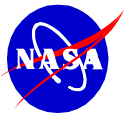




SPACE SHUTTLE PROGRAM
Space Shuttle Systems Engineering and Integration Office
NASA Johnson Space Center, Houston, Texas



STS-123

Combined SSP/Joint Flight Readiness Review

MS/Donald S. Noah
February 28, 2008





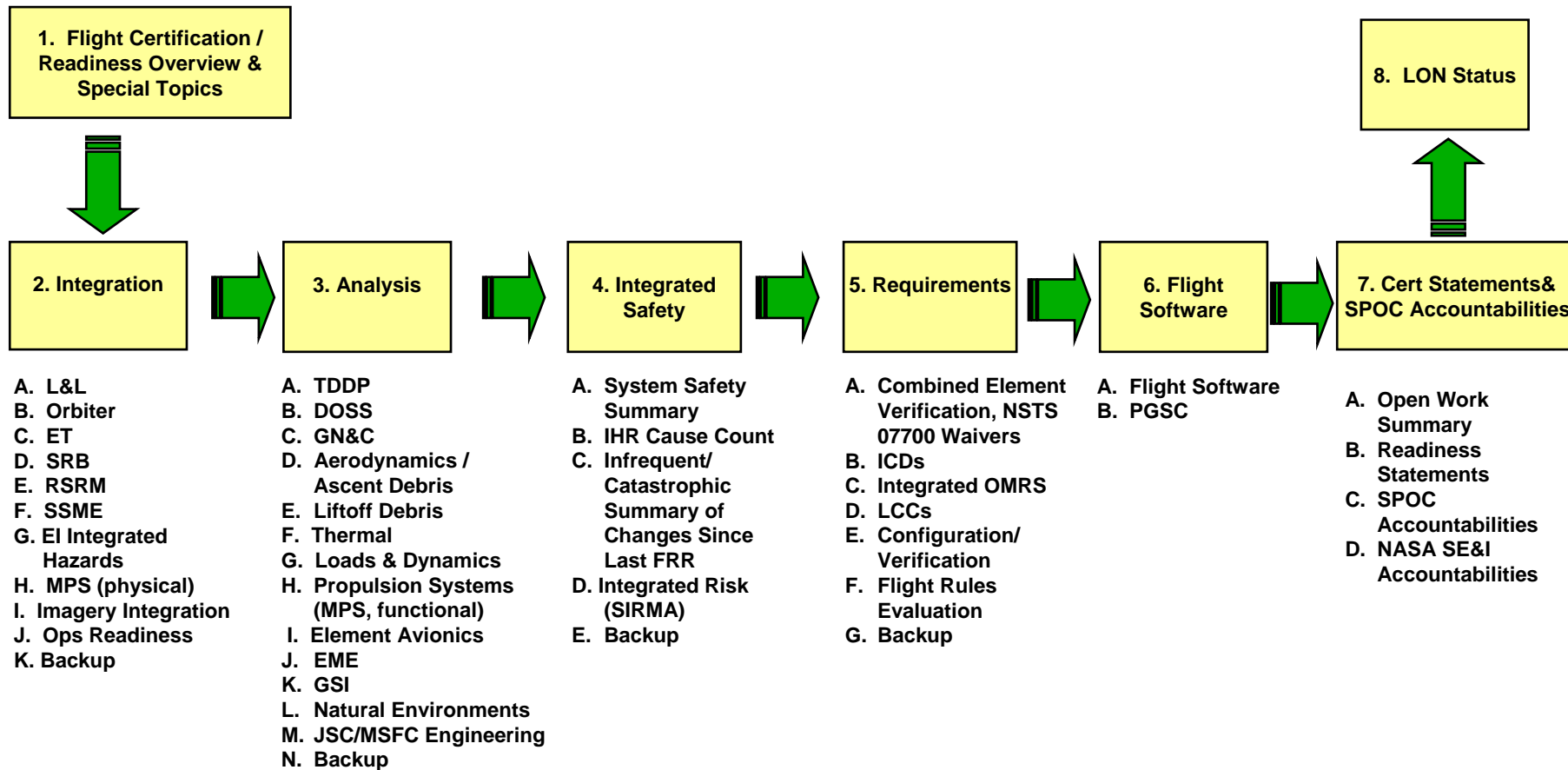
Presenter	MS/D. S. Noah	
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Agenda

- **Systems Engineering & Integration**
 - SE&I FRR Roadmap
 - Flight Preparation Readiness
 - ET OML ICD Waiver
 - DOLILU Operational Support System (DOSS)
 - Debris Radar
 - STS-118 Main Injector LOX Dome Contamination
 - Payload and General Support Computer Readiness
 - Post-separation Lighting
 - Integrated Debris Risk Assessment
 - Flight Software Readiness
 - Integrated Hazard Report Changes Summary
 - Integrated In-flight Anomalies (IFAs)
 - Non-Standard Open Work Summary
 - Launch On Need (LON)
 - Certificate of Flight Readiness



SE&I FRR Roadmap





Flight Preparation Readiness

Presenter	MS/D. S. Noah	
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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



ET OML ICD Waiver

Presenter	MS/D. S. Noah	
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- **ET Project identified Lockheed Martin drawings outside of OML ICD tolerances at 9 IFR locations (4 LO2 tank IFRs & 5 Intertank IFRs) which have existed since ET-51**
 - LO2 tank IFRs have exceedances for the aft-facing ramp only
 - Intertank IFRs have exceedances for multiple ramp faces
- **SE&I Joint Aerodynamics/Loads/Aero-heating Technical Panel met on 2/25/08 to assess the rationale for the proposed ET OML ICD waiver**
 - **Technical Assessment Findings**
 - No impact to ET certification due to the methodology employed by LM/MAF to assess the static air load stress on these protuberances.
 - No increases in dynamic airloads are anticipated for the as-built geometry
 - Existing aero-heating environments were developed for a more severe protuberance geometry and are conservative for the as-built geometry
 - SE&I Joint Aerodynamics/Loads/Aero-heating Technical Panel recommended approval of the ET OML ICD waiver for STS-123
- **SICB approved the ET OML ICD waiver on 2/26/08**



DOLILU Operational Support System (DOSS)

Presenter MS/D. S. Noah

Date 02/29/08

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- DOLILU Block Update 2008.1 Incorporated (CR S052550NR Submitted on 2/12/2008 by MOD)
 - Update Code For ET Fitting Load Application Points(Previously discussed @ FRR)
 - DOLILU Verification testing was completed on 1/14/08
 - Tested Again During TCDT



Debris Radar Readiness

Presenter MS/D. S. Noah

Date 02/29/08

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- **STS-122:**
 - Excellent track quality for X3, C1 radars throughout ASTT
 - X4, although planned for support, did not track until late in ascent due to a pedestal software issue
 - Software Corrected and Tested
- **STS-123**
 - NDR Configuration:
 - 1 MCR C-band radar, under Radome
 - 2 NASA X-band radars
 - NASA #1 on SRB vessel *Liberty Star*
 - NASA #2 on *Runnymede-Class* ARMY LCU
 - First operational SRB tracking, following ASTT, by both X-bd radars
 - Ascent team training continues
 - Orbit team training complete
 - NDR Readiness will be reviewed again 2/27/08



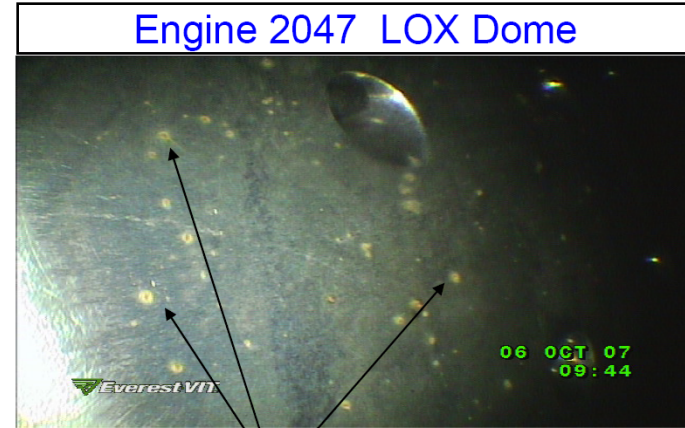


STS-118 Main Injector LOX Dome Contamination

Presenter MS/D. S. Noah	
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Issue

- Small lightly adhered iron oxide deposits were found in all three STS-118 engines (2047, 2051, 2045) main injector LOX domes during post flight inspections
- Spots vary in diameter from ~0.02" to ~0.050", height less than 0.001"
- Similar contamination found in STS-120 engines post flight, STS-122 engines (2059, 2052, 2057) on Pad and STS-123 engines (2044, 2054) in OPF-2



Investigation Status

- Integrated Systems Review Board established 10/30/07 and a fault tree developed to isolate contamination source
- Board meetings have closed ~65% of fault tree
- No material used in SSME LOX sys fab can form rust
- KSC Facility GN2 Pipeline replacement is a credible source of contamination
- Purge line filter sampling results consistently showing Fe and FeO contaminants from low alloy steel
- Inconel Plate Purge testing to begin on 2/22/08
- STS-118 Integrated IFA Interim Closure extended for STS-123
- Target completion for final closure by STS-124 SSP FRR

STS-123 SSME Flight Rationale

- STS-123 engines inspected and will be MR's use-as-is
- Material does not violate LOX particulate contamination maximum size of 800 microns (.031")
- LOX dome contamination from source external to SSME
- Multiple filters/screens in place from Ground O2 source to SSME
 - LOX Tank, MLP, ET, Orbiter
- Multiple filters/screens in place for GN2 and He purge sources to SSME
 - GSE supplies, Orbiter MPS filters





Payload and General Purpose Support Computer Readiness

Presenter	MS/D. S. Noah	
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• Hardware and Software Summary

- The Payload and General Purpose Support Computers (PGSC) were developed to enhance crew situational awareness
- STS-123 Will Be the Ninth Space Shuttle Flight of the IBM ThinkPad A31p PGSC and Associated 28V DC Power Supply
 - Third flight of A31p Docking station
 - First flight of new Netgear Wireless Access Point developed by Boeing and Energia to SSP-50094.
 - ET umbilical camera download driver fixed with modification to Windows XP
 - Extensively tested in building 44 lab
 - Performance also much better than Windows 2000 firewire driver used on STS-118 and previous flights
 - Will use STS-120 software and firmware for STS-123 for WLE System



