FLIGHT READINESS STATEMENT
STS-113/ET-116
EXTERNAL TANK PROJECT
PRE-FLIGHT REVIEW

EXTERNAL TANK ET-116/STS-113, AS IDENTIFIED IN THE EXTERNAL TANK PROJECT PRE-FLIGHT REVIEW DATED OCTOBER 24, 2002, IS CONSIDERED READY TO SUPPORT FLIGHT UPON ACCEPTABLE DISPOSITION OF OPEN/PLANNED WORK AND/OR OPEN ACTIONS.

N. E. OTTE/MP31

for J. BULLMAN/ED10

for R. M. MUNAFO/ED30

for A. C. ADAMS/QS20

A. A. McCOOL/MP01

P. K. McCONNAUGHEY/ED20

S. D. ROSE/ED40

for J. S. CHAPMAN/TD01

J. W. SMELSER/MP31, CHAIRMAN

October 24, 2002

Space Shuttle
External Tank

Pre-Flight Review

STS-113/ET-116

LOCKHEED MARTIN

Agenda

Overview — ***Jim Feeley***

Prior Mission Performance Summary

Mission/External Tank Highlights

Mass Properties Status

Change / Senior Management Review Item

- *LO2 Feedline Repair Using BX-265 Foam (B02070)*

Special Topic

- *Undersized Intertank Stringers*

SRM&QA Assessment

KSC Processing

Verification/Certification

Mission Unique Assessment

Readiness Statements

Appendices

Overview

This review includes:

- Mission STS-112/ET-115 performance summary
- Items specific to mission STS-113
- First time differences or "out-of-family" non-conformances on ET-116 that were not previously flown and/or reviewed
  - One significant change (presented with Senior Management Review Item)
  - Minor changes included in Appendix A
  - Reallocations were reviewed – No items affected form, fit or function

FRR Series	***STS-113/ET-116***
• ET/SRB Mate Review	09/09/2002
• Michoud Operations President's Review	08/21/2002
• S&MA Pre-Flight Assessment	10/10/2002
• ET Project Pre-Flight Review	10/24/2002
• Space Shuttle Vehicle FRR	10/31/2002
• Pre-launch Mission Management Team Review	11/08/2002

Prior Mission Performance Summary

STS-112/ET-115, 10/07/2002 - Launch

System	***Performance***
• **OMRSD**	• No ET violations
• **LCC**	• No ET violations
• **Instrumentation**	• Nominal performance
• **MPS**	• Nominal performance
• **ET Hazardous Gas**	• No ET violations
• **TPS**	• All observations acceptable per NSTS 08303
• **ET Disposal**	• Nominal

Prior Mission Performance Summary

STS-112/ET-115, 10/07/2002 - Launch

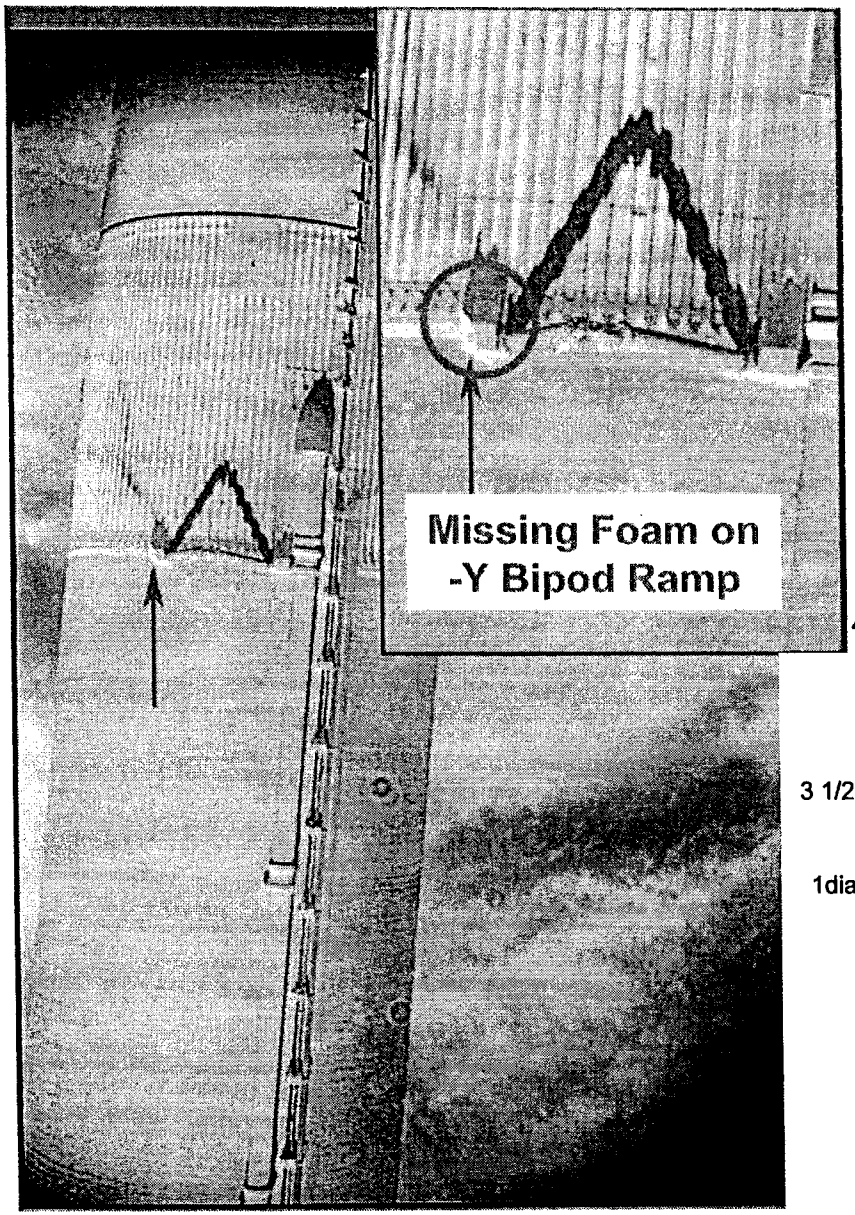
System	***Performance***
• **ET Observation Camera**	• Camera system provided a view of the STS-112 liftoff and transmitted video throughout the flight • Image was obscured at SRB separation for remainder of ET flight
• **Post Launch Film Review**	• No ET issues identified
• **Orbiter Tile Damage**	• Total lower surface hits in-family of vented Intertanks – Diameter > 1“ 22 • Total 81 • Total lower surface hits fwd of main landing gear exceeds upper control limit for vented Intertanks
• **Post Launch Film Review**	• See subsequent charts

