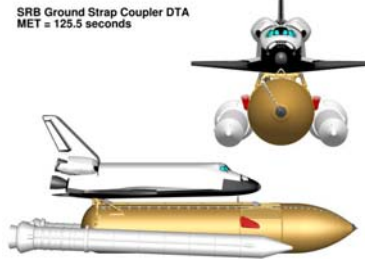


<b>DTA Timeline from ET/SRB Interface</b>		Presenter	Doug Drewry/MS
		Date	6/21/11

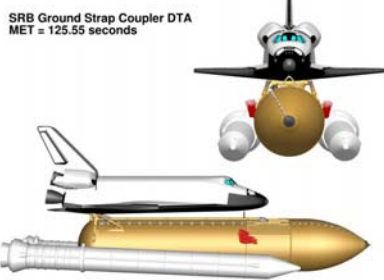
**SRB Separation + 0.1 second debris traces**



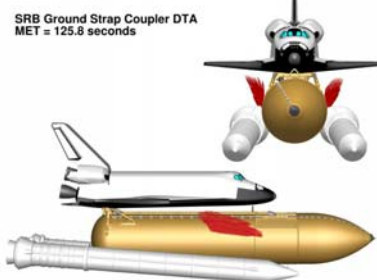
**SRB Separation + 0.7 seconds**



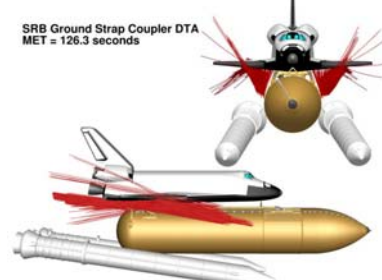
**SRB Separation + 0.75 seconds**



**SRB Separation + 1 second**



**SRB Separation + 1.5 seconds**



<b>Ground Strap Coupler Impacts on Orbiter</b>		Presenter	Doug Drewry/MS
		Date	6/21/11



**Maximum Impact TKE = 1.23 ft-lbs**

The following table lists worst case impact conditions for some key Orbiter components.

Component	Mass <i>lb<sub>m</sub></i>	Maximum TKE			Max. velocity		Max. angle	
		Velocity <i>ft/sec</i>	Angle <i>deg.</i>	TKE <i>ft-lb</i>	Velocity <i>ft/sec</i>	Angle <i>deg.</i>	Velocity <i>ft/sec</i>	Angle <i>deg.</i>
Wing RCC	0.0022	169	1.6	1.0	169	1.6	150	39.9
Orbiter Tile	0.0022	190	0.9	1.2	190	0.9	151	22.8
Body Flap	0.0022	154	1.2	0.8	154	1.2	151	5.1
Elevons	0.0022	187	1.4	1.2	187	1.4	66	8.8
Carrier Panels	0.0022	168	1.0	1.0	168	1.0	136	14.9
Main Gear/Special Tile	0.0022	136	13.7	0.6	136	13.7	136	13.7





<b>FOD Potential</b>		
Presenter	Doug Drewry/MS	
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- ET/SRB attach hardware has locations with potential for holding FOD
- For STS-134 and STS-135, RSRB, ET, and Ground Ops reviewed documentation, close out photos, Baseline Configuration Imagery (BCI), tool box checks, parts kits, etc. No anomalous or unusual findings except as noted below:
  - STS-134/ET-122 stringer mods performed in integration cell after E/B-2 closeout
    - Controls in place including sealed enclosure for work
    - Possible some bolt fragments were left in intertank
      - No credible path from intertank to external
      - No external hardware or tools unaccounted for
    - For STS-135/ET-138, stringer mod work performed in c/o cell
      - Four bolt fragments in intertank unaccounted for
      - Will re-inspect intertank post tanking test
  - STS-134 had a high wind event at pad
    - Inadequate BCI at pad to adequately examine E/B-2 area after event
    - For STS-135, will use improved process with visual access to both E/B areas