Payload and General Purpose Support Computer Readiness

Presenter	MS/D. S. Noah	
Date	02/29/08	Page 10 rev

- **Integrated Testing**

- Integrated Testing SAIL testing completed 01/23/08
- Bench Review completed 01/29/08
- Testing on vehicle on PAD complete
- Late Update Disk L-10 days (03/04/08)
- Post Installation cable test (03/08/08)



Post-separation Lighting – Predictions, Mar 11 – 31

Presenter MS/D. S. Noah

Date **02/29/08**

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Launch

- Mar 11 – Mar 27: **DARK**
- Mar 28 – Mar 31: **DAYLIGHT**

ET Sep Imagery

- Mar 11 – Mar 27: **DARK**
- Mar 28 – Mar 31: **DAYLIGHT, non-Optimal**

Handheld ET (post-pitcharound) Imagery

- Mar 11 – Mar 29: **DARK**
- Mar 30 – Mar 31: **DAYLIGHT, non-Optimal**

Based on data provided by DM/Angela Braun using
 Sept '07 trajectory

DETTPS Camera Settings with FLASH

- DAYLIGHT settings (f/8, ISO 100, 1/250)
- DARK settings (f/4, ISO 200, 1/250)

Post-ET Sep MNVRs*

- Mar 11 – Mar 27: Nominal +X, No pitch
- Mar 28 – Mar 29: Nominal +X, No pitch
- Mar 30 – Mar 31: Nominal +X, Nominal pitch

per the following table



SEP	HH	+X	Pitcharound
Dark	Dark	Nominal	Delete
Dark	Lit	Nominal	Early
Lit	Dark	Nominal	Delete
Lit	Lit	Nominal	Nominal

* With DET TPS flash, +X mnvr to be performed on all flights, daylight or dark.



Post-separation Lighting – ET Lighting STS-122 Actual vs. Predicted

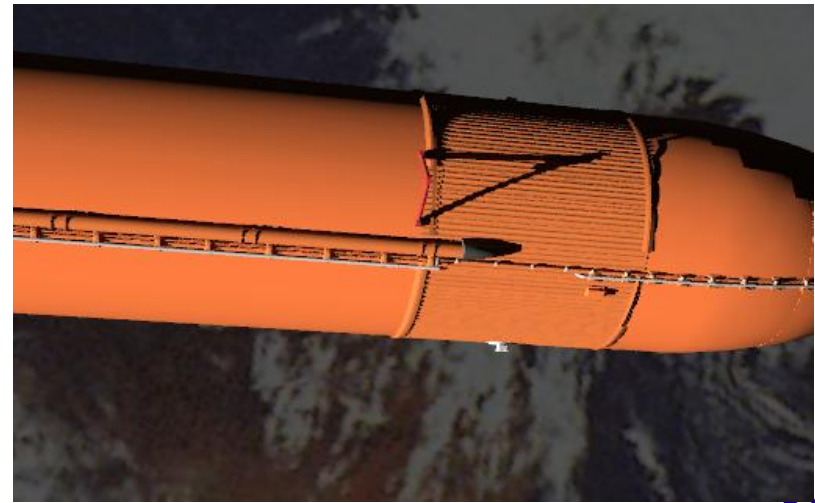
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S122E007548



S122E007557





Debris Special Topic

STS-123 FRR Presentation

James Peters, MS2

281-483-3823

Systems Engineering & Integration Office

Space Shuttle Program Office



STS-122 Debris Summary

Presenter **James Peters**

Date **02/29/08** Page **14**

- 8 STS-122 Debris IIFAs were taken:
 - STS-122-I-001: Stinger Tile Observed Falling after SSME Startup
 - STS-122-I-003: Liftoff Debris
 - STS-122-I-004: LH2 Tank Acreage Loss Adjacent to Xt 1129 LO2 Feedline Bracket Base Closeout
 - STS-122-I-005: LH2 Tank Acreage Debris Loss Aft of +Y Bipod at Xt 1145
 - STS-122-I-006: Intertank Acreage Losses
 - STS-122-I-007: SRB Red Rocket Tape Foreign Material
 - STS-122-I-008: SRB Missing SF-EPDM, Unknown Release Time
 - STS-122-I-009: ET-TPS Loss of STBD Aft Strut at 93 seconds

Flight	STS-114	STS-121	STS-115	STS-116	STS-117	STS-118	STS-120	STS-122
Total Debris IIFAs	25	9	7	9	6	5	5	8
Ascent	10	3	6	8	5	4	4	7
Liftoff	9	6	1	1	1	1	1	1



STS-122 Debris Summary

- STS-122 Debris Observation Summary:
 - The cracked foam on the LO2 Feedline Yokes at Xt1129 and Xt1377 did not liberate
 - The Tyvek covers performed as expected with all releasing before 170 mph
 - Weather conditions (temp, humidity, wind and light rain) for STS-122 were conducive for low/medium icing on the vehicle
 - No significant TPS or WLE damage was noted during OBSS inspection, RPM or Late Inspection
 - Focused inspections were requested for the displaced OMS Pod blanket(s)

Flight	STS-114	STS-121	STS-115	STS-116	STS-117	STS-118	STS-120	STS-122*
Total Bottom TPS Hits	125	86	104	124	247	160	247	141
Number >1"	17	10	5	16	15	22	12	5
Largest Length	4.5"	1.5"	2"	3"	1.7"	3.5"	2.5"	1.5"
TPS Volume Loss (in ³)	5.120	1.251	1.894	3.827	1.980	7.537	1.973	TBD

* The STS-122 data is preliminary pending the final report



Debris IFA Disposition Summary

- STS-122-I-001: Stinger Tile Observed Falling after SSME Startup
 - Orbiter will address the details of keeping this classified as “Unexpected” debris
- STS-122-I-003: Liftoff Debris
 - Debris release mitigated for identified potential sources of critical debris: 1) removal of items and 2) added inspections of system level components (e.g. water pipes, cable trays, lightning mast, etc)
 - Ongoing mitigations include FOD awareness, attrition-based removal of unistrut clamp hardware, routine inspections and monitoring for facility corrosion
 - Two updates to NSTS 60559 recommended as part of this IFA closure:
 - Broken/degraded tie wrap
 - Strain relief spring from vertical cable trays on side 3 of FSS
 - Risk Assessment indicates that given the proposed mitigations, observed debris poses no appreciable increase in risk
 - Much lower debris environment observed on STS-122



Falling Stinger Tile



Debris IFA Disposition Summary

- STS-122-I-004: LH2 Tank Acreage Loss Adjacent to Xt 1129 LO2 Feedline Bracket Base Closeout
 - A 0.017 lbm loss due to cryopumping was observed at 132 seconds
 - A Focused PRA for cryopumping in this area Outboard of the LO2 Feedline Bracket:
 - /2,500 for Tile
 - 10,000 for RCC, Special Tile, and Tile shear

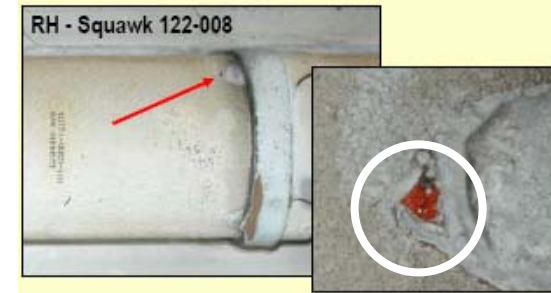
- STS-122-I-005: LH2 Tank Acreage Debris Loss Aft of +Y Bipod at Xt 1145
 - A 0.019 lbm loss due to cryopumping was observed at 440 seconds
 - A Focused PRA for cryopumping in this forward LH2 acreage area (Xt113-1200):
 - 1/5,000 for Tile Shear,
 - 1/10,000 for RCC, Tile and Special Tile





Debris IFA Disposition Summary

- **STS-122-I-007: SRB Red Rocket Tape Foreign Material**
 - A piece of red vinyl tape was found on the RH forward skirt system tunnel cover
 - Mass is <0.0002 lbm, deterministic limit
 - The mitigation strategy is to remove the red vinyl tape after the RT455 installation and prior to Acrymax paint application, thus eliminating the source
- **STS-122-I-008: SRB Missing SF-EPDM, Unknown Release Time**
 - SRB will address the details of keeping this classified as “Unexpected” debris
- **STS-122-I-009: ET-TPS Loss of STBD Aft Strut at 93 seconds**
 - A 0.097 lbm loss was observed at 93 seconds at the LO2 Umbilical Cable tray @ Xt2077
 - The 0.097 lbm exceeds the Risk Assessment mass (0.066 lbm)
 - Loss was attributed to combination of Void DeltaP and Bond Line adhesion failure for SRB Plume heating
 - Release is outside of the Critical debris location (aft of Xt2058)





STS-122-I-006: LH2 Intertank Flange Losses (STS-122 Imagery Observation Summary)

Facts:

- At ~85 sec, there was a debris release observed on the port side of the vehicle
- Debris was seen in both the Fwd & Aft SRB cameras at about the 85 second timeframe
 - The fwd viewing camera shows multiple pieces of debris and the aft viewing camera shows a single piece of debris
 - Camera resolution
 - 30 ft/sec resolution
- There was a foam loss observed from the ET Separation images on the LH2 IT Flange on the -Y side
- No other observed ET foam losses on the -Y side
- Still evaluating SRB Debris evidence

Circumstantial Data:

- The LH2 IT Flange loss is the “Best Candidate” for the 85 second event
 - No other debris releases from this location were observed
- Mass determination:
 - The Total loss of 0.023 lbm is an estimate with potential +/- error
 - The mass of the multiple pieces is indeterminate