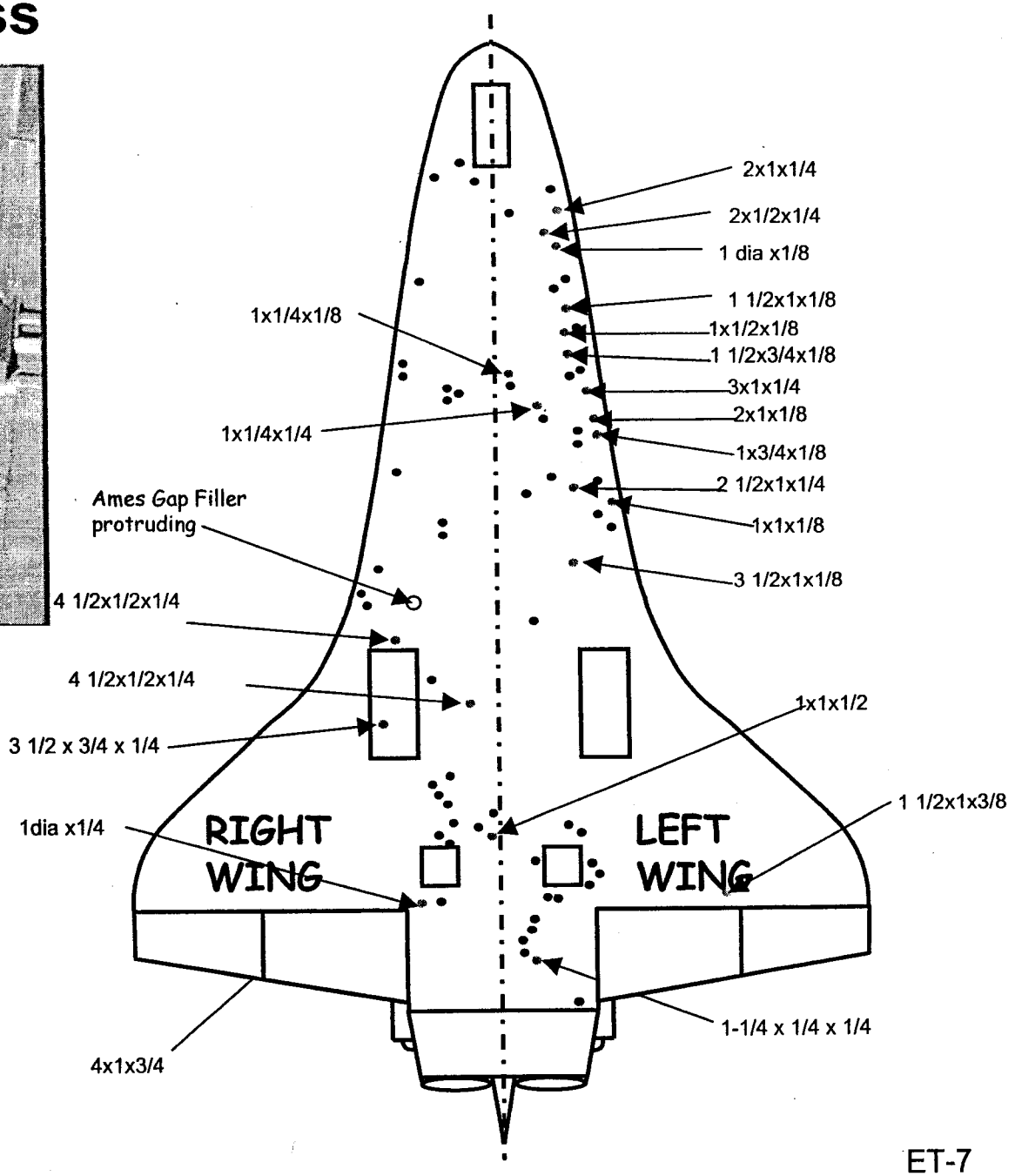
STS-112/ET-115 Foam Loss

Issue

- Post separation photos showed several areas of foam loss
  - Small areas in -Y thrust panel 'non-vented' foam
    - Size and extent of the 'white marks' could not be determined due to the view angle
    - Debris transport analysis showed that foam from this area would not impact the Orbiter
  - Three divots in the Intertank / LH2 tank flange area and missing foam (≈4" x 5" x 12") on –Y bipod ramp exposing bipod housing SLA closeout
  - Tile damage on left wing of Orbiter increased for STS-112
    - BNA debris transport analysis- I/W
  - In-Flight Anomaly candidates to be presented to SSP PRCB today, 10/24/2002
    - Intercenter Photo Review Working Group recommending bipod ramp foam loss as IFA

STS-112/ET-115 Foam Loss





STS-112/ET-115 Foam Loss

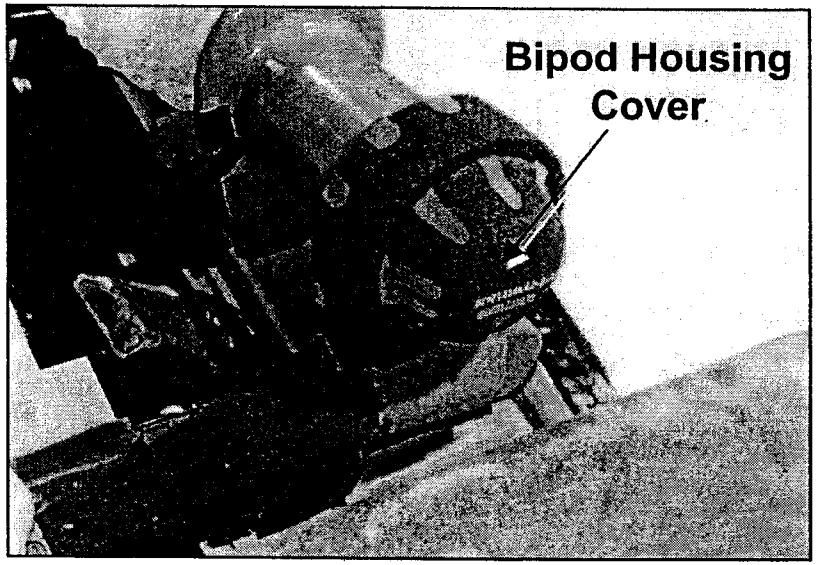
Discussion

- Review of failure history showed 2 prior occurrences of bipod foam loss (STS-32R/ ET-32 and STS-50/ET-50)
  - Cause of previous failures attributed to subsurface void(s) in two-tone foam acreage with Isochem layer between CPR-488 and BX-250
  - Acreage configuration changed at ET-51 to enhance spray processing (two-gun spray) to eliminate voids in foam
- Review of ET-115 build paper showed no out of family processing
  - Nominal material characteristics and foam application parameters
- Review of KSC processing paper (pre and post Orbiter mate) showed no anomalies
- Walk down inspections at KSC (pre cryo load and prelaunch) showed no anomalies

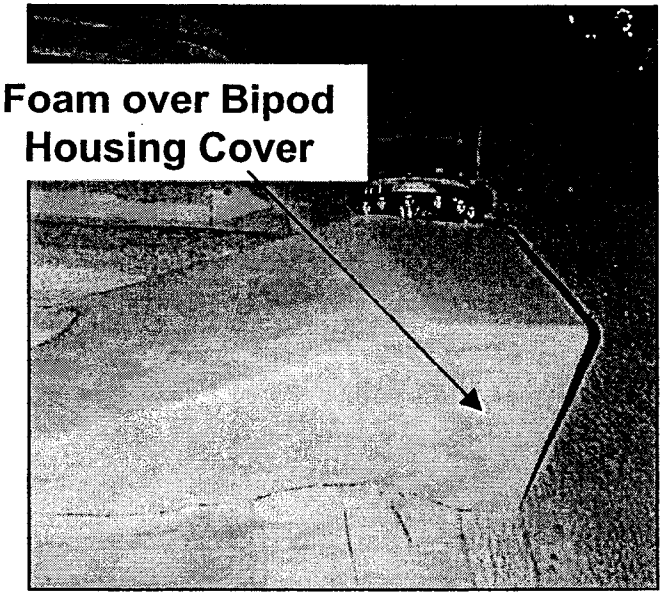
STS-112/ET-115 Foam Loss

Discussion

- Complex closeout geometry and ergonomics could allow air entrapment in closeout
  - Foam is manually sprayed first on the bipod fitting and then sprayed forward to make up the ramp
    - Foam is trimmed and machined to final drawing requirements
  - Review of environments at or prior to 33 sec in flight (Mach 0.6 to 0.8) showed sufficient ΔP to induce outgassing in the presence of a subsurface void in the foam



Bipod Attach Fitting (Prior to Foam Closeout)



Bipod Attach Fitting (After Final Machining)

STS-112/ET-115 Foam Loss

Rationale for Flight

- Most probable cause of foam loss is suspect subsurface void(s) during bipod ramp closeout coupled with launch environments
  - ET-115 is first observed bipod ramp foam loss since ET-50 (61 ETs/122 ramps)