<b>FOD Mitigation for STS-135</b>		
Presenter	Doug Drewry/MS	
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- Enhanced inspections performed in VAB to clear the vehicle for rollout which included borescope inspections behind RSS crossover cavity
- PAD A planned inspections
  - Borecope the crossover areas during final SRB inspections at L-3 or in the event of an off-nominal high wind event



Borescope Dry-run at Pad A



BCI Dry-run at Pad A





**STS-134-I-002 Cylindrical Object Observed  
 Near +Y Thrust Panel During SRB Separation**

Presenter	Doug Drewry/MS	
Date	6/21/11	Page 21

**Summary: Recommend closure of IIFA STS-134-I-002 as UA**

- **Flight Rationale for FOD:**
  - Strength of controls for FOD prevention
  - Standard processing with ET mods performed in c/o cell prior to integration
  - Additional inspections of STS-135 E/B external area prior to rollout
  - Tool box checks, parts checks, paper reviews, close-out and BCI photo review
  - Enhanced imagery at pad
  
- **Flight Rationale for RSRB flight hardware:**
  - Coupler and Lock Pin remain “Unexpected” debris and RSRB assessment shows release is possible but unlikely.
    - 38 recent tests resulted in no liberations of coupler
    - Lock pin is bonded with epoxy and no history of loss
  - DTA indicates window where Coupler/Pin debris can impact Orbiter to be less than 1 sec. duration.
    - Front side RCC damage is expected and possibility of punch through should impact occur
    - Half of tile damages pass deterministically, 1/3 of damages have low risk of failure, remaining damages are marginal
  - On orbit inspections are capable of detecting RCC damage from metallic debris of this type



**STS-135  
 SSP Flight Readiness Review  
 Integrated Hazard Report  
 and  
 Integrated In-flight Anomalies  
 Summary**

**MS3/Brenda Eliason  
 June 21, 2011**





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

Presenter	<b>MS/B. ELIASON</b>	
Date	<b>06/21/11</b>	Page 23

- **STS-133-I-002, ET Intertank Stringer Cracks**
  - Status – ECD 6/27/11
- **STS-134-I-001, Unexpected Debris/Expected Debris Exceeding Mass Allowable Prior to Pad Clearance (Liftoff Debris)**
  - Status – CLOSED
- **STS-134-I-002 , Cylindrical Debris Observed Near +Y Thrust Panel During SRB Sep**
  - Status – CLOSED



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

Presenter	<b>MS/B. ELIASON</b>	
Date	<b>06/21/11</b>	Page 24

<b><u>IFA Number: Title</u></b> <b>Description</b>	<b>STS-135 Status and Rationale</b>
<ul style="list-style-type: none"> <li>▪ <b><u>STS-133-I-002: ET Intertank Stringer Cracks</u></b></li> <li>▪ TPS crack observed on the LO2 Intertank (IT) flange closeout at ~Xt 852 on Panel 2 during tanking for STS-133 launch attempt on 11/5/10</li> <li>▪ Subsequent TPS removal revealed foam cracking caused by underlying stringer cracks</li> <li>▪ Tanking test performed post-repair stringer on 12/17/10</li> <li>▪ NDE following the tanking test revealed additional stringer cracks</li> </ul>	<ul style="list-style-type: none"> <li>• ET-137 cracked stringers were repaired.</li> <li>• Radius block modification were implemented on all accessible stringers.</li> <li>• ET-137/STS-133 was loaded and launched successfully on 2/24/11.</li> <li>• Radius block mods were performed on the LO2 flange end of ET-138.               <ul style="list-style-type: none"> <li>• No impact of radius block mods on integrated loads.</li> <li>• STS-135/ET-138 Tanking Test performed 6/15/11.</li> </ul> </li> <li>• No significant increase in the risk of TPS release due to re-spray in areas of stringer mods.</li> <li>• <b>OPEN, ECD 6/27/11</b></li> </ul>