- All the Imagery Analysis Teams agree on the facts and circumstantial data



**Example of Aft SRB
Camera Looking Forward**



**Example of Fwd SRB
Camera Looking Aft**

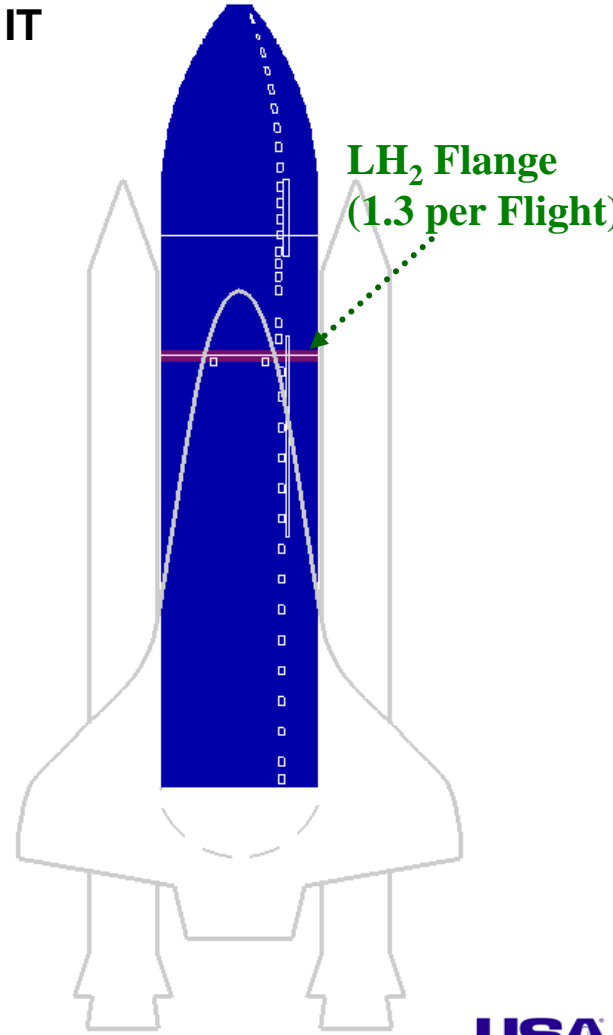
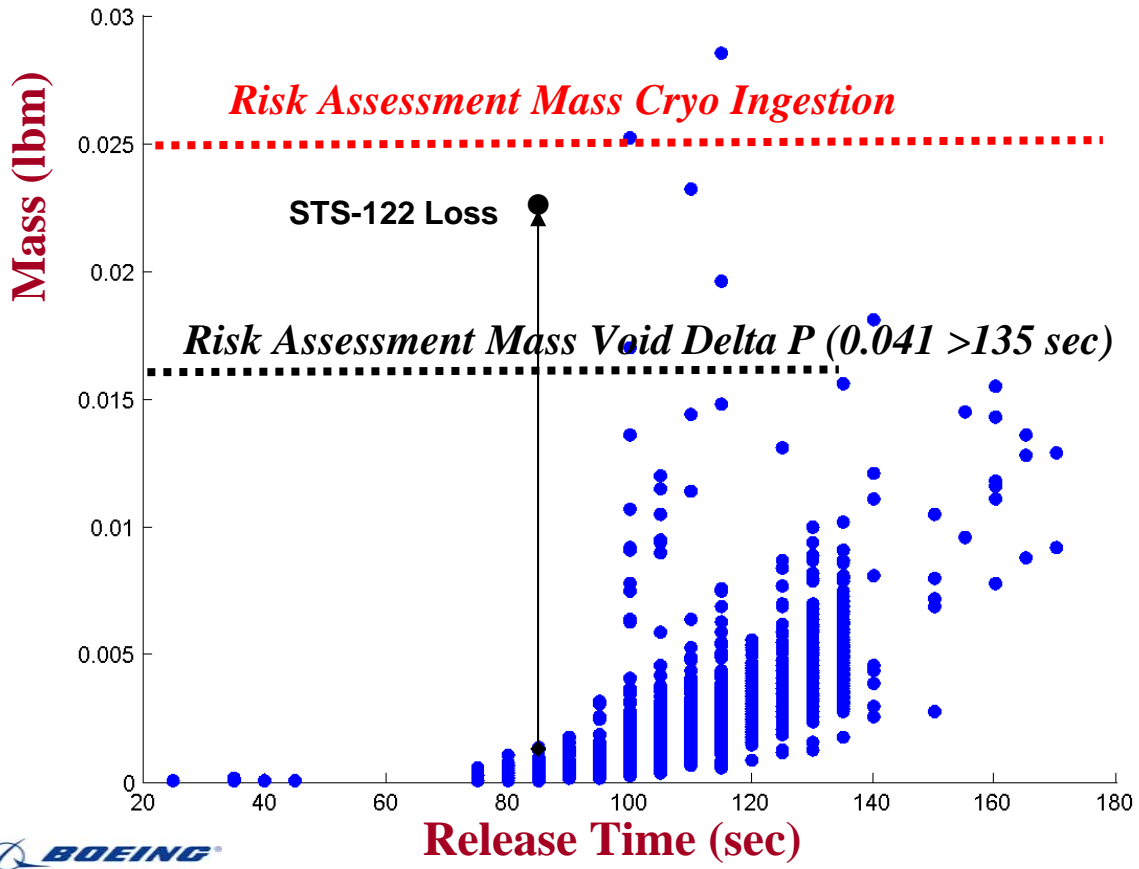


LH2 IT Flange Risk Assessment (IDBR-01 Cause N)

Presenter **James Peters**

Date **02/29/08** Page **20**

- Integrated risk for this cause is based on the following LH2 IT Flange Debris Cloud and Nominal Heating Profile
- Release rate since return to flight is 5 in 8 flights
 - Two on STS-114, one on STS-117, Two on STS-122





Flight History Since RTF

Flight	Failure Mechanism	Phi	Xt	Mass (lbm)	Release Time
STS-114	Cryoingestion	-83	Xt1120	0.034	Post SRB Sep.
STS-114	Cryoingestion	-90	Xt1121	0.014	Post SRB Sep.
STS-117	Cryoingestion	-68	Xt1121	0.006	Unknown
STS-122	Cryoingestion	-55	Xt1120	0.023	85 sec
STS-122	Cryoingestion	62.5	Xt1121	0.012	Unknown



Pre-STS122: LH2 IT Flange Risk Results

- Results for Void/Delta-P and Cryoingestion Failure:
 - Results are based on ET provided debris cloud for the LH2 IT flange
 - Version 1.0 PRA Model, no updates

	Risk Index ET Debris Table
Tile	<1/10,000
Special Tile	<1/10,000
RCC	<1/10,000
Overall	1/5,000

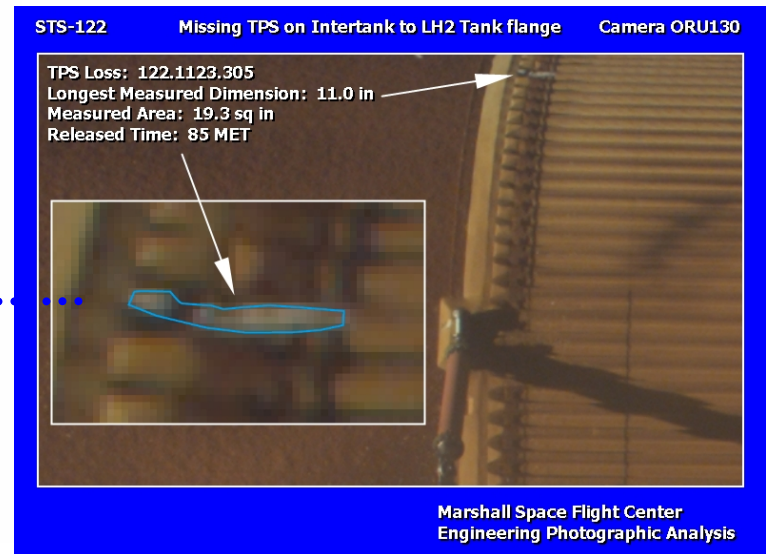
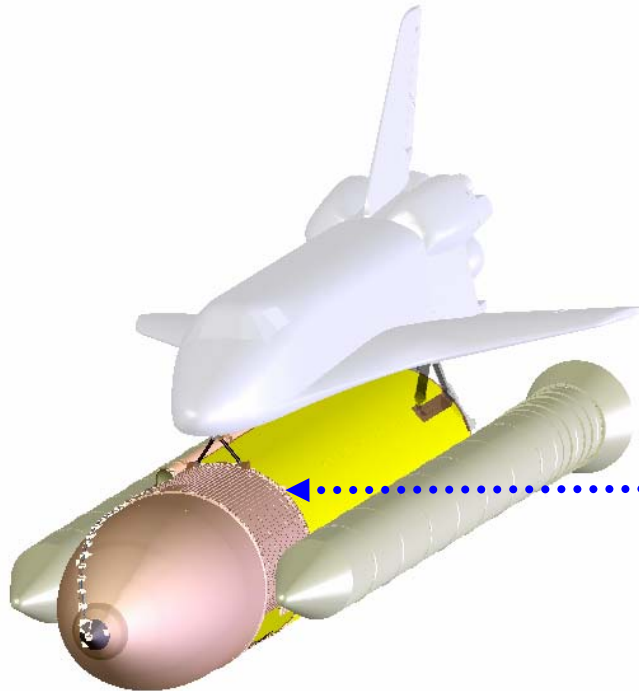
- Results Pre-STS122 documented in IDBR-01 as "Remote/Catastrophic"
 - Planned to recommend risk reduction to "improbable" after STS-123

HAZARD SEVERITY AND LIKELIHOOD OF OCCURRENCE WITH CONTROLS IN PLACE

L I K E L I H O O D	PROBABLE			
	INFREQUENT			
	REMOTE			Cause N
	IMPROBABLE			
		MARGINAL	CRITICAL SEVERITY	CATASTROPHIC



STS-122 LH2 IT Flange (85 sec)



- LH2 Flange at -55° Release Observed at 85 Seconds (M2.7)
- Estimated Mass of 0.023 lbm
 - $>+3\sigma$ Relative to MAF Debris Table (Void/ ΔP and Cryogenic Debris)