- Foam required during prelaunch to preclude ice/frost formation
  - Prelaunch inspections would reveal any concern for ice/frost formation
  - Analysis shows that remaining SLA is sufficient to protect bipod attachments from overheating

- No significant increase in Orbiter tile damage depth (0.25" max.)
  - Not safety of flight concern

Mission/External Tank Highlights

STS-113/ET-116

Mission	***STS-113***
Launch	***11/10/2002 (NET)***
• Window	TBA
• Pad	39-A
• Orbiter	Endeavour (OV-105, nineteenth flight)
• Orbital Inclination	51.6 degrees/122 nautical miles
• ET Photo Coverage	• Crew photos from cockpit window • Umbilical well cameras
Mission Objectives	• International Space Station (ISS) 16th flight (11A) – Crew rotation – Delivery of the first port truss segment (to be attached to the central truss segment) – Delivery of Crew and Equipment Translation Aid (CETA) Cart B (to be used by space walkers to move along the truss segment)
Landing	***11/20/2002***
External Tank	***ET-116***
DD250 Acceptance	11/28/2001
Shipped to Launch Site	01/31/2002

116PFR.4250.10/2002

Agenda

Overview

Prior Mission Performance Summary

Mission/External Tank Highlights

➡ ***Mass Properties Status*** ***Rick Spring***

Change / Senior Management Review Item

- *LO2 Feedline Repair Using BX-265 Foam (B02070)*

Special Topic

- *Undersized Intertank Stringers*

SRM&QA Assessment

KSC Processing

Verification/Certification

Mission Unique Assessment

Readiness Statements

Appendices

Mass Properties Status

STS-113/ET-116

ET-116 Weighing

- ET-116 was weighed at MAF on November 26, 2001 using the Weigh Tronix weighing system
  - Predicted Weight 58,391 lbs.
  - As-weighed 58,452 lbs.
  - Delta to Predicted + 61 lbs.

Mission Planning

- MMC-ET-SE40, ET Project - Mass Properties Weight and Balance Report, was submitted November 27, 2001 to support mission planning
- Coordination with Level II on October 10, 2002 indicates approximately 583 lbs. performance margin for STS-113

Agenda

Overview

Prior Mission Performance Summary

Mission/External Tank Highlights

Mass Properties Status

Change / Senior Management Review Item ***Philip Kopfinger***

- ***LO2 Feedline Repair Using BX-265 Foam (B02070)***

Special Topic

- *Undersized Intertank Stringers*

SRM&QA Assessment

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Readiness Statements

Appendices

ET-116 LO2 Feedline Repair Using BX-265 Foam

Issue

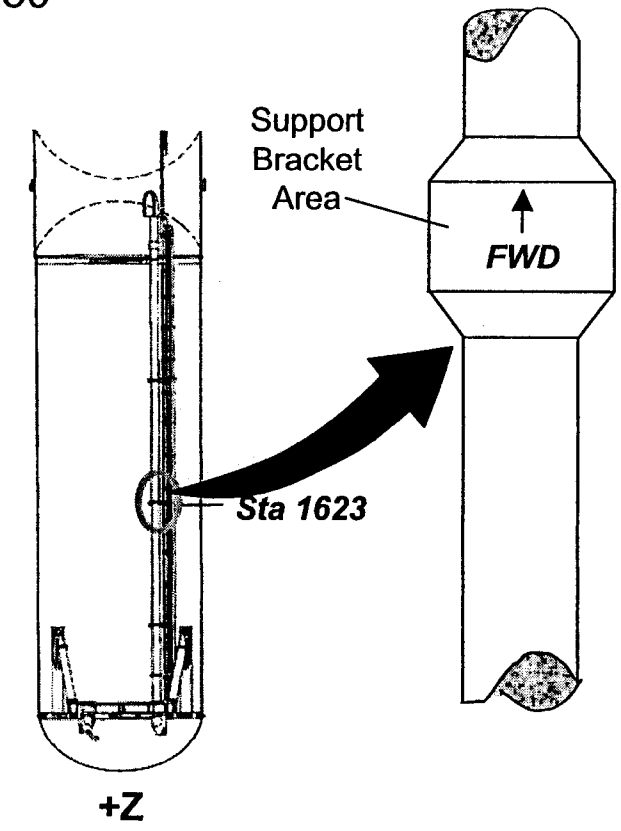
- Repair performed on LO2 feedline foam insulation (BX-250) at Sta. 1623
  - Repair required based on foam insulation bond-adhesion (plug-pull) test evaluation

Background

- All LO2 feedlines using BX-250 material required plug-pull test evaluation based on investigation results of debonded material identified during production at MAF
  - Cause was isolated to unique production processing of the support bracket regions of LO2 feedline sections with BX-250

Actions Taken

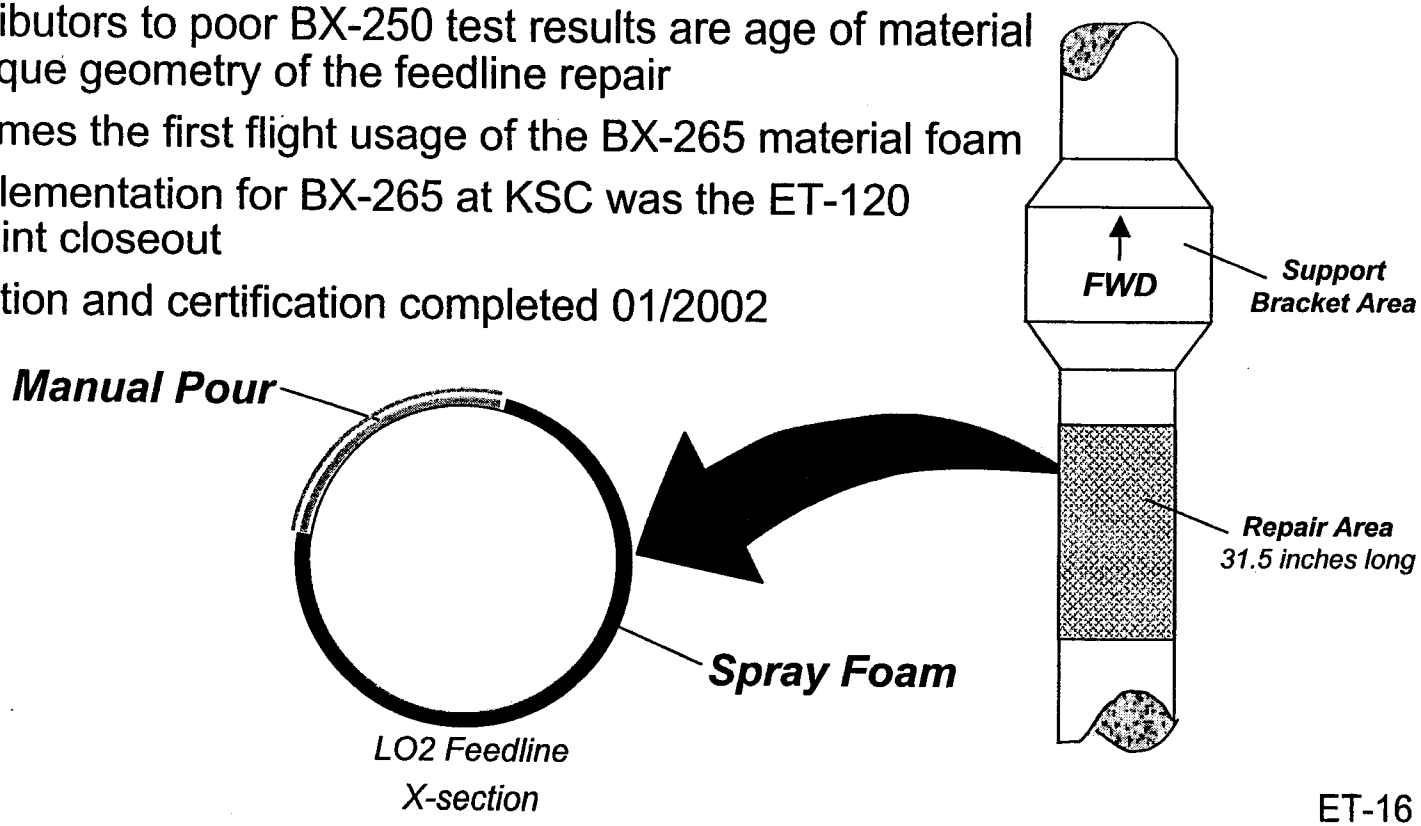
- Performed plug-pulls on ET-116 feedline sections
  - Plug pulls at 3 of 4 stations were acceptable
    - Lowest value of 13.9 psi (35 psi required) at Station 1129 accepted based on analytical assessment and past flight performance
    - Lower strengths previously accepted (12.6 psi min) and flown for locations on ET-112 and ET-113 with no issues
  - Plug pulls at Sta. 1623 indicated a foam debond and required repair
    - Fifteen plug pulls performed to ascertain foam integrity
      - Values range from 0 to 72.1 psi