## Integrated In-Flight Anomalies (IIFAs)

Presenter **MS/B. ELIASON**

Date **06/21/11**

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<b>IFA Number: Title</b> <b>Description</b>	<b>STS-135 Status and Rationale</b>
<p>▪<b>STS-134-I-001: Unexpected Debris/Expected Debris Exceeding Mass Allowable Prior to Pad Clearance (Liftoff Debris)</b></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"> <li>• Risk Assessment indicates that given the proposed mitigations, observed debris poses no appreciable increase in risk.</li> <li>• Liftoff debris risk is currently characterized as infrequent, catastrophic due to significant uncertainties in controls and significant limitations in analysis.</li> <li>• 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.</li> <li>• <b>CLOSED</b></li> </ul>



## Integrated In-Flight Anomalies (IIFAs)

Presenter **MS/B. ELIASON**

Date **06/21/11**

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<b>IFA Number: Title</b> <b>Description</b>	<b>STS-135 Status and Rationale</b>
<p>▪<b>STS-134-I-002: Cylindrical Debris Observed Near +Y Thrust Panel During SRB Sep</b></p> <p>▪A cylindrical shaped object was observed in seven frames of video from the right SRB ET Observation camera approximately 0.5 sec after SRB separation (~125 sec MET)</p>	<ul style="list-style-type: none"> <li>• Investigation ongoing to understand risk for STS-135             <ul style="list-style-type: none"> <li>• Appears to be metallic with maximum length ~ 3", maximum diameter ~1"</li> </ul> </li> <li>• Potential sources are being evaluated.             <ul style="list-style-type: none"> <li>• STS-134 processing reviewed for FOD potential.</li> <li>• Flight hardware that could be a debris source is a grounding strap coupler between SRB and ET or a separation bolt lock pin</li> <li>• All sources are unexpected debris</li> </ul> </li> <li>• Flight Rationale is based on:             <ul style="list-style-type: none"> <li>• Strength of controls for FOD prevention</li> <li>• Risk acceptance for potential flight hardware source</li> </ul> </li> <li>• <b>CLOSED</b></li> </ul>





## Integrated Hazard Report Changes Since STS-134

Presenter **MS/B. ELIASON**

Date **06/21/11** Page **27**

- None



## Integrated Hazard Risk Matrix

Presenter **MS/B. ELIASON**

Date **06/21/11** Page **28**



Pre-decisional. Internal use Only.

Hazard Report #	Integrated Hazard Titles	Controlled Risk				Accepted Risk					
		Controlled Risk	remote-marginal	improbable-marginal	improbable-critical	probable-marginal	infrequent-marginal	remote-critical	remote-catastrophic		
<b>"Accepted Risk" Hazard Reports</b>											
IDBR-01	Ascent Debris Impact to SSV	7		7	29			22	7		
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			
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		
ISPR-04	SRB Hold Down Post (HDP) System Malfunction	1			1			1			
ISPR-05	SRB Umbilical System Malfunction	3			3			1			
ITHM-01	Exposure to Thermal Environment Exceed Capability of SSV	15	1	5	2	7	3	1	1		
IVLD-01	Exposure to Induced Environments Exceed Structural Capability of SSV	22			22			26			
ILIT-01	Adverse Effects of Lightning	0						6			
<b>Accepted Risk Distribution Totals</b>		(see next page)		148	0	2	2	131	0	0	13







<b>Imagery Hardware</b>		Presenter <b>MS/B ELIASON</b>
<b>ELVIS</b>		Date <b>6/21/11</b> Page <b>31</b>

**ET LO2 Feedline Camera (ET-138)**

- Camera system installed and on schedule with nominal checkouts
  - ET-138 camera batteries exceeded the 3 year shelf-life requirement (3/14/2011)
    - Performed three charge/discharge cycles to verify battery life
      - Waiver EK10798 approved
  - Camera timer disabled to allow longer run time
    - Approved at 6/16/11 Daily PRCB
- **Ready to support. No open issues.**

**Ground Network & TV**

- Nominal ground network and TV truck status
  - Working additional assets for imagery recording late in ET trajectory
- **Ready to support. No open issues.**

**SRB Cameras (BI-146)**

- Hardware installation and closeouts on schedule with nominal checkouts
- **Ready to support. No open issues.**