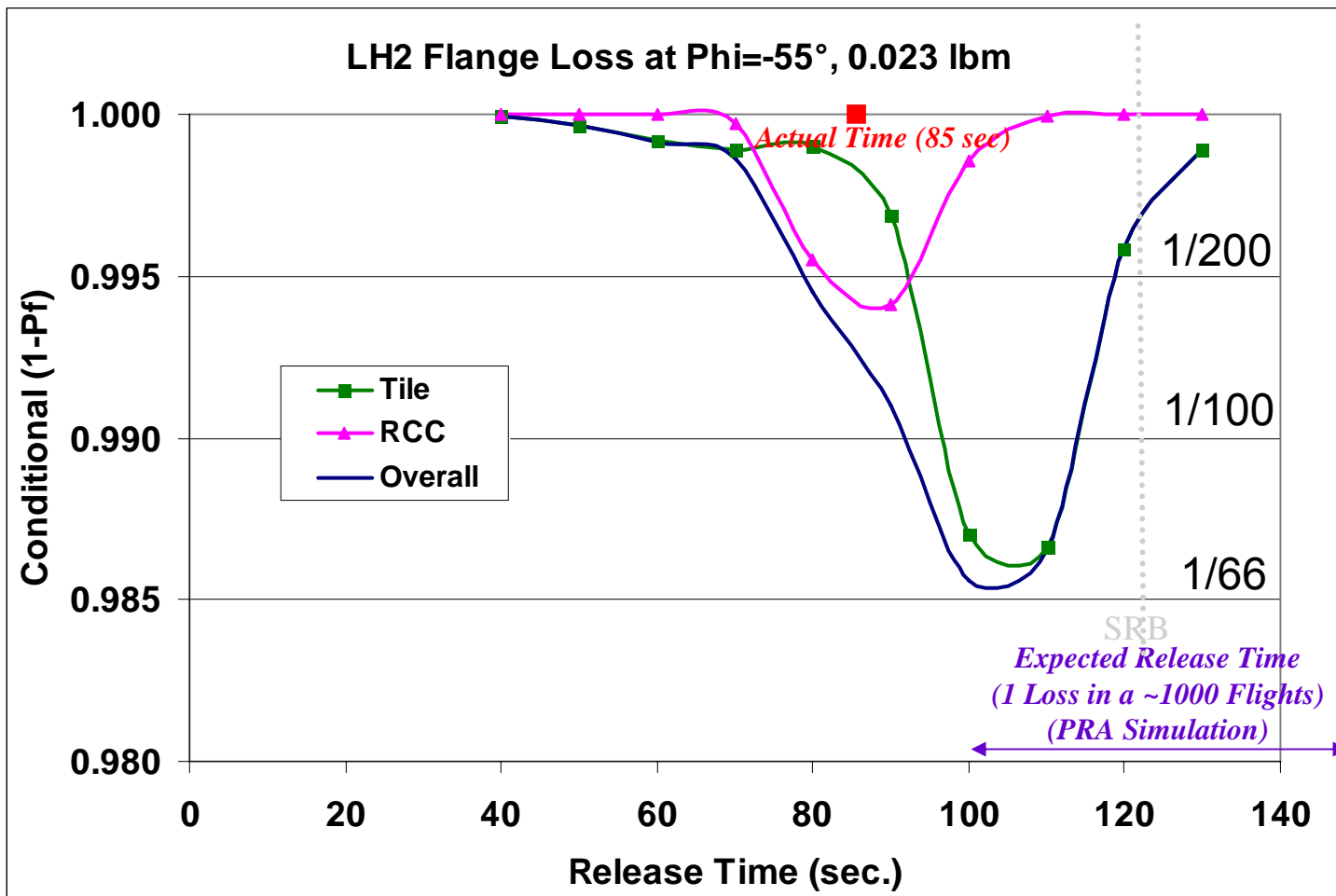


STS-122 LH2 IT Flange (85 sec)
Conditional Time Profile

Presenter **James Peters**

Date **02/29/08**

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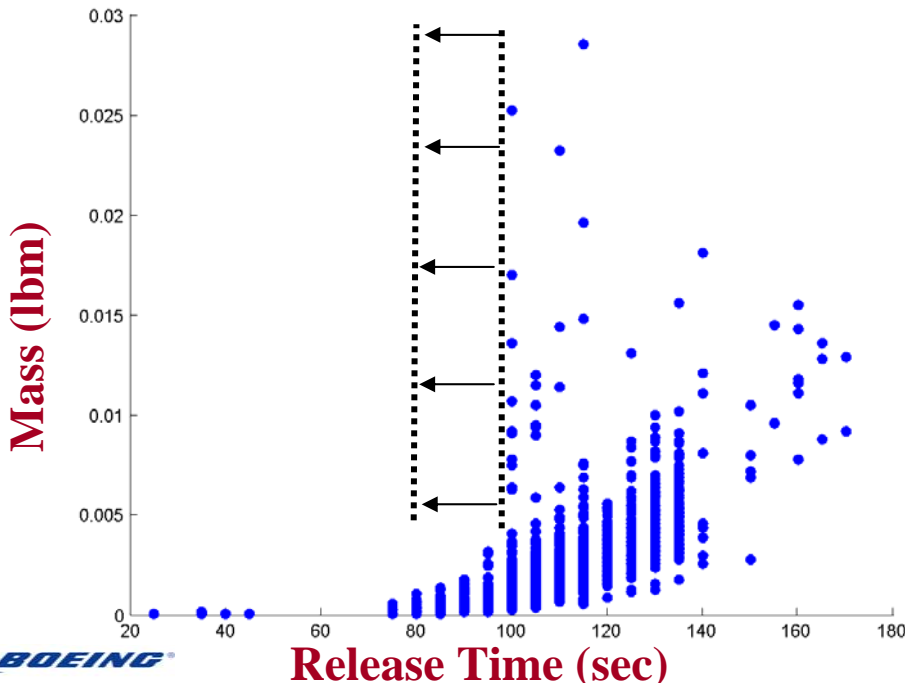
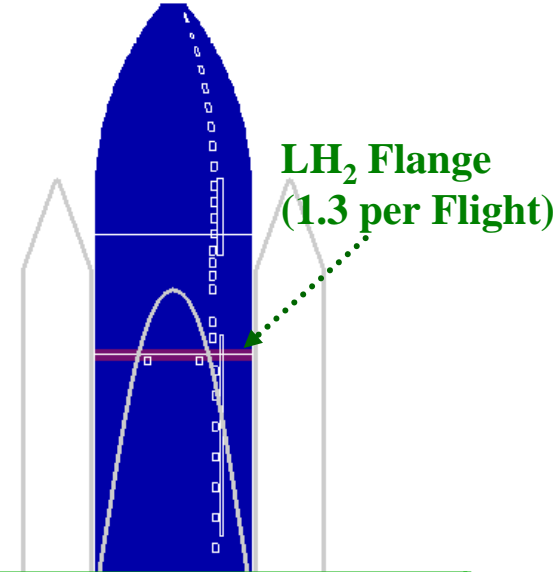
LH2 IT Flange Mass Distribution (Void DeltaP & Cryo Failure Mechanism)

Presenter **James Peters**

Date **02/29/08**

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- MAF Debris Table (Below) Analyzed with a 20 sec. shift
- Version 1.0 PRA Model with the following updates:
 - Refined Orbiter Tile Allowable Map-Large Increases in Allowables Especially for Large Foam (see backup)
 - Threshold Velocity Model Update Due to Small Foam on Tile Impact Testing-Large Increase in Threshold for Small Debris
 - Lift Computed Simultaneously with Drag to Capture Some Feedback-Likely a Small Effect



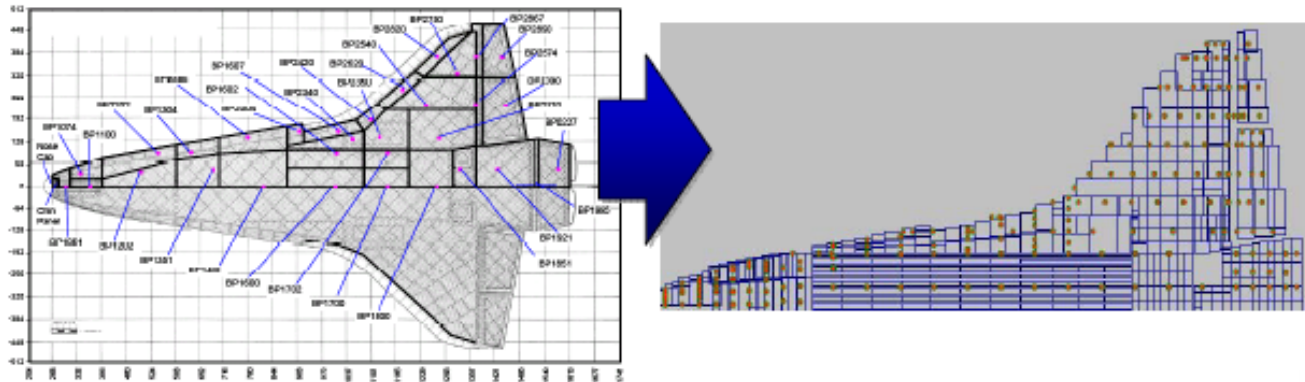
	Nominal Heating-Time Shift by 20 seconds
Tile	1/10,000
Tile Out	1/10,000
Special Tile	1/10,000
RCC	1/10,000
Overall	1/2,500



Updated Damage Map

Orbiter baselined updated PRA Expected and High Confidence Foam & Ice Lower Surface Tile Damage Maps: Ref: 11/27/07 DIG

- The Updated PRA maps utilize the 441 stress analysis regions which cover the lower surface of the vehicle
 - Previously only 32 zones covered the vehicle



- Overall increase in allowable depths for all maps are due to:
 - Discretization of the lower surface using analysis regions rather than zonal regions
 - Decrease in thermal and mechanical loads for high confidence and mean maps for large foam and ice
 - Updated thermal and stress models for large foam and ice maps
 - Cavity changes for large foam and ice maps
- Depending on the debris source, this changes tile risk results by nearly an order of magnitude



Summary

- The LH2 IT Flange losses on STS-122 represent an increase in risk for this debris source
 - The debris released from the -55 degree Phi location was “outside” of the debris cloud in terms of mass and release time
 - Difficult to quantify the change in risk
 - Shifting the debris cloud 20 seconds earlier to include the STS-122 loss causes an increase risk
 - The debris cloud “releases” predominately “small” masses (<0.005 lbm) and could dilute the cryo risk
 - DIG will investigate breaking out the cryo and Void DeltaP separately but, this will take time
 - Update IDBR-01 as appropriate
 - The release rate since RTF is lower than the model predicts (0.5/flight compared to 1.3/flight)
 - The 32 grid foam on tile damage map overpredicts the foam risk compared to the 441 zone foam on tile damage map
 - Can significantly lower the tile risk results depending on the debris sources
 - Breakup for cryopumping was not considered even though the data suggests the cryopumping events release in multiple pieces
 - ET Project did not identify any process escapes
 - IDBR-01 to remain closed for one-flight effectivity



STS-123 Debris Risk Assessment Summary

Presenter **James Peters**

Date **02/29/08**

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- The debris events observed on STS-122 do not represent an increase in debris risk
 - There were no IDBR-01 updates in terms of debris risk level or risk number
 - IDBR-01 remains closed and effective thru STS-123