ET-116 LO2 Feedline Repair Using BX-265 Foam

Discussion

- Inspection resulted in the decision to remove foam and repair (approx 31.5" long and 360° around the line)
- Repair required 2 step closeout
  - Manual pour on back side of line (near tank)
  - Foam spray application on outboard side of line
- Decision made to repair debonded area with current production material (BX-265) due to inconsistent results for repair attempts using BX-250
  - Suspected contributors to poor BX-250 test results are age of material coupled with unique geometry of the feedline repair
  - This repair becomes the first flight usage of the BX-265 material foam
    - Planned implementation for BX-265 at KSC was the ET-120 third hard point closeout
      - Qualification and certification completed 01/2002



ET-116 LO2 Feedline Repair Using BX-265 Foam

Basis for Certification for BX-265 Material – Test and Similarity

- Liquid Properties
  - Chemical composition, viscosity, specific gravity, reactivity and instrumental fingerprinting
- As-Sprayed Material
  - Physical properties
    - Density, flammability, thermal conductivity, specific heat, coefficient of thermal expansion (CTE) and Poisson's ratio
  - Mechanical properties
    - Tensile, compressive, and shear strength
    - Combined tension and flexure @ cryogenic temperature (cryoflex)
- Lot to lot variation of physical, mechanical and liquid properties
  - Four lots evaluated

ET-116 LO2 Feedline Repair Using BX-265 Foam

Basis for Certification for BX-265 Material – Test and Similarity (continued)

- Multiple Environment Testing
  - Aero thermal – Ascent / entry
    - Recession data
  - Thermal vacuum
    - Recession data
    - Debris "popcorning" assessment
  - Thermal acoustic
    - Recession data
  - PAL ramp – Cryogenic strain (flexure)
  - Wide panels – Cryogenic strain
- Production Verification
  - Cell validation
  - Production validation – Full scale

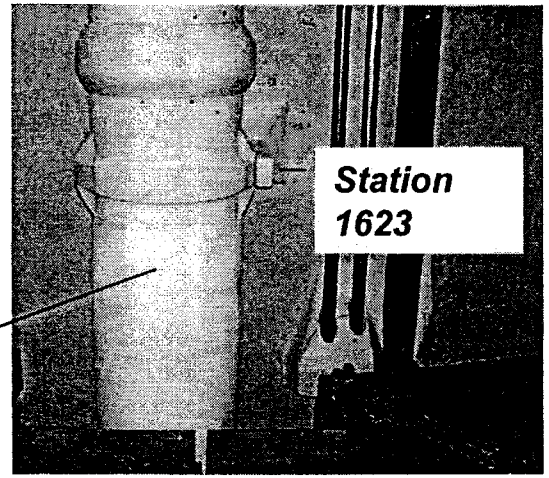
BX-250 vs BX-265 Development / Qualification Material Properties Comparison / Results

- Acceptance Material Properties Comparison
  - Mechanical properties for BX-265 similar to BX-250 (and much greater than requirements)
  - Thermal conductivity equivalent
  - Recession response of replacement foam (BX-265) equivalent to previous BX-250 foam
- All Test Results Were Acceptable

ET-116 LO2 Feedline Repair Using BX-265 Foam

Basis for Certification for Repaired Feedline Foam

- Demonstrated feedline repair process using simulated repair geometry and orientation during validation activities at MAF
  - Performed 2 engineering development sprays
    - Acceptable plug pull values (35 psi or greater)
  - Performed 2 production manual verification sprays
    - Two consecutive successful sprays
    - All plug pulls had acceptable values
      - Low Value 42.80
      - Average Value 53.98
      - High Value 64.80
- Performed final acceptance plug pulls on ET-116 repaired part
  - Acceptable values (61.9 and 41.2)



Agenda

Overview

Prior Mission Performance Summary: None

Mission/External Tank Highlights

Mass Properties Status

Change / Senior Management Review Item

- *LO2 Feedline Repair Using BX-265 Foam (B02070)*

➡ ***Special Topic*** ***Jeff Pilet***

- ***Undersized Intertank Stringers***

SRM&QA Assessment

KSC Processing

Verification/Certification

Mission Unique Assessment

Readiness Statements

Appendices

Undersized Intertank Stringers

Issue

- Undersized Intertank Al 2090 stringers potentially installed on completed Intertanks and ETs
  - No final stock material thickness verification following complete part processing at Aerochem