<b>Imagery Hardware</b>		Presenter <b>MS/B ELIASON</b>
<b>ELVIS (cont'd)</b>		Date <b>6/21/11</b> Page <b>32</b>

**Digital ET Thermal Protection System (DETTPS)**

- Camera configured for **Daylight** settings through **27 JULY**
- **Ready to support. No open issues.**

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**

- Reduced crew size affects imagery acquisition
  - Expected to be delayed by ~4-5 minutes
  - Likely will only get stills only, no video
- Expect dark conditions **2 – 16 AUGUST**
- **Ready to support. No open issues.**







<b>Imagery Hardware</b> <b>Non-ELVIS</b>	Presenter	MS/B ELIASON
	Date	6/21/11

**Orbiter MiniCam**

- Hardware installation and closeouts on schedule with nominal checkouts
- New configuration with PLT prelaunch activation (was done by crew on mid deck) at ~L-9 min
- **Ready to support. No open issues.**



<b>Imagery Hardware</b> <b>Ground</b>	Presenter	MS/B ELIASON
	Date	6/21/11

**Ground Cameras**

- Cameras configured nominally per Launch & Landing PRD
- Patrick Distant Object Attitude Measurement System (DOAMS) site quality issue
  - Mitigation is to add tracker at Cocoa Beach DOAMS, as was done for STS-133, -134
- Numerous experimental cameras deployed
  - Not for operational use or analysis
- **Ready to support. No open issues.**

**Photo Targets**

- STS-134 FSS and MLP targets performed as expected
- Two photo targets on FSS 295' level were not in camera FOV
  - Resolved with camera set-up adjustments
- Most targets survived the STS-134 launch intact
  - Thermal degradation on some targets (as expected)
- All FSS and MLP targets are installed for STS-135
  - Survey of MLP targets and replaced FSS targets to be performed
- **Ready to support. No open issues.**





**Lighting Predictions, July 8 – August 31**

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**Launch\***

- July 8 – July 20: **DAYLIGHT**
- July 21 – Aug 16: **DARK**
- Aug 17 – Aug 31: **DAYLIGHT**

**Post ET-Sep Mnvs**

- July 8 - Aug 1, Aug 17 – Aug 31: **Nominal +X, Nominal Pitch**
- Aug 2 – Aug 16: **Nominal +X\*, No Pitch**

**ET Sep Imagery\***

- July 8 – July 26: **DAYLIGHT**
- July 27: **DAYLIGHT, Non-Optimal**
- July 28 – Aug 16: **DARK**
- Aug 17 – Aug 31: **DAYLIGHT**

\* Modified +X (20 sec) mnvs may be executed instead of the nominal (11 sec) burn on days with no pitch mnvr, provided MOD has no other prop, traj, or rmdz constraints.

**Handheld ET (post-pitcharound) Imagery\***

- July 8 – July 29: **DAYLIGHT**
- July 30 – Aug 1: **DAYLIGHT, Non-Optimal**
- Aug 2 – Aug 16: **DARK**
- Aug 17 – Aug 18: **DAYLIGHT, Non-Optimal**
- Aug 19 – Aug 31: **DAYLIGHT**

**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"

\* Based on **March** reference trajectory; minor adjustments possible when updated reference trajectory released



**CoFR Products & Readiness**

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- All 43 STS-134 NIRD Reportables have been closed with supporting rationale
- STS-135 Imagery Readiness Review with the IATs and hardware teams held 6/13/11

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-135.	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-135 SSP Flight Readiness Review Radar Status

**MS/Joe Hamilton**



Pre-decisional. Internal Use Only.



Pre-decisional. Internal Use Only.

## **Debris Radar Configuration for STS-135:**

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- **STS-135 NDR Configuration:**
  - 1 MCR C-band radar
  - 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 has been completed





**NDR Issues During STS-134:**

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**NDR-C1 Radar:**

Problem: None.

**NDRX-3 Radar:**

Problem: None.

**NDRX-4 Radar:**

Problem: IMU pointing data dropouts caused transient tracking errors.

