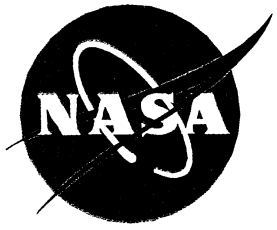
FLIGHT READINESS STATEMENT
STS-107/ET-93
EXTERNAL TANK PROJECT
PRE-FLIGHT REVIEW



EXTERNAL TANK ET-93/STS-107, AS IDENTIFIED IN THE EXTERNAL TANK PROJECT PRE-FLIGHT REVIEW DATED JUNE 21, 2002, IS CONSIDERED READY TO SUPPORT FLIGHT UPON ACCEPTABLE DISPOSITION OF OPEN/PLANNED WORK AND/OR OPEN ACTIONS.

N. E. OTTE/MP31

A. A. McCOOL/MP01

for J. BULLMAN/ED10

for P. K. McCONNAUGHEY/ED20

for P. M. MUNAFO/ED30

S. D. ROSE/ED40

A. C. ADAMS/QS20

6/21/02

J. S. CHAPMAN/TD01

J. W. SMELSER/MP31, CHAIRMAN

June 21, 2002

Space Shuttle
External Tank

Pre-Flight Review

STS-107/ET-93

93PFR.4250.ls.06/02

Agenda

Overview	***Lynn Servay***
Prior Mission Performance Summary	
Current Mission/External Tank Highlights	
ET-93 Mass Properties Status	Rick Spring
Changes	Lynn Servay
SRM&QA Assessment	Terry McKeough
KSC Processing	Scott Otto
Verification/Certification	Lynn Servay
Mission Unique Assessment	
Readiness Statement	

Appendices

- A: Minor Changes
- B: SRM&QA Assessment
- C: KSC Processing
- D: Level II Waivers/Level III Deviations

Overview

ET-93 is the second External Tank in LWT Deferred Build Block

- DD-250 acceptance was in November 2000 following acceptance of ET-111 (STS-108)
- First deferred LWT, ET-92 (STS-99), was delivered in April 1999 and flew in February 2000

This review includes items specific to mission STS-107 and ET-93

- All significant changes to the LWT configuration have been previously flown / presented
  - Significant changes previously flown on SLWT are identified and minor changes are shown in Appendix A
- First LWT to fly with three Block II Engines
  - ET-93 fully certified for increased LH2 prepress pressures
    - Changes to LWT certification presented at ET-92
- ET-93 has no "out-of-family" non-conformances

FRR Series

• ET/SRB Mate Milestone Review	05/06/2002 (A)
• Michoud Operations President's Review	05/14/2002 (A)
• Pre-Flight Review	06/21/2002
• Space Shuttle Vehicle FRR	07/11/2002
• Mission Management Team (L-2 Day)	07/17/2002

Prior Mission Performance Summary

STS-111/ET-113, 05/30/2002 - Launch Scrubbed Due to Weather Violations

System	Performance
• *OMRSD*	• No ET violations
• *LCC*	• No ET violations
• *Instrumentation*	• Nominal performance
• *MPS*	• No ET issues
• *ET Hazardous Gas*	• No ET violations

• *TPS*	• All observations acceptable per NSTS 08303
	  • Typical crack observed in -Y vertical strut closeout
	  • No cracks observed on Intertank stringer panels

Prior Mission Performance Summary

STS-111/ET-113, 06/05/2002 Launch

System	Performance

• ***OMRSD***	• Min. LO2 replenish flow rate requirement violated
	  • Facility flow indication failed
	  • Waiver processed to proceed with operations using other measurements to monitor system

• ***LCC***	• No ET violations
• ***Instrumentation***	• Nominal performance
• ***MPS***	• Nominal performance
• ***ET Hazardous Gas***	• No ET violations
• ***TPS***	• Conditions noted during previous tanking unchanged • Cracks observed in +Y Longeron closeout • MR rationale provided; no impact to countdown
• ***ET Disposal***	• Nominal
• ***Film Review - Post-Launch***	• No ET Issues

• ***Orbiter Tile Damage***	• Lower surface hits forward of main landing gear
	  • STS-111: 20 with 7 > 1" (preliminary)
	  • Average: 29 with 5 > 1"

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Mission/External Tank Highlights

STS-107/ET-93, 07/19/2002

Mission

Launch

- Window
- Pad
- Orbiter
- Orbital Inclination
- ET Photo Coverage

Primary Payload

Landing

- Time
- Location

External Tank

DD250 Acceptance

Shipped to Launch Site

STS-107

07/19/2002

2h 30m

B

Columbia (OV-102)

39° - Insertion at 150 NM

- Crew photos from cockpit window
- Umbilical well cameras

FREESTAR - Fast Reaction Experiments Enabling Science, Technology, Applications & Research

08/04/2002

TBD

KSC

ET-93

11/02/2000

12/14/2000

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ET-93 Mass Properties Status

STS-107/ET-93

ET-93 Weighing

- ET-93 was weighed at MAF on November 2, 2000 using the Weigh Tronix weighing system

– Predicted Weight	65,108 lbs.
– As-weighed	64,940 lbs.
– Delta to Predicted	- 168 lbs.