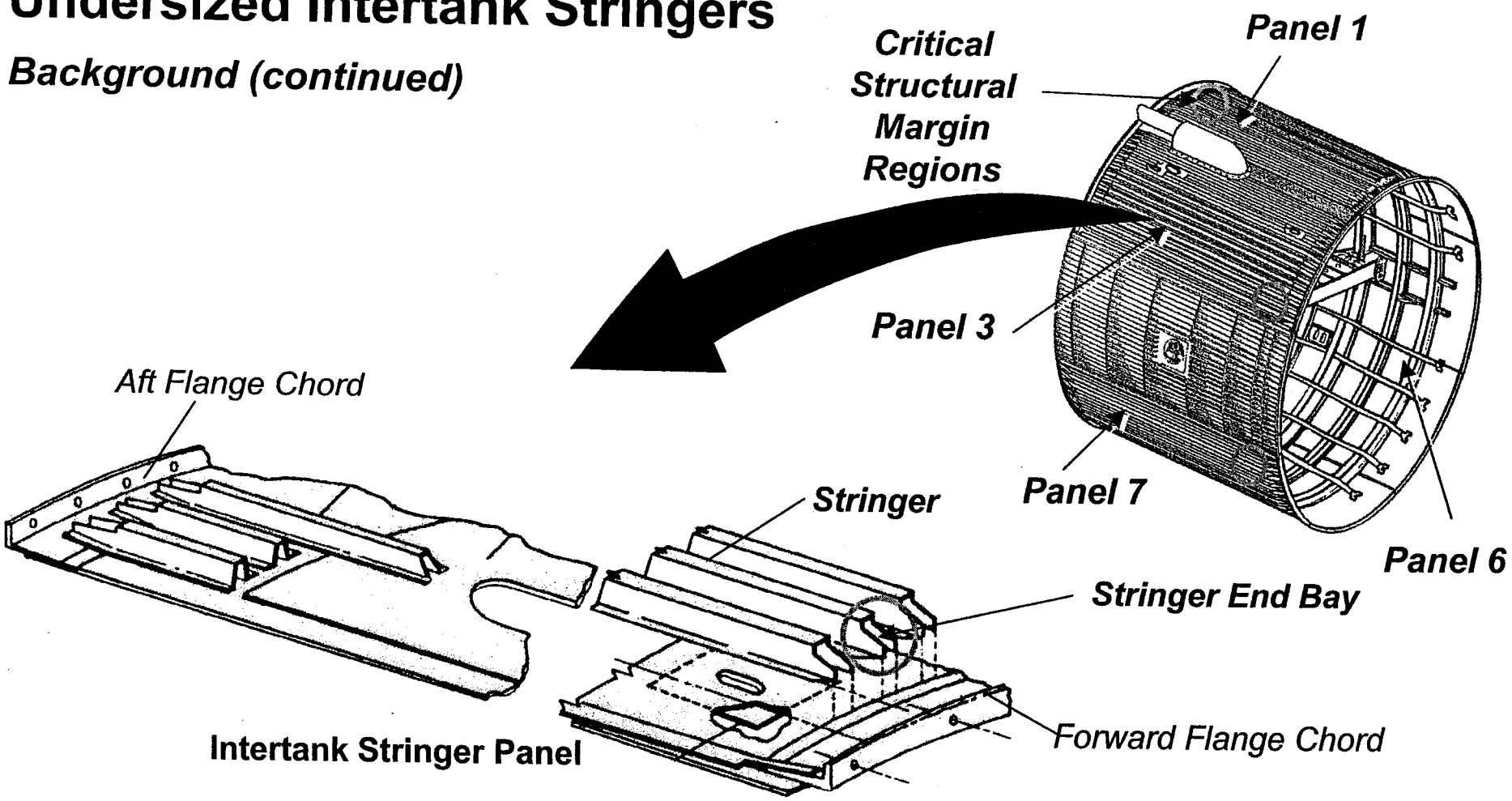
Background

- Stringers in process flow identified at the low end or below minimum thickness tolerance
  - Stock material thickness verification performed at material receipt from Dynamic Metal Forming (DMF)
  - Majority of stringers are locally chem-milled to achieve final part thickness requirements
    - Chem-milled thicknesses are verified after final processing
  - Stringer thicknesses in non-chem milled areas were not re-verified after final processing

- Process investigation performed and shows that the normal processing of non-chem milled stringer regions could remove an additional 0.0028"
  - Subsequent thickness measurements of coil stock shows that raw material (pre-processed parts) meets the receiving inspection requirement (0.061 min.)

Undersized Intertank Stringers

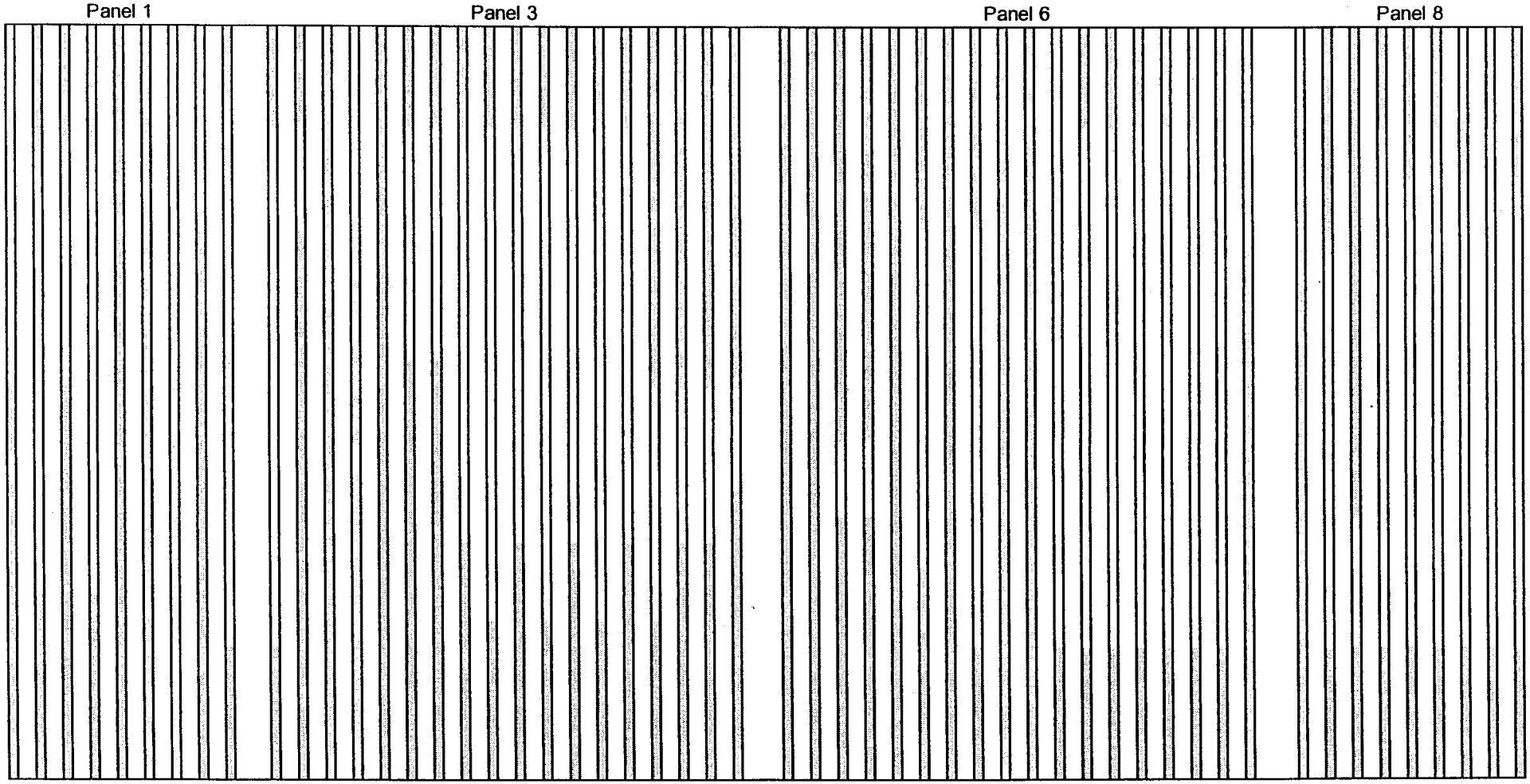
Background (continued)



Stringer (X-Section)

Undersized Intertank Stringers

Background (continued) – Stringer Location Map



Formed stringers that are chem milled

Non-chem milled areas (regions potentially undersized)

Extruded stringers

Undersized Intertank Stringers

Actions Taken

- Initiated thickness verification of all accessible stringers (≈1500 parts)
  - Stringers installed on ETs with end bays exposed and loose parts
  - Performed at least 1 measurement per stringer end

- Performed confidence study to ensure that 2-point (forward and aft) measurement was adequate representation of entire stringer thickness
  - Data showed end measurements adequately correlate with stringer end bay regions

- Statistical analysis used to derive statistical minimum based on actual thickness measurements
  - Assessed 2070 measurements divided into two separate data groups
    - Forward vs aft end measurements
    - Chem milled vs non-chem milled parts

  - Data showed differences in 3σ low values

	Chem milled	*Non-chem milled*
• Forward	0.0566"	0.0559"
• Aft	0.0566"	0.0524"

Undersized Intertank Stringers

Rationale for Flight

Analysis

- Skin/stringer column buckling analysis revised to incorporate reduced stringer thicknesses for two scenarios
  1) Assumed worst case lower bound: 0.053" minimum
  2) Statistically derived 3 sigma low: 0.056" minimum

- Initial analysis using the lower bound thickness showed local areas of negative ultimate stability margins of safety near the cryo 'end bay' regions
  - End bay regions receive additional thermally induced loading resulting from cryo 'cinching' affect near the LH2 and LO2 tanks
  - Low margin areas isolated to aft region of Panel 1 and the forward regions of Panels 2/3 and 6/7

- Revisions were made to the analysis methodology to reduce conservatisms and achieve more realistic structural margins of safety for these regions