STS-123 FLIGHT SOFTWARE SUMMARY

Presenter	USA/Chris Hickey	
Date	02/29/08	Page 29

- **Third flight of Primary Avionics Software System (PASS) and Backup Flight System (BFS) Operational Increment 32 (OI-32)**
 - PASS and BFS configured for 3-string GPS navigation
 - One new PASS code patch for STS-123 (minor discrepancy correction)
 - Allows manual deselection of a failed Speed Brake Thrust Controller switch contact before De-Orbit
 - No BFS changes
- **Third Flight of MEDS Integrated Display Processor (IDP) /MEDS Multi-function Display Unit Function (MDUF) combination (VI 5.00/5.00)**
 - No changes for STS-123
- **Seventh flight of Miniature Airborne Global Positioning System (GPS) Receiver Shuttle - 3 String (MAGRS-3S) Link 7**
 - No changes for STS-123
 - Second flight of 3-string GPS – no software anomalies on STS-118



STS-123 FLIGHT SOFTWARE READINESS SUMMARY

Presenter USA/Chris Hickey

Date 02/29/08 Page 30

- **Integrated Avionics Verification (IAV) is complete**
 - A total of 17 test cases were performed in the Shuttle Avionics Integration Laboratory (SAIL) and successfully analyzed in support of STS-123
- **SAIL facility will be in a condition of readiness for mission support**
- **Formal Software Readiness Review (SRR) was conducted on 02/14/08**
 - No known constraints
- **With the successful completion of scheduled open work, FSW is in a condition of readiness for flight**



STS-324 (STS-123 Rescue Mission)

Presenter USA/Chris Hickey

Date 02/29/08

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- In the event of call-up by SSP, STS-324 would be flown on OV-103 using the STS-122 Base Load as well as the flight specific I-load patches released for the STS-322 Rescue LON
 - Pre-Callup work
 - Patch for flight specific I-Loads was generated and released for STS-322 training
 - Post Call-up
 - Development/release of
 - 1 PASS data patch
 - 1 BFS code patch
 - 1 standard PASS GMEM (OMS Mixed Crossfeed)
 - 1 PASS/BFS I-load Patch
 - Level 8 Testing and Integrated Avionics Verification
 - No changes required for MEDS or MAGRS-3S
- Formal Software Readiness Review will be conducted after call-up.
- Based on expected content, FSW can support a rescue LON launch 32 days after STS-324 call-up



INTEGRATED HAZARD REPORT SUMMARY

Presenter MS/D. S. Noah

Date 02/29/08

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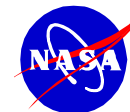
- **Three Integrated Hazard Reports Open (updates in signature)**
 - IFSW-02, Erroneous Input to Flight Software Can Result in the Loss of Vehicle Command and Control
 - Causes for Launch and Landing and MOD Erroneous Inputs Moved to Undeveloped Events section per Program Direction
 - Report Will Be Closed For All-Flights Effectivity
 - IVLD-01, Exposure to Induced Environments Exceed Structural Capability of SSV
 - Incorporated Open Work Closures
 - Effectivity STS-119, STS-123 through STS-126
 - One Open Work Remains, Associated With Roll Maneuver
 - IVLD-02, System Instability Results In Structural Failure of SSV
 - One Cause, Presence of Flutter During SRB Reentry Results in Structural Failure, Moved to Undeveloped Events Section, as it is a Non-Flight Condition
 - Incorporated Open Work Closures
 - Report Will Be Closed For All-Flights Effectivity



INTEGRATED HAZARD REPORT SUMMARY

Presenter	MS/D. S. Noah	
Date	02/29/08	Page 33

- **Updated Fourteen Integrated Hazard Reports**
 - IDBR-01, External debris Impacts the SSV
 - IEME-01, Adverse Electromagnetic Effects (EME)
 - IFSI-04, Outer Mold Line/Pad Configuration Error
 - IMEO-01, Hazardous Environment in the Aft Compartment
 - IMEO-02, Malfunction of Integrated Hydraulic System (Systems 1, 2 and 3)
 - IMPS-03, Improper IMPS Configuration During SSME Operation
 - IMPS-04, Off-Nominal Purges
 - IMPS-09, Hazardous Environment due to H2 External to Space Shuttle Vehicle
 - IMPS-12, Hazardous Environment due to Excessive O2 External to Space Shuttle Vehicle
 - IMPS-16, Loss of MPS He System
 - INEV-01, Exposure to Natural Environment Exceeds Capability of the Space Shuttle Vehicle (SSV)/Elements
 - IFSW-02, Erroneous Input to Flight Software can Result in the Loss of Vehicle Command and Control
 - IVLD-01, Exposure to Induced Environments Exceed Structural Capability of SSV
 - IVLD-02, System Instability Results In Structural Failure of SSV



INTEGRATED IN-FLIGHT ANOMALIES – FROM STS-120/118

Presenter	MS/D. S. Noah
Date	02/29/08
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IIFA / MSFC PRACA Record	Integrated In Flight Anomaly Title	Integrated Hazard Report	STS-123 Closure Status
STS-122-I-001 I00115	Stinger tile observed falling after SSME startup	IDBR-01	Open
STS-122-I-002 I00116	Ku Band radiated in Hi power	ICOM-01	Open
STS-122-I-003 I00117	Liftoff Debris	IDBR-01	Closed
STS-122-I-004	LH2 acreage loss adjacent to Xt 1129 LO2 feedline base closeout	IDBR-01	Closed
STS-122-I-005	LH2 acreage loss aft of +Y bipod	IDBR-01	Closed
STS-122-I-006	TPS loss on LH2 intertank flange +Z/-Y	IDBR-01	Closed
STS-122-I-007	2 locations of red foreign material located on SRB	IDBR-01	Closed
STS-122-I-008	Missing/Peeled SF-EPDM on RH Forward Segment Factory Joint	IDBR-01	Open
STS-122-I-009	LO2 umbilical cable tray foam loss (aft of Xt-2058)	IDBR-01	Open
STS-122-I-010	STS-122 LH2 ECO Failure	IMPS-03	Closed
IIFAs from previous flights			
STS-117-I-007 I00096	FOD Found in Aft Compartment	IMEO-01	Closed
STS-118-I-002 I00103	LO2 Feedline Bracket Loss	IDBR-01	Closed
STS-118-I-008 I00112	Contamination in SSME LOX Dome	IMPS-02	Closed



Non-Standard Open Work

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Open Work	Completion Date
Systems Safety -Disposition of IHRs IFSW-02, IVLD-01 and IVLD-02	02/28/08
-Disposition of IIFAs: STS-122-I-001, STS-122-I-002, STS-122-I-008, and STS-122-I-009	02/28/08



LON Status

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- **Flight Readiness Verification**
 - No updates to process, methods, or databases
- **System Integration's STS-324 Flight Products**
 - Leverage STS-124 products where appropriate
 - Mission unique products will be assessed and developed by each technical discipline based on:
 - Data trending & anomaly resolutions from previous flights
 - Design constraints implemented for STS-124
 - Requirements documented in the STS-324 FRD and TDDP
- **Mission Unique Open Work (Post call-up for Launch NET 4/24/08)**
 - **Loads & Dynamics**
 - Liftoff Loads Flight Margins Assessment (FMA) ECD: L-3 Wks
 - **Integrated Propulsion**
 - ET Pressurization Assessment ECD: L-2.5 Wks
 - RSRM Preflight Assessment ECD: L-2.5 Wks
- **Standard Open Work (Post call-up for Launch NET 4/24/08)**
 - Uplink (Update) FRV Assessment ECD: L-1 Wk
 - Normal Pre-launch Configuration and Testing ECD: L-1 Wk

No technical and/or schedule constraints to STS-123 or STS-324 call-up





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-123, pending completion of open work.

/s/ Donald S. Noah

Donald S. Noah
Manager Systems Engineering and Integration Office



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Back-up charts



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Standard Open Work

Open Work	Completion Date	
TDDP		
- TDDP-DOL (support DOL products)	03/03/08	M. Arreola (USA)
- TDDP change notice (RSRM L-3 day PMBT prediction update)	03/08/08	M. Arreola (USA)
DOSS		
- L-7 day SIRB review	03/05/08	M. Fatehi (USA)
- L-2 verification test (incorporate L-8 day TDDP & L-3 day change notice)	03/09/08	M. Fatehi (USA)
GN&C		
- Update FRV results to SIRB	03/05/08	M. Fatehi (USA)
- Normal prelaunch configuration & testing	03/07/08	M. Fatehi (USA)
Loads & Dynamics		
- Normal prelaunch configuration and testing	03/09/08	M. Miller (USA)
Flight Rules Evaluation		
- Assessment of late FR CRs	03/10/08	T. Hughes (USA)



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Standard Open Work

Open Work	Completion Date	
Software		
- NIRD CCT	L-3 days	MS/E. St. Peter
ELVIS		
- ET LO2 Camera MILA Downlink Check	S009	MSFC/M. Butler
- Install SRB DAS in Fwd Skirt and Battery Charge	L-2 weeks	MSFC/D. McIntosh
- Recharge of ET LO2 Camera Battery	L-1 week	MSFC/M. Butler
- ET LO2 Camera Cover Removal /Window Cleaned	L-1 day	MSFC/M. Butler
- SRB Camera Cover Removal / Windows Cleaned	S0007	MSFC/D. McIntosh
- ET Camera Open Loop MILA Comm Check	S0007	MSFC/M. Butler
- SRB DAS Battery Recharge*		MSFC/D. McIntoch
- SRB SSVR Battery Recharge**		MSFC/D. McIntoch
Ground Cameras		
- Trackers Towed to Camera Site Locations	L-1 week	SC/R.Page
- Cameras Positioned and Rough Set	L-3 days	KSC/R. Page
- Film Loaded and Final Set	L-1 day	KSC/R. Page
<u>Required After Launch Slip</u> * After 12 weeks since previous charge ** Certified for 5 launch scrubs + 1 full flight of powered time (conservative)		




Integ Hazard Cause Count Changes

Likelihood	Probable			
	Infrequent	2		17
	Remote	2	2(*3)	128(*136)
	Improbable	11	11	265(*295)
		Marginal	Critical	Catastrophic
		Severity		

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

Pre-decisional. Internal use Only.