Mission Planning

- MMC-ET-SE40, ET Project - Mass Properties Weight and Balance Report, was submitted November 2, 2000 to support mission planning
- Coordination with Level II on June 17, 2002 indicates approximately 935 lbs. performance margin for STS-107

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ET-93 Changes

Configuration changes from last LWT (ET-92)

Change	Description	Basis for Certification
ET/SRB Aft Fairing Closeout (B02051)	Added RTV silicone sealant bead to reduce or eliminate foam migration into ET/SRB fairings	Previously flown on SLWT
Machine Foam on Intertank Panels (B02059)	Machined net spray foam on Intertank +Z stringer panels	Similar to configuration flown on SLWT
Intertank Foam Venting at MAF (B02059A/B)	Implemented final LWT Intertank vented foam configuration	Similar to configuration flown on SLWT
Outer Frame Chord Extrusion Allocation (B02022)	Completed the incremental implementation of 2219 Class II extrusions on tank frames	Similarity -Flown at frame 1871 on ET-92 -Fully implemented on SLWT

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SRM&QA Assessment

as of 06/17/2002

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) • **T-068, LO2 Feedline Foam Debond**	***Closed Pending Action*** • ET-93 Cleared – Defect isolated to lines with BX-250 foam. ET-93 sprayed using manual process using different foam (SS1171)

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KSC Processing - Status

as of 06/17/2002

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
  - No items were elevated to the SMR

Limited Life Component/ET Status

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

OMRSD Exceptions/Waivers: None

KSC Processing - Status

as of 06/17/2002

Changes

- ET modifications
  - Mod Kits 0
  - DC&R 0
  - Bldg 45 0
  - FEC 2
  - OMRSD 1
  - LCC 1
- Software 0
- GSE Modifications 1

SIM Launch (S0044) 06/21/02

SIM Load (S0056) 07/09/02

STS-107/ET-93

- Installation of GUCP Inconel Bellows
- Conathane repair of suspect burst discs
- RCN MT15867, Generic GH2 Vent QD Leak Check
- LCN 01095R01, Haz Gas Clean Up
- ET bipod heater voltage regulator

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Verification/Certification

as of 06/19/2002

Item	Status
NSTS 07700, Volume X, Book 1, Baseline • Revision M, Change 283	Complete - No Issues
Certification documentation	
• Hardware Certification Sheets (HCS) - Machine SOFI on +Z Intertank Skin/ Stringer Panels (B02059) • T501L, Acreage Foam (NCFI 24-124)	Complete - No issues
• Certificates of Qualification (COQ)	No new items
Waivers/Deviations	No new items

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STS-107 Mission Unique Assessment

as of 06/19/2002

Category/Item	Status
STS-107 Liftoff Loads Environments • One ET indicator exceeded the defined limit - Assessment shows exceedance is acceptable • ET EIS design FS requirements not violated - Review of MRB actions using updated loads is in work	• Formal letter documenting response is required prior to FRR • ECD 6/28/02
MPS Preflight Prediction Package • Mission specific trajectories provided for STS-107	• Preliminary assessment indicates no issues - ECD 07/09/2002
Debris from BSM during SRB Separation • Boeing identified potential of contaminant (RTV) in BSM impacting ET	• Assessment in work

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Readiness Statement

The External Tank, ET-93, is certified and ready for STS-107 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 Summaries/Status
- Limited Life Component Status
- Alternate Blowing Agent Usage at KSC
- Facility Modifications
- Software Changes: None
- OMRSD Exceptions/Waivers: None
- OMRSD Changes (RCNs)

D: Level II Waivers/Level III Deviations

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

Change	Description	Basis for Certification
Modify SSME Block II Start Transient (B02034)	▪ Replaced LWT proof test requirements document with SLWT requirements document ▪ Deleted weld requirements from drawings and maintain requirements in weld acceptance requirements	▪ No change to requirements - Duplicate documentation eliminated
Intertank Flight Door Installation at MAF (B02049)	▪ Moved final close-out of the Intertank door from KSC to MAF	▪ Similarity - Point of incorporation change - Previously implemented on SLWT
Primer Touch-up on GFE Parts (B02054-001)	▪ Producibility change to allow primer touch-up on GFE Bolt Catcher per STP 3003, not to exceed 3 sq. in	▪ Similarity - Previously implemented on SLWT