Undersized Intertank Stringers

Rationale for Flight

- ***Analysis***
  - Analysis methodology for Panel 1 region was revised to use more representative thermal gradient and thermally induced stresses for critical load conditions
    - Current analysis conservatively uses the following
      - Prelaunch thermal gradient (Temp. = -423°F @ LH2-to-Intertank interface)
      - Ultimate Safety Factor of 1.40 on thermally induced loading
    - Revised analysis now uses the following
      - Thermal gradient consistent with critical High-Q load condition @ t = 63 secs. (Temp. = -360°F @ LH2-to-Intertank interface)
      - Retained Ultimate Safety Factor of 1.40 on thermally induced loading
  - Results of analysis shows adequate structural Factor of Safety for column buckling failure mode for the critical location

Design	***t stringer (in)***	***FS***	***FS required***
• Engineering requirement	0.059 min.	1.55	1.40
• 3σ Low	0.056 min.	1.48	1.40
• Lower bound	0.053 min.	1.41	1.40

Undersized Intertank Stringers

Rationale for Flight

- ***Analysis***
  - Analysis methodology for Panel 2/3 and 6/7 regions was revised to assume the critical stringer is 'ineffective' resulting in load redistribution to adjacent structure
    - Critical stringer locations are adjacent to thrust panels near LO2 tank interface
  - Results of analysis shows adequate structural Factor of Safety for column buckling failure mode

Design	*t stringer (in)*	*FS*	*FS required*
• Engineering requirement	0.059 min	1.54	1.29
• 3σ Low	0.056 min	1.48	1.29
• Lower Bound	0.053 min	1.29	1.29

Undersized Intertank Stringers

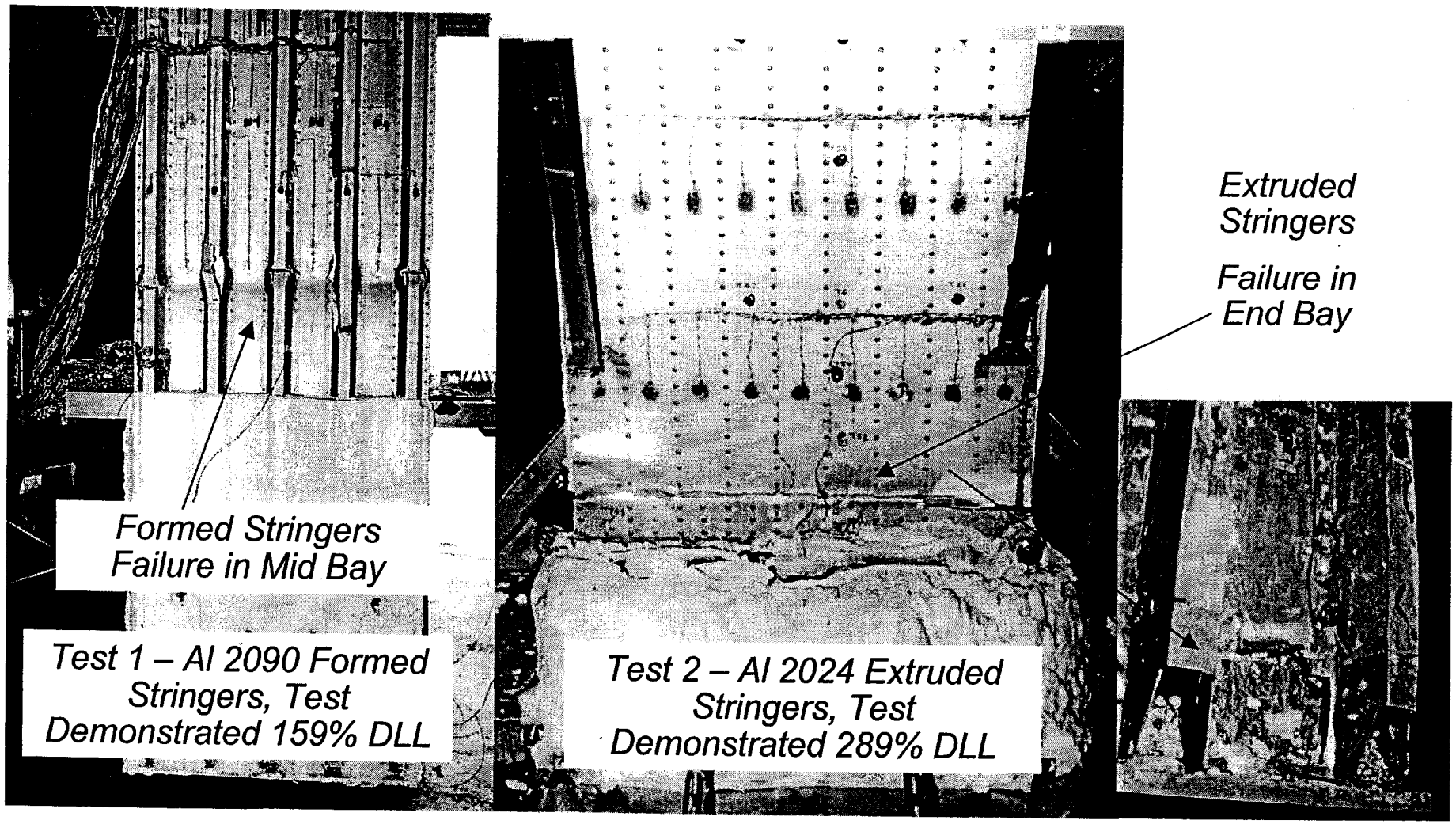
Rationale for Flight

- ***Test***
  - Intertank skin/stringer component structural verification testing was performed during the SLWT development program
    - Two tests performed to capability and demonstrated load levels well beyond design requirements (159% DLL and 289% DLL)
  - Column buckling structural analysis conservatively correlates to structural test performance
    - Test 1 predicted MS @ failure = 0.0 – Mid bay region w/ no cryo cinching affects
    - Test 2 predicted MS @ failure = -0.13 – End bay cryo region
  - Review of strain gage data also shows good correlation of analytically predicted stresses

Undersized Intertank Stringers

Rationale for Flight

- ***Structural Verification Tests***



Undersized Intertank Stringers

Rationale for Flight

- ***Summary***
  - Column buckling analysis methodology correlates conservatively with structural test results
  - Revised analysis methodology shows positive ultimate margins of safety using conservative lower bound stringer thickness values
  - Corrective action development in work, ECD 11/04/2002

Agenda

Overview

Prior Mission Performance Summary: None

Mission/External Tank Highlights

Mass Properties Status

Change / Senior Management Review Item

- *LO2 Feedline Repair Using BX-265 Foam (B02070)*

Special Topic

- *Undersized Intertank Stringers*

➡ ***SRM&QA Assessment*** ***Terry McKeough***

KSC Processing

Verification/Certification

Mission Unique Assessment

Readiness Statements

Appendices

SRM&QA Assessment

as of 10/23/2002

Item	***Status***
• ***ALERTS***	None
• ***MRB Assessment***	Complete - No issues/no impact to hazard controls
• ***Hazard Assessment***	Complete - All hazard reports were re-assessed and hazard controls verified
• ***CIL Retention Rationale***	Complete - No issues/no impact to CIL retention rationale
• ***Corrective Action Problem Summary (CAPS)***	
• P-097, GO2 vent/relief valve ATP leak test failure	Delivered ETs cleared – Valves successfully passed ATP

Agenda

Overview

Prior Mission Performance Summary: None

Mission/External Tank Highlights

Mass Properties Status

Change / Senior Management Review Item

- *LO2 Feedline Repair Using BX-265 Foam (B02070)*

Special Topic

- *Undersized Intertank Stringers*

SRM&QA Assessment

➡ ***KSC Processing*** ***Brian Knipfing***

Verification/Certification

Mission Unique Assessment

Readiness Statements

Appendices

KSC Processing

as of 10/23/2002

Discrepancy Reports (DRs)/Problem Reports (PRs) Review

- PR/MRB discrepancies/dispositions similar to previously flown vehicles
  - All KSC/MRBs have been reviewed by MAF Reliability for potential SMR
  - The LO2 Feedline Foam Repair was elevated to SMR *(Previously presented)*

