FLIGHT READINESS STATEMENT
STS-110/ET-114
EXTERNAL TANK PROJECT
PRE-FLIGHT REVIEW

EXTERNAL TANK ET-114/STS-110, AS IDENTIFIED IN THE EXTERNAL TANK PROJECT PRE-FLIGHT REVIEW DATED MARCH 13, 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

for H. V. McCONNAUGHEY/TD60

J. W. SMELSER/MP31, CHAIRMAN

03/13/2002

Space Shuttle
External Tank

Pre-Flight Review

STS-110/ET-114

LOCKHEED MARTIN

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Agenda

- ***Overview*** — ***Dawn Diecidue***
- ***Prior Mission Performance Summary***
  - STS-109/ET-112
- ***Mission/External Tank Highlights***
- ***Mass Properties Status***
- ***Changes:*** *No significant items*
- ***Senior Management Review NCDs:*** *None*
- ***SRM&QA Assessment***
- ***KSC Processing***
- ***Verification/Certification***
- ***Mission Unique Assessment***
- ***Readiness Statements***
- ***Appendices***

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Overview

This review includes:

- Items specific to missions STS-110
- First time differences and "out-of-family" non-conformances on ET-114 that were not previously flown and/or reviewed
  - No significant changes or Senior Management Review NCDs
    - Minor changes included in Appendix A

FRR Series	***STS-110/ET-114***
• ET/SRB Mate Review	01/15/2002
• Michoud Operations President's Review	03/08/2002
• ET Project Pre-Flight Review	03/13/2002
• Space Shuttle Vehicle FRR	03/26/2002
• Pre-launch Mission Management Team Review	04/02/2002

Prior Mission Performance Summary

STS-109/ET-112, 03/01/2002 Launch

System	***Performance***
• ***OMRSD***	• No ET violations
• ***LCC***	• No ET violations
• ***Instrumentation***	• Nominal performance
• ***MPS***	• No ET issues
• ***ET Hazardous Gas***	• No ET violations
• ***TPS***	• No issues
• ***ET Disposal***	• Nominal
• ***