Minor Class II Changes - Structural

Change No.	Description
H35809-994	Producibility - Replace VPPA weld process with previously used TIG process for downhand welding on LH2 barrel assemblies.
H36809-081	Drawing Error - Delete references to unused drawings on the Ogive & Barrel Mechanical Assembly drawing. No change in engineering requirements.
H36809-159	Drawing Error - Revised the Intertank Main Frame assembly to show the correct roll tie clip location.
H36809-165	Producibility - Revised LH2 tank proof test requirements with new truss installation • Reduced load cylinder ramp rate from 0.5% per second to 0.25% per second • Increased the actual proof pressure time requirements for the proof test • Decreased Y axis maximum deflections on load cylinders from 10.5" to 10.2" – No change to proof test load; Previously implemented for SLWT
H36809-168	Producibility - Revised Intertank Main Frame assembly drawing to delete holes no longer required since the deletion of CDF.
H36809-194	Drawing Error - Revised LO2 Fwd Ogive Gore assembly to add requirement to chem. film ogive clips after welding and penetrant inspection. Requirement was inadvertently deleted from clip installation drawing during early LWT builds and was reinstated for SLWT.
H36809-230	Producibility - Revised SRB beam assembly to delete doublers, attach hardware and holes no longer required for the Range Safety System.

Minor Class II Changes - Structural

Change No.	Description
H36809-267	Drawing Error - Revised Intertank Main Frame assembly to delete installation of two fasteners not required for this installation. Fasteners are installed on drawing that installs the roll tie.
H36809-310	Producibility - Revised Walking Loads Limitation Document. Cleaned up entire document and eliminated requirements for prior builds. Requirements not changed
H36809-352	Drawing Error - Revised LH2 aft dome assembly to correct clip callout on field of drawing. The correct clip is called out in the parts list.
H36809-785	Drawing Clarification - Revised Weld Acceptance Manual to clarify which welds require 7.5 degree angle x-ray.

Minor Class II Changes - TPS

Change No.	Description
H36809-211	Drawing clarifications to machining of foam within the "Non-automated machine zone" on Intertank Thrust Panel. Similar to changes made on SLWT Thrust Panels.
H36809-236	Drawing incorporation error - revised the off-site third hard point foam closeout to agree with actual trim configuration performed at MAF.
H36809-254	Drawing clarification for LH2 Barrel foam application - revised the graphics for the cryoflex specimen to show a net sprayed foam surface rather than a machined surface.
H36809-317	Drawing errors - revised the Intertank foam machining drawing to reflect the automated machining configuration.
H50001-816	Manufacturing aid - Revised LH2 and LO2 umbilical cable tray component part drawings to add future closeout notations. When allowed by engineering drawing, areas scheduled for TPS closeout at subsequent assembly may be repaired during the scheduled closeout.
J31210-001	Producibility – Revised the "Seal & Blend nose cone installation" drawing to include the use of Al tape barriers to reduce risk of PDL foam migration

Minor Class II Changes – Electrical

Change No.	Description
H35809-950	Revised Intertank Electrical installation of restore/touch-up in primer where electrical components are no longer used. Primer was not applied in area where components were to be mounted.
H50001-807	Producibility - Revised electrical interconnector diagrams to replace 22AWG hard copper conductor with 20AWG soft copper conductor to eliminate difficulty in certifying crimp configurations. Form, fit and function remains unchanged as the two configurations are equivalent and interchangeable.

Minor Class II Changes – Propulsion/Mechanical

Change No.	Description
J31162A-025, -026, -027, -028	Producibility - Revised Intertank tube installation on deferred LWTs to reflect the changes implemented on SLWT. Redeveloped tube bend lengths and updated the harness installation and views.

Class Changes - STPs/STMs/STDs/AVL

Change No.	Document	Description
H36809-796	L1A1 Appendix STML1A1 Polyurethane Foam	Revised material code sheet source appendix, L1A1, to reflect PDL-1034 manufacturing location change. Update material specification, STML1A1, for incoming material inspection test procedures, clarification of shipping requirements, and to reflect latest practices in listed applicable documents.
H36809-302	STP2003 Countersinking & Flush Requirements	Revised specification to add new class of countersinking which will allow the design engineer to specify the diameter and angle of the countersunk hole and the flushness requirement for the installed fastener.
J31125-042	25L31-GROUP 25L32-GROUP	Created new standards and new AVLs for replacement of icebox rivets – 25L31 for solid universal head and 25L32 for 100 degree head. Replacement rivets are the same material and strength but modified to drive in the hard condition.