Limited Life Component/ET Status

- All within required life through scheduled launch date plus 90 days

OMRSD Exceptions/Waivers

- Helium Inject Flow Rate (WK10284 and EK10285)

OMRS Exception / Waiver – Helium Inject Flow Rate

File IV Waiver (WK10284) and File II Exception (EK10285)

Problem Description

- During Pad Validation testing both the primary and secondary helium bubbling differential pressure transducers were indicating less than 1.0 psid
  - OMRS File IV requirement: 1.0 to 1.9 psid on either transducer
  - Actual readings: Primary = 0.97 psid; Secondary = 0.99 psid

Rationale for Acceptance

- The 1.0 to 1.9 psid differential pressure range corresponds to the ICD flowrate range of 0.54 to 0.84 lbs/minute
  - Flowrate testing at MAF indicated 56 SCFM or 0.58 lbs/minute
- Analysis indicates that depending on the Helium supply conditions differential pressures less than 1.0 psid can still occur with the minimum acceptable helium flow rate
- A table of acceptable differential pressures versus Helium supply conditions is in work to be used on DOL to determine minimum pressure limit

Status

- Pending Level II approval, ECD 10/28/2002

OMRS Exception / Waiver – Helium Inject Flow Rate

File IV Waiver (WK10284) and File II Exception (EK10285)

Problem Description

- During Pad Validation testing both the primary and secondary helium bubbling differential pressure transducers were indicating less than 1.0 psid
  - OMRS File IV requirement: 1.0 to 1.9 psid on either transducer
  - Actual readings: Primary = 0.97 psid; Secondary = 0.99 psid

Rationale for Acceptance

- The 1.0 to 1.9 psid differential pressure range corresponds to the ICD flowrate range of 0.54 to 0.84 lbs/minute
  - Flowrate testing at MAF indicated 56 SCFM or 0.58 lbs/minute
- Analysis using worst case supply conditions of 700 psig helium at 90 deg F indicated that a minimum delta pressure of 0.94 psid is acceptable for ET-116 to protect the ICD minimum flowrate value of 0.54 lbs/minute
- The loading software procedure workarounds for the 0.94 psid minimum value have been successfully tested against the LPS Simulation Math Model

Status

- Pending Level II approval, ECD 10/25/2002

KSC Processing

as of 10/23/2002

Changes	***STS-113/ET-116***
• Mod Kits	0
• DC&R	0
• Bldg 45	0
• FEC	1
- Implement new GUCA GH2 vent QD	KET-0084 *
• OMRSD	0
• LCC	0
• Facility	2
- Pad A ET Bipod Heater Voltage Regulator **	
- MLP-2 ET GH2 Prepress Flowrate Increase	
• Software	0
SIM Launch (S0044)	***10/15/2002***
SIM Load (S0056)	***10/28/2002***

* Previously implemented on STS-108 (12/05/01)

** Previously presented at STS-111 but not implemented

Agenda

Overview

Prior Mission Performance Summary: None

Mission/External Tank Highlights

Mass Properties Status

Change / Senior Management Review Item

- *LO2 Feedline Repair Using BX-265 Foam (B02070)*

Special Topic

- *Undersized Intertank Stringers*

SRM&QA Assessment

KSC Processing

➡ ***Verification/Certification*** ***Jim Feeley***

Mission Unique Assessment

Readiness Statements

Appendices

Verification/Certification

as of 10/23/2002

Item	**Status**
NSTS 07700, Volume X, Book 1, Baseline	**Complete - No issues**
• Revision M, Change 285	
Certification Documentation	
• Certificates of Qualification (COQ)	**No new items**
• Hardware Certification Sheets (HCS)	**Complete - No issues**
◦ T504Y, Validation / Implementation of BX-265 (B02070)	
Deviations/Waivers	**No new items**

Mission Unique Assessment

as of 10/23/2002

Item	***STS-113/ET-116***
STS-113 Liftoff Loads Environments • *Apparent* LH2 tank proof test load indicator exceedance during the STS-113 Flight Margin Assessment - Load indicators revised to reflect design loads	No issues - Predicted loads are within design load limits
Review of MRB actions using updated loads • New loads or environments requiring assessment	No items identified
MPS Preflight Prediction Package	ECD 10/25/2002

Readiness Statement

The External Tank, ET-116, is certified and ready for STS-113 flight pending completion/closure of open and planned work

Appendices

A: Minor Changes

B: SRM&QA Assessment

- NCD Assessment Criteria

C: KSC Processing

- PR/MRB Summaries
- Modification Status
- Limited Life Component Status
- OMRSD Exceptions / Waivers
- Software Changes: None
- Facility Modifications: None

D: Level II Waivers

Change Presentation Criteria

- Changes for Presentation
  - Type I Documentation
  - Requirements
  - Configuration (affects part interchangeability)
  - Materials (requires SE16 revision)
  - Technical Changes to Processes (STPs)
- Changes for inclusion in Appendix
  - Minor configuration (affects part interchangeability)
  - Minor updates - Does not affect part interchangeability, materials or processes
    - Revise point of incorporation
    - Drawing clarification
    - Non-flight hardware installation/removal
    - Datum changes
    - Update usage/List of Materials
    - Drawing incorporation errors
    - Manufacturing aid
    - Drawing errors
    - Fastener type/grip
    - Producibility enhancement
    - Update supplier list
    - Laboratory test procedures
    - Materials
- All Class I and Class II changes have been reviewed by the MSFC Resident Office
- All Class II STP/STM/Standard/Code sheet changes have been submitted to the MSFC Materials, Processes and Manufacturing Department for concurrence

Minor Changes – STD/STM/STP/AVL

Change No.	Document	Description
H35809-814	Structure	Producibility enhancement – Revised LO2 barrel panel and assembly drawings to clarify use of scribe lines. Scribe lines are to be used in aligning the welded assembly as well as orientation during assembly. The scribe lines were revised to extend the full width of the weld land.
H36809-056	Structure	Producibility enhancement – Revised LO2 forward ogive gore panel drawings to clarify flag notes used for control of machined steps for tapering and and relax tolerances on material thickness over a specified percentage of area. Notes deleted from field of drawing and replaced by general notes to clarify engineering requirements. *This change was for ET-117 and subs. ET-117 LO2 tank forward and aft ogive and barrel assembly were reallocated to ET-116 (POD 3600-2432/2433/2435)*
H36809-130	Structure	Drawing Error - Correct location of dimension extension line that was inadvertently moved on the current revision of the machined panel drawing. Location of extension was correct on previous revision and on the supplier's NC machining tape.
H36809-196	Prop/Mech	A tool number replaced part number for Hydrogen Vent Disconnect's Protective Cap (RG42690-4). The Test Specs for the H2 Vent Disconnect, ET Section was revised to reflect this change.