Hazard Report #	Integrated Hazard Titles	Controlled					Accepted Risk					Total			
		Controlled Risk	remote-marginal	improbable-marginal	improbable critical	improbable-catastrophic	Accepted Risk	probable-marginal	infrequent-marginal	remote-critical	remote-catastrophic		probable-critical	infrequent-critical	infrequent-catastrophic
															
	"Accepted Risk" Hazard Reports														
IDBR-01	Ascent Debris Impact to SSV	6				6	29					23		6	
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	10				10	4					3		1	
IMPS-04	Off-Nominal Purges	11				11	1					1			
IMPS-09 ²	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	21				21	26					26			
ILIT-01	Adverse Effects of Lightning	0					7					3		4	
	Accepted Risk Distribution Totals	(see next page)					149	0	2	2	128	0	0	17	0

Notes: *: The previous flight risk numbers are in parenthesis to right, if different from upcoming mission
 1: The integrated risk matrix includes all (integrated plus element/organizational level) open work
 2: IMPS-09, IMPS-10, and IMPS-11 were combined into one tree due to similarity





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Integ Hazard Cause Count Changes

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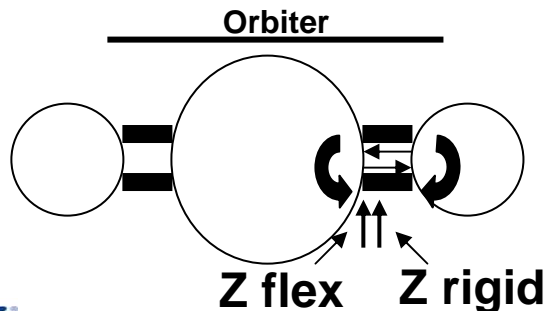
		<u>"Controlled Risk" Hazard Reports</u>																			
IARO-01	Aerodynamics Environment not per Specified Design	1			1	0															
IEPD-01	Inability to Power Critical Functions			3	5																
IFSI-01	ET/SRB System Interface Failure	6			6	0															
IFSI-02	ET/Orbiter System Interface 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 ²	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			5	6	29															
IVLD-02	System Instability Results In Structural Failure of SSV	13			13	0															
	Controlled Risk Distribution Totals	239	2	11	11	265	149	0	2	2	128	0	0	17	0						



DOLILU Operational Support System (DOSS)

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- **DOLILU Block Update: Update ET Fitting Load Application Points**
 - Both rigid body and flex body based programs are used for loads analysis
 - SRB roll maneuver balanced load case generation using the flex body program has identified an error in the coding of a load indicator used in rigid body loads analyses
 - Aft upper and lower attach strut load indicators are affected (diagram below)
 - Rigid body loads programs are used on day of launch and for calculating preflight load indicators for dispersed trajectories
 - Reported at Loads Panel on 6/14/07
 - The error in the rigid body implementation of the equation was identified because the flexible and rigid results were more different than expected for the differences in technique alone
 - Error is only in the calculation of the couple due to the “Z” forces
 - Resulted from inconsistent definition of the load application point

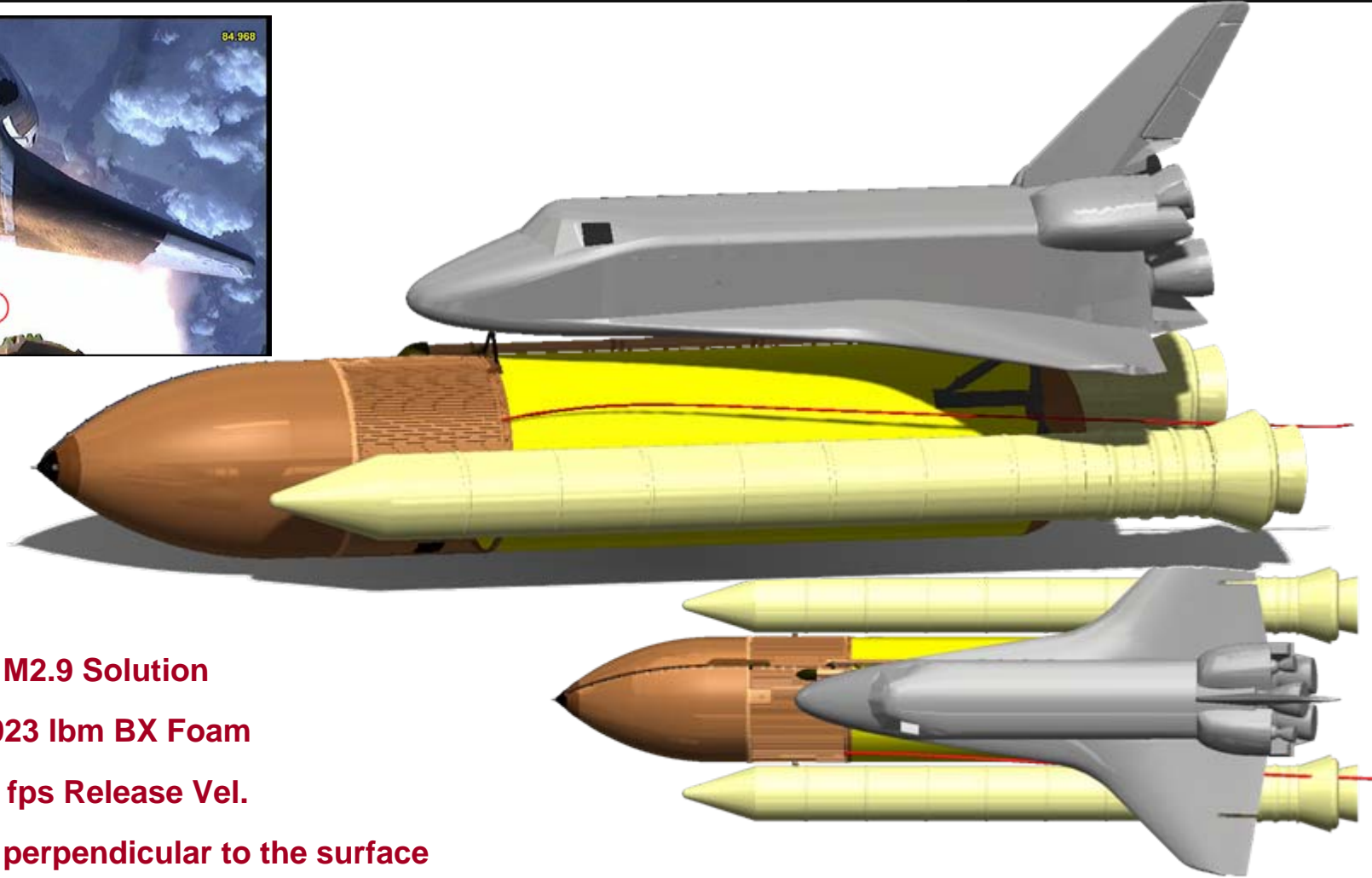


Rigid body load application point is offset from application in flex body model by ~17 inches resulting in different load distributions between the 2 struts.



STS-122 LH2 IT Flange (85 sec) Nominal Trajectory

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M2.9 Solution

0.023 lbm BX Foam

51 fps Release Vel.

Release angle perpendicular to the surface

Imagery suggests the debris followed close to the "zero" lift trajectory



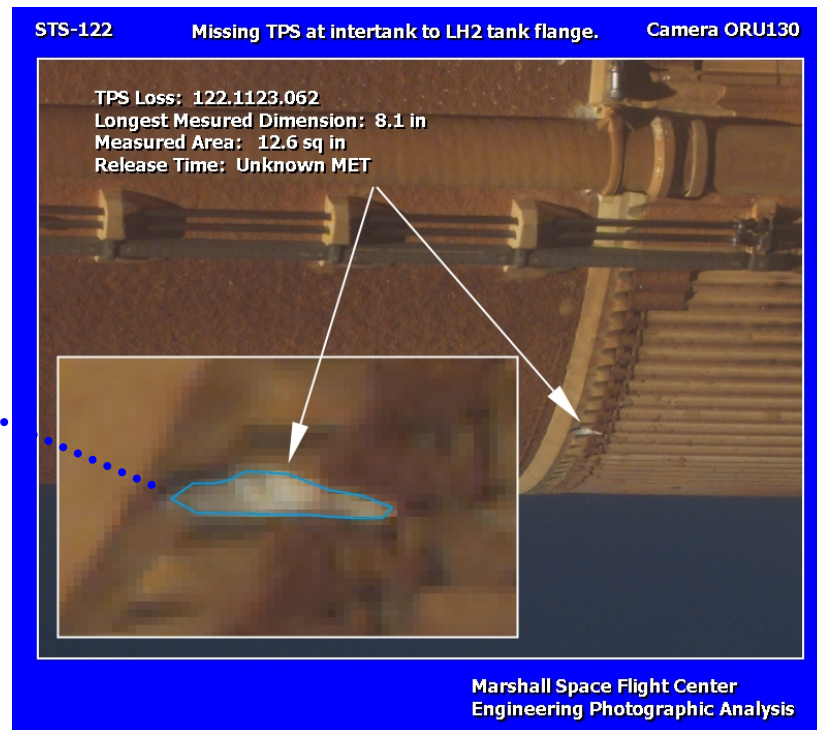
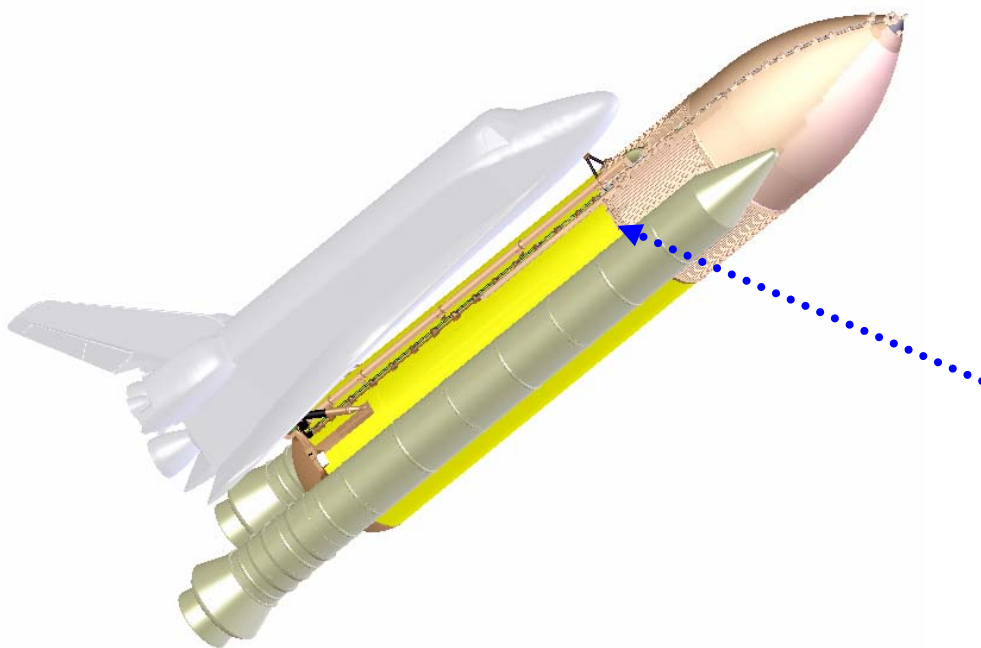