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-93 DR/PR/OMRSD Waiver/Exceptions

as of 6/18/2002

System	Discrepancy	Problem	MRB Items	Exceptions/ Waivers
• Electrical	0	1	0	0
• Propulsion/ Pneumatics	0	1	0	0
• Structures	0	5	0	0
• Thermal (TPS)	3	4	1	0
Total	3	11	1	0

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ET-93 PR/MRBs

as of 6/18/2002

PR No.	Title/Description	Disposition
ET-93-TS-0005	Voids in AFT/FWD periphery closeout of +Y ET/SRB fairing	MRB approved to rework and repair periphery closeouts

ET-93 KSC Modification Summary/Status

Item	Title	Status
FEC KET-0073R1	Inconel bellows probe on 7" GH2 vent disconnect	Complete
FEC KET-0080	Conathane repair of suspect burst discs	Complete

ET-93 Limited Life Components

Cycle Sensitive

Description	Part No.	Serial No.	Limit	Required	Remaining
LH2 Manhole Cover Assy	80914081488 -019	0000894120	100	2	100
LO2 Tank Mechanical Assy	80912002000 -019	0000935600	100	2	100
LH2 Tank Proof Test	80914002000 -019	0000954040	100	2	100
LO2 Manhole Cover Assy	80911001205 -010	0000908750	100	2	100
LO2 Fwd Ogive Cover Plate	80911001207 -029	0000908780	100	2	100
LH2 Manhole Cover Assy -Aft	80911001444 -010	0000890780 0000908970	100	2	100

ET-93 Limited Life Components

Age Sensitive

Description	Part No.	Serial No.	Limit	Initiation	Expiration
External Tank	80901000000 -289	00000086	6 Yrs	11/2000	11/2006

ET-93 Limited Life Components

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

Description	Part No.	Lot No.	Serial No.	Latest Retest	Expiration
Separator Assy GUCP	PD5000020-059	AAH	0001169	12/18/2001	12/2004
Cartridge Assy	PD5000020-030	AAH	0001355	12/18/2001	12/2004
Cartridge Assy	PD5000020-030	AAH	0001356	12/18/2001	12/2004

OMRS - Generic GH2 Vent QD Leak Check

RCN MT15867

Background

- Eliminate conflict in leak check requirement for use with new design QD and for those flows when a new QD is required as a substitute prior to ET-122
  - GH2 7" vent QD redesigned for ET-122 and subs
  - The new design 7 inch QD is being installed on ET-116 (per FEC KET-0084) due to lack of QD availability
    - New design QD has only two body seals
    - Old (current) design 7 inch QD has three body seals
  - A new design 7 inch QD was previously leak tested and installed for STS-108
    - OMRS exception was processed to only perform the leak of the two body seals

Description of Change

- Revised QD leak check requirements to eliminate part number and quantity of seals to be tested

Rationale

- Successful leak check of vent disconnect

LCC - Haz Gas Clean Up

LCN 01095R01

Change

- Clarified time effectivity callouts (time periods) in the following SSIDs:
  - HAZ-04, ET Intertank Hydrogen Concentration Anomaly
  - HAZ-09, Excessive Hydrogen Concentration at ET Ground Umbilical Anomaly
  - HAZ-11, Excessive Hydrogen Concentration at Eight-Inch Feedline Torque Box Anomaly
- Revised the 17" ET/Orbiter hydrogen disconnect external leakage redline limits and preplanned contingency procedures (PCPs) in HAZ-12, Orbiter/ET Umbilical Hydrogen Concentration Anomaly (Leak Detectors 54/55)
  - Was: <40,000 ppm (4%) redline limit with MMT Chair notification/concurrence to proceed with count at >20,000 ppm
  - Now: 10,000 ppm (1%)

LCC - Haz Gas Clean Up

LCN 01095R01

Background / Reason

- Time effectivity callouts will now be consistent with remainder of Haz Gas LCCs
- Revision to HAZ-12 consistent with KSCs ground safety policy – Requirement of SF> 4
  - Previous limit established during the LH2 leak investigation (1990)
  - PSIG statistical review of LD54/55 data from 102 tankings since implementation of the Haz Gas monitoring system supports the new limit of 10,000 ppm

Rationale for Acceptance

- Presented to / approved at PRCBD (S072380BU) on 05/09/02
- Previously implemented on STS-111

Facility Modifications

Pad B ET Bipod Heater Voltage Regulator

Description

- Replaced GSE voltage regulators and variacs that provide power to the ET bipod heaters with a single programmable AC voltage source that will fit into the existing rack, have a higher reliability and quicker response times

Reason

- 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 specified voltage recovery time after application of a load

Rationale

- Pending validation of new regulators post installation

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 07700-10-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