Resolution: Evaluating IMU interface for potential software error. Either the software will be repaired and tested, or previous version of hardware will be used. ECD: 7/5/11



**Readiness for STS-135:**

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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-135 SE&IO Pre-Flight Readiness Review Flight Software



Pre-decisional. Internal Use Only.



Pre-decisional. Internal Use Only.

## STS-135 FLIGHT SOFTWARE SUMMARY

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- Eighth flight of PASS and BFS Operational Increment 34 (OI-34)
  - No logic changes from previous flight software systems
  
- Eighth flight of MEDS Multifunction Display Unit Function (MDUF) VI 6.00 and sixth flight of MEDS Integrated Display Processor (IDP) VI 7.01
  - No changes from previous flight software
  
- Ninth flight of MAGRS-3S Link 613-9966-008 GPS FSW
  - No changes from previous flight software





## FSW READINESS SUMMARY

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- **Integrated Avionics Verification (IAV) is complete**
  - **A total of 14 cases were executed and analyzed in support of STS-135**
    - **Included testing of full flight system (PASS/BFS STS-135/OI-34 flight systems 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 06/06/11**
  - **No known constraints**
- **With the completion of planned open work, FSW will be ready to support STS-135 launch**



## STS-135 FLIGHT SOFTWARE FLIGHT READINESS STATEMENT

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**Full compliance with SPOC Flight Software CoFR requirements is documented in the STS-135 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 6/10/11

**Patti A. French**                      **Date**  
**Associate Program Manager**  
**USA Flight Software**





# STS-135 SSP Flight Readiness Review PGSC



Pre-decisional. Internal Use Only.



Pre-decisional. Internal Use Only.

## Payload and General Support Computer Readiness – STS-135

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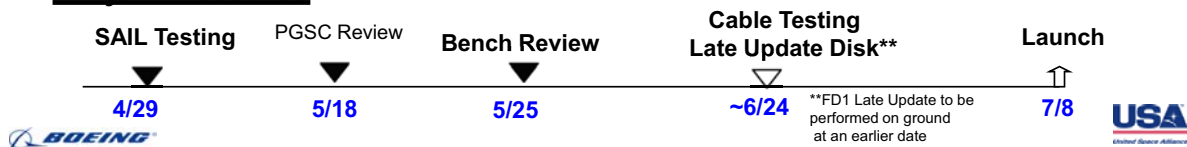
### Hardware and Software Summary

- STS-135 will be the fourteenth flight of the IBM ThinkPad A31p PGSC
  - 6 PGSC units (None currently planned for ISS transfer)
  - Sixteenth flight of the A31p Docking Station (OCA and WinDecom)
  - Fourteenth flight of Netgear Wireless Access Point.
    - *Note: Network anomaly initially observed on STS-134; Resulted from incorrect Access Point being setup with STORRM payload ; Anomaly eventually resolved with reconfiguration of STORRM with correct STORRM Access Point.*
  - New software
    - TriDAR v4.2

### IFA Summary

1. **KFX PGSC failure** – system replaced with backup PGSC. KFX returned to nominal operations. Closed
2. **Color Printer** – (1) Red text printed as yellow. Ground ceased using red text color in messages.  
 (2) Multiple blank pages. Roller cleaning seemed successful. ECD: 6/24/11

### Major Milestones





<b>STS-135 Non Standard Open Work</b>	Presenter MS/Terri Murphy	
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	ECD
<b>Systems Safety</b> -Approval of Integrated Flight Anomaly -STS-133-I-002, ET Intertank Stringer Cracks	06/27/11
-PGSC -STS-134-S-002, STS-134 Shuttle Color Printer Behavior	06/24/11



<b>Alternate/Dissenting Opinions</b>	Presenter MS/Terri Murphy	
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- **Alternate/dissenting opinions were actively solicited at the SE&I STS-135 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-135, pending completion of open work.**

**/s/Donald S. Noah**

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**Donald S. Noah**  
**Manager Systems Engineering and Integration Office**