STS-122 LH2 IT Flange (Unknown Release Time)

Presenter **James Peters**

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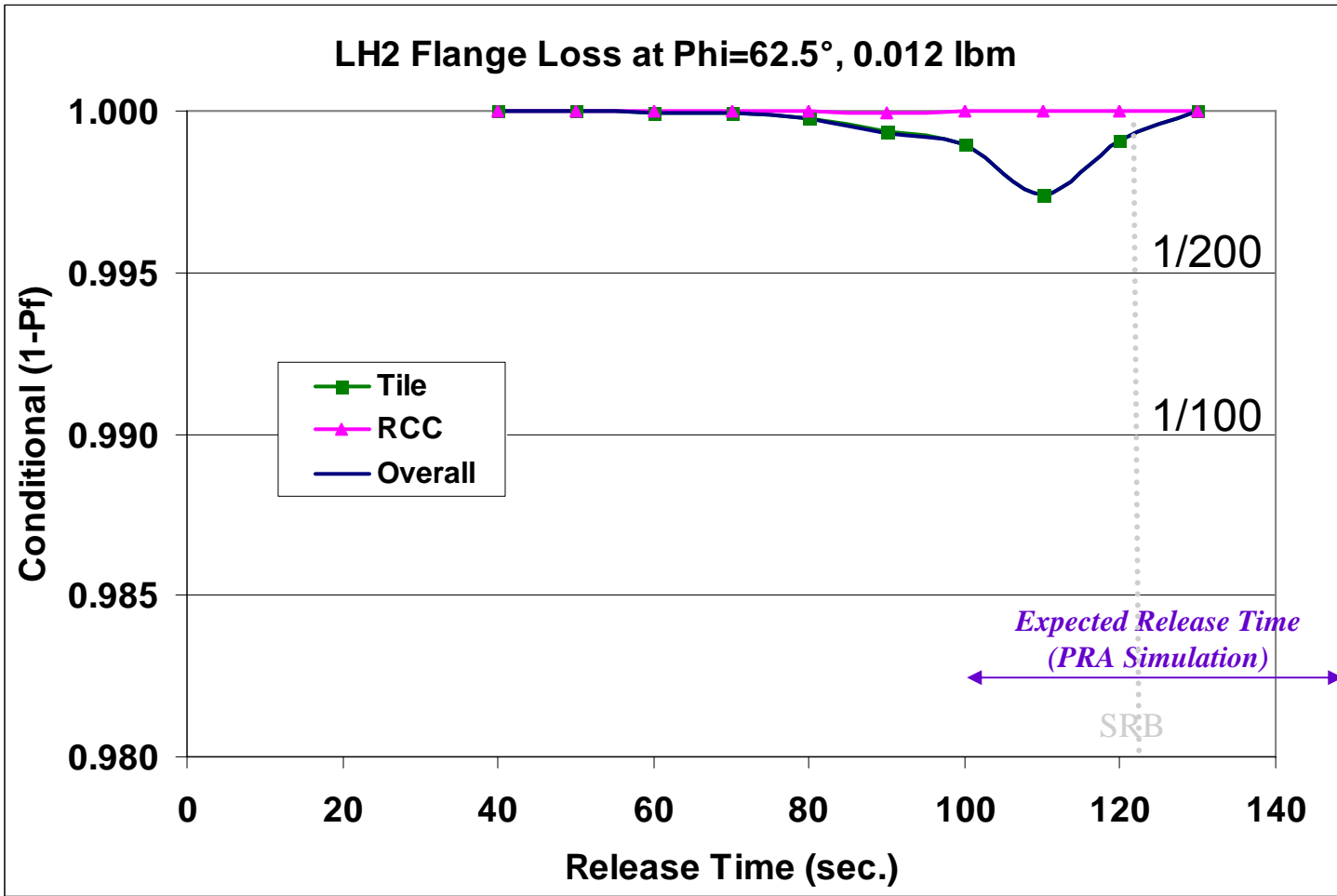


- LH2 Flange at 62.5° Release at Unknown Time
- Estimated Mass of 0.012 lbm
 - 2.8 σ Relative to MAF Debris Table (Void/ Δ P and Cryoingest Debris)



STS-122 LH2 IT Flange (Unknown Release Time) Conditional Time Profile

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LH2 Acreage Analysis (NCFI Foam) thru STS-122

Presenter **James Peters**

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	LH2 Acreage - General	LH2 Acreage - General	LH2 Acreage - Forward Location	LH2 Acreage - Forward Location	LH2 Acreage - Inboard of LO2 Feedline	LH2 Acreage - Outboard of LO2 Feedline
Xt Locations	Xt1130-1700	Xt1130-1700	Xt1130-1200	Xt1130-1200	Xt1130, 1377, 1624, 1871, 1973 (Phi=18.5)	Xt1130, 1377, 1624, 1871, 1973 (Phi=29)
Mass Distribution	Historical Log-Normal	Historical Log-Normal	Historical, Log-Normal (3sigma = 0.067)	Historical, Log-Normal (3sigma = 0.067)	Uniform (0.001 to 0.04 lbm)...largest observed: 0.029 lbm	Uniform (0.001 to 0.04 lbm)...largest observed: 0.031 lbm
Release Rate	1.0/flight	1.0/flight	0.6/flight, based on post RTF observations	0.6/flight, based on post RTF observations	1.0/flight, based on post RTF observation (lower before RTF)	1.0/flight, based on post RTF observation (lower before RTF)
Risk Assessment Mass	<135, 0.004 lbm >135, 0.015 lbm 0.082 lbm for cryopumping	<135, 0.004 lbm >135, 0.015 lbm 0.082 lbm for cryopumping	0.082 ET recommended for cryopumping	0.082 ET recommended for cryopumping	0.18 ET recommended	0.18 ET recommended
Failure Mode(s)	Unknown	Cryopumping	Unknown	Cryopumping	Cryopumping	Cryopumping
Timing	Worst time	Cryopumping	Worst time (~60 sec)	Cryopumping	Cryopumping	Cryopumping
Comments	Losses of previous CPR488 foam were excluded	Losses of previous CPR488 foam were excluded	STS-120 and STS-122 masses are not included in mass dist.	STS-120 and STS-122 masses are not included in mass dist.	Losses distributed uniformly between brackets	Losses distributed uniformly between brackets





Integrated Hazard Report Cause Count Changes

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- **Remote Critical**
 - 1 removed from Risk Matrix
 - Transferred to ET (1)
- **Remote Catastrophic**
 - 8 removed and 1 new cause added
 - IEME-01 (3)
 - 2 transferred to:
 - Orbiter (1)
 - SRB (1)
 - 1 was a transfer to LL now is an undeveloped event
 - IVLD-01 (5)
 - Transferred to:
 - SRB (2)
 - LL (3)
 - Added (1) new integrated cause
 - IMPS-03 (1)



STS-122 Integrated IFAs – Overview

Presenter MS/D. S. Noah

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- **SICB held on 02/19/2008 to review Element IFAs and baseline SEI Integrated IFAs**
- **Ten (10) STS-122 SEI Integrated IFAs identified**
 - Eight debris IFAs
- **Forward work includes review of Orbiter post landing inspection results**



STS-122 Integrated IFAs

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- **Stinger Title Observed Falling after SSME Startup, STS-122-I-001**
 - Several camera views noted part of tile missing
 - Unexpected debris loss in violation of NSTS 60559
 - IDBR-01, Ascent Debris impact to SSV
- **Ku Band Radiated in Hi Power, STS-122-I-002**
 - During Ku band stow while docked, the Ku band radiated in high power
 - Violation of flight rules/hazard controls in ICOM-01
 - Reference MOD IFA STS-122-D-001
 - ICOM-01, Adverse Effects due to Intentional RF Environment
- **Lift Off Debris, STS-122-I-003**
 - Unexpected/expected debris prior to pad clearance
 - Exceeds NSTS 60559 mass allowable or risk baseline
 - See *KSC IFAs*
 - IDBR-01, Ascent Debris impact to SSV



STS-122 Integrated IFAs

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- **LH2 acreage loss adjacent to Xt 1129 LO2 feedline base closeout, STS-122-I-004**
 - Multiple Debris Pieces seen at MET 132 sec (multiple pieces released)
 - Exceeds NSTS 60559 mass allowable
 - Reference ET IFA STS-122-T-002
 - IDBR-01, Ascent Debris impact to SSV
- **LH2 acreage loss aft of +Y bipod, STS-122-I-005**
 - Debris seen at MET 440 sec Impacting Orbiter
 - Exceeds NSTS 60559 mass allowable
 - Reference ET IFA STS-122-T-003
 - IDBR-01, Ascent Debris impact to SSV
- **TPS loss on LH2 intertank flange +Z/-Y, STS-122-I-006**
 - Foam loss at I/T to LH2 flange closeout at 5-6th stringer +Z of -Y thrust panel (MET 85 sec) and 3rd stinger +Z of +Y thrust panel (time of loss unknown)
 - Outside of risk assessment for time of occurrence and frequency of release
 - Reference ET IFA STS-122-T-001
 - IDBR-01, Ascent Debris impact to SSV



STS-122 Integrated IFAs

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- **2 locations of red foreign material located on SRB, STS-122-I-007**
 - Foreign material (red rocket tape) identified on the forward skirt system tunnel cover and RT455 joint closeout
 - Potential ascent debris source
 - IDBR-01, Ascent Debris impact to SSV
- **Missing/Peeled SF-EPDM on RH Forward Segment Factory Joint, STS-122-I-008**
 - Missing section SF-EPDM noted on the RH foreword segment factory joint weatherseal at ~197° (approx 2in x 3in, 0.060in thick)
 - Potential ascent debris source
 - IDBR-01, Ascent Debris impact to SSV
- **LO2 umbilical cable tray foam loss (aft of Xt-2058), STS-122-I-009**
 - Debris seen at MET 93 seconds
 - Exceeds NSTS 60559 mass allowable
 - Reference ET IFA STS-122-T-004
 - IDBR-01, Ascent Debris impact to SSV