Minor Changes – STD/STM/STP/AVL

Change No.	Document	Description
H36809-223	Prop/Mech	Vendor requested to revise the Hydrogen Vent Disconnect, ET side drawing to represent the as cast dimensions. No change to the final machined part.
H36809-234	Prop/Mech	Protective Plug NAS815-2A which was used on the Hydrogen Vent Disconnect, ET side was no longer available, it was replaced by a new similar Protective Plug PD-20.
H36809-538	Structure	Producibility - Added tolerance to the LO2 tank proof test drawing vent time to reduce NCDs.
H36809-628	TPS	Incorporation error - Revised Aft Interface pressurization line guide rail support drawing to add two notes that were inadvertently deleted by a previous change. Notes dealt with ablator thickness acceptance at part corners and material application type. No hardware affected
H36809-645	TPS	Incorporation error - Revised pressurization line barry mount SLA application drawing to correct sheet one revision status for respective draw sheet. Sheet one revision status was changed with no affected changes to draw sheet. No hardware affected

Minor Changes – STD/STM/STP/AVL

Change No.	Document	Description
H36809-673	TPS	Drawing error - Revised Intertank Sta. 1082 pressurization line / cable tray support bracket foam closeout drawing to add an overlap foam coverage requirement rather than a common mismatch requirement. Mismatch requirement could expose substrate if a tolerance stack occurred. No such exposure occurred on hardware.
H36809-719	TPS	Drawing error - Revised aft Interface GO2 Press line/LO2 Umbilical Cable Tray Interface clearance from 0.02 inches to 0.06 inches. Also, revised remaining TPS thickness allowed on inboard side of cable tray from 0.80" min to 0.70" min. Precludes potential foam interference (as noted on ET-110)
H36809-737	TPS	Producibility Enhancement – Revised LH2 tank ice/frost ramp drawing to allow migrated foam from between the bladder mold and acreage foam to remain as long as this migrated foam meets the in-process finished product acceptance criteria and excess migrated foam has been removed to level off acreage foam rind nodules. Shore "A" testing of migrated foam is not required.
H36809-742	TPS	Manufacturing Aid - Revised acceptance manual to allow for Shore "A" hardness test on foam repairs after a 2 hour cure instead of the 24 hour cure specified for normal processing

NCD Assessment Criteria

Assessment of all MRB Items

- Adequacy of technical dispositions
- Completeness of required repair/retest
- First time occurrences/SMR
- Verification of margin of safety assessment/documented
- Review of impact to hazards
- Engineering review for impact to loads
- Engineering review for reduced extrusion to plate weld allowables

ET-116 DR/PR/OMRSD Waiver/Exceptions

as of 10/23/2002

System	Discrepancy	Problem	MRB Items	Exceptions/ Waivers
• Electrical	0	0	0	0
• Propulsion/ Pneumatics	0	1	1	0
• Structures	3	3	0	0
• Thermal (TPS)	0	6	3	0
Total	3	10	4	0

ET-116 PR/MRBs

as of 10/23/2002

PR No./Status	Title/Description	Disposition
ET-116-TS-0001	Suspect BX-250 foam application on LO2 feedline (*Presented as SMR)*	• MRB approved to accept low plug pull values at Sta 1129 – Adequate bond adhesion is present to ensure that foam is not debonded – FS > 2.0 • MRB approved to repair feedline foam at Sta 1623 using validated BX-265 spray process
ET-116-TS-0004	Voids in forward periphery closeout on -Y aft ET/SRB fairing	MRB approved to use as repaired • Trim to provide processed edges and repair with PDL • Additional bondline will not affect closeout peformance

ET-116 PR/MRBs

as of 10/23/2002

PR No./Status	Title/Description	Disposition
ET-116-TS-0005	Voids in forward periphery closeout on +Y aft ET/SRB fairing	MRB approved to use as repaired • Trim flush with top/bottom of fairing • Repair with PDL • Additional bondline will not affect closeout peformance
ET-116-FP-0001	LH2 umbilical disconnect purge barrier seal tear above GH2 2-inch disconnect	Approved "use-as-is" • Boeing GFP • Seal tear is in middle of seal and seal remains securely bonded • Seal performance is unaffected, undamaged portion of the seal will contain the GN2 purge in this cavity

ET-116 KSC Modification Summary/Status

Item	Title	Status
FEC KET-0084	Implement new GUCA GH2 vent QD	Complete

ET-116 Limited Life Components

Cycle Sensitive

Description	Part No.	Serial No.	Limit	Required	Remaining
LH2 Manhole Cover Assy	80914081488-509	0001044300	14	2	14
LO2 Tank Mechanical Assy	80912002000-509	0001072090	14	2	14
LH2 Tank Mechanical Assy	80914002000-509	0001106200	14	2	14
LO2 Manhole Cover Assy	80911001205-509	0001095240	14	2	14
LO2 Fwd Ogive Cover Plate	80911001207-509	0001076590	14	2	14
LH2 Manhole Cover Assy -Aft	80911001444-509	0001044240	14	2	14
LH2 Tank Cap Closure Siphon	80911001445-502	0001135460	14	2	14

ET-116 Limited Life Components

Age Sensitive

Description	Part No.	Serial No.	Limit	Initiation	Expiration
External Tank	80901010000-509	00000109	6 Yrs	11/28/2001	11/28/2007

Age Sensitive Pyrotechnics - 10 Years Life/Requires Lot Verification Tests After 4 and 7 Years

Description	Part No.	Lot No.	Serial No.	DLAT* / Retest	Expiration
Separator Assy GUCP	PD5000020-059	AAJ	0001380	12/14/2001	12/14/2005
Cartridge Assy	PD5000020-030	AAJ	0001457	12/10/2001	12/10/2005
Cartridge Assy	PD5000020-030	AAJ	0001459	12/10/2001	12/10/2005

** Destructive Lot Acceptance Test*

Facility Modifications

Pad A ET Bipod Heater Voltage Regulator

Description

- Replaced GSE voltage regulators and variacs that provide power to ET Bipod heaters with programmable AC voltage sources that fit into the existing rack, providing higher reliability and quicker response times
- Previously presented for STS-111 (Pad A) and STS-107 (Pad B), parts availability delayed implementation at Pad A
  - STS-112 was first usage at Pad B
  - STS-113 will be first usage at Pad A

Reason for Change

- Previous equipment is obsolete and no longer supported by the original manufacturer
- The existing regulators have shown increasing signs of age by failing to meet the specified voltage recovery time after application of load

Rationale for Acceptance

- Increased reliability and enhanced performance
- System validation is complete

Facility Modifications

MLP-2 ET GH2 Prepress Flowrate Increase

Description of Change

- Replaced MLP-2 0.38 inch GH2 prepress orifice with an 0.42 inch orifice

Reason for Change

- MLP-2 ET GH2 Pre-press flowrate has been consistently low due to 2000 psig GHe supply pressure losses upstream of the S72-0685-2 GH2 prepress panel
  - Pressure losses are the result of a unique piping configuration on MLP-2
- Modification eliminates the need for a customized version of LCC ET-04 GH2 prepress cycle count during terminal count for MLP-2

Rationale for Acceptance

- Flowrate demonstrated during Orbiter/ET VAB integration testing and Pad Validation

Level II Waivers - Baseline

Document / Requirement	Authority	Paragraph	Waiver No.	Effectivity
NSTS 07700, Volume X, Book 1, Space Shuttle Flight and Ground System Specification, Requirements				
Electrical bonding	PRCBD S040732M 09/09/88	3.6.14	378	ETs 23, 27-29, 31 & up
Soldering, circuit boards, and connectors	PRCBD S040732M 09/09/88	3.6.15.1.1	379	ETs 23, 27-29, 31 & up
PD7400106 circuit boards	PRCBD S040732M 09/09/88	3.6.15.2.1	382	ETs 23, 27-29, 31 & up
Pressure transducer circuit boards	PRCBD S040732M 09/09/88	3.6.15.2.1	383	ETs 23, 27-29, 31 & up

Level II Waivers - Baseline

Document / Requirement	Authority	Paragraph	Waiver No.	Effectivity
NSTS 07700, Volume X, Book 1, Space Shuttle Flight and Ground System Specification, Requirements				
Applicability of Space Shuttle Manned Spacecraft Criteria and Standards (NSTS 08080-1)	PRCBD S061451 08/08/00	Table 2.0	683	ET-96 & up
NSTS 07700-10-MVP-01, Shuttle Master Verification Plan - Volume I, General Approach and Guidelines				
Environmental acceptance of ET components	PRCBD S002130H 03/07/89	3.7.1	13	ETs 23, 27-29, 31 & up
SW-E-0002 - Ground Support Equipment General Design Requirements				
Factor of safety applied to yield for feet on ground half of GUCA	PRCBD S087020L 08/17/88	3.4.2.1	21	ETs 23, 27-29, 31 & up