STS-122 Integrated IFAs

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- **STS-122 LH2 ECO Failure, STS-122-I-010**
 - LH2 ECO #3 and #4 failed the OMRSD SOOFD0.121 pre-replenish sensor checkout during the December 6, 2007 STS-122 LH2 Tanking and ECO#3 failed during the December 9, 2007 STS-122 LH2 Tanking
 - Violation of hazard controls in IMPS-03
 - Reference ET IFA STS-122-T-008
 - IMPS-03 Improper IMPS Configuration During Engine Operation



STS-122 Integrated IFAs: STS-122-I-001

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-3.463 sec MET

Stinger Tile Observed Falling After SSME Startup



NIRD: 122-011



STS-122 Integrated IFAs: STS-122-I-004

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132.9 - 133.2 sec MET

Multiple Debris Pieces Observed with Inconclusive Orbiter



NIRD: 122-001



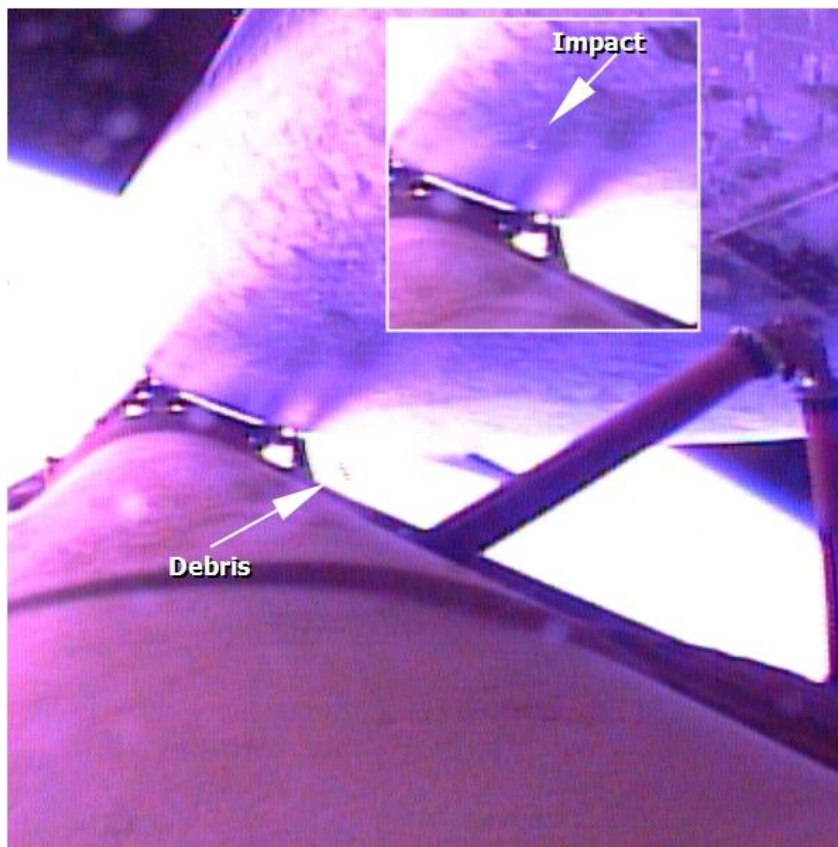
STS-122 Integrated IFAs: STS-122-I-005

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440.1 sec MET Debris Observed Impacting Orbiter Belly



NIRD: 122-009



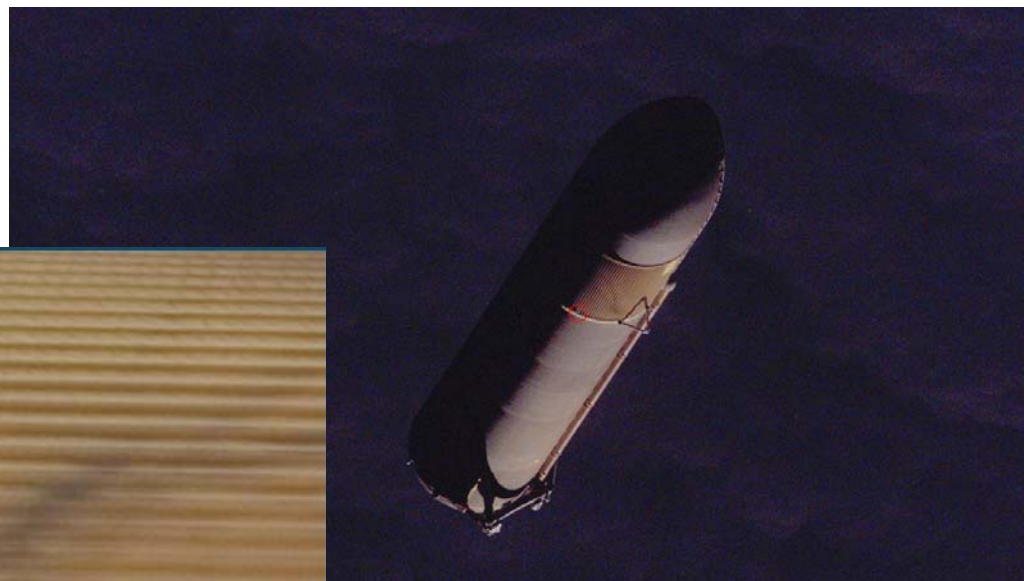
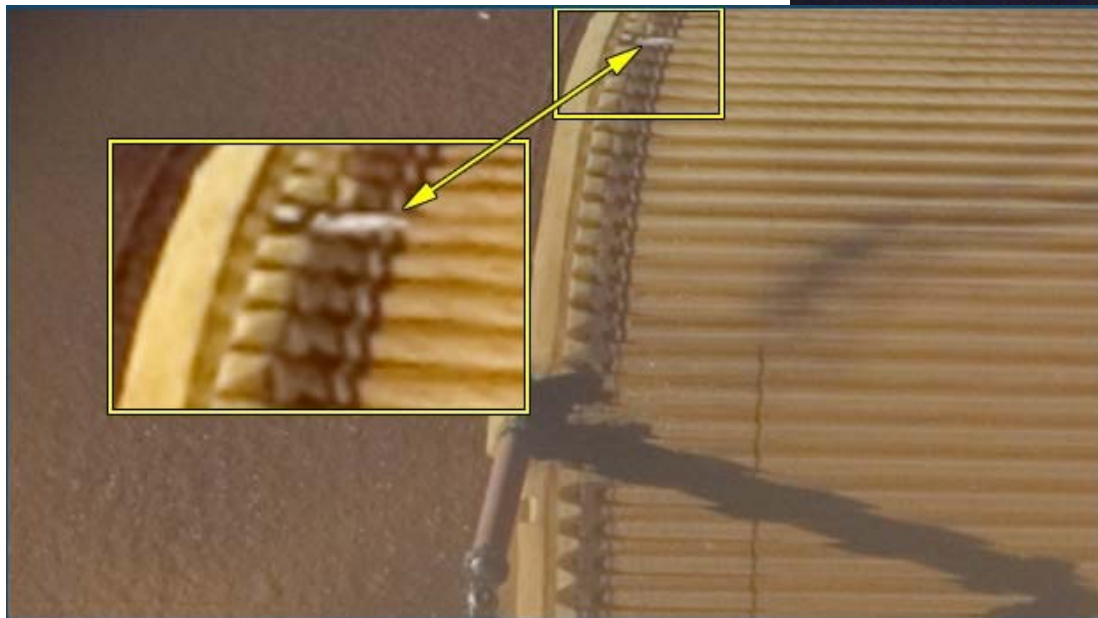
STS-122 Integrated IFAs: STS-122-I-006

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NA sec MET

TPS Loss on LH2/Intertank Flange, +Z/-Y

NIRD: 122-014



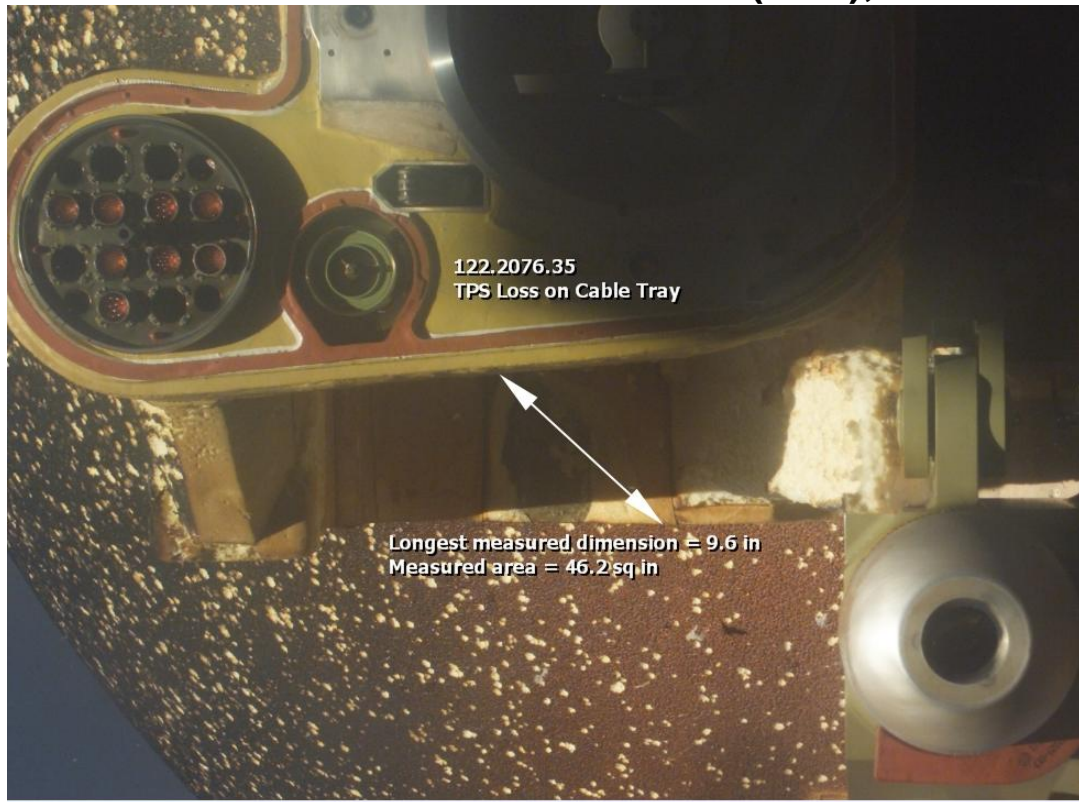


STS-122 Integrated IFAs: STS-122-I-009

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NA sec MET

ET TPS Loss Aft of STBD Aft Strut (EO3), ~Xt 2058



NIRD: 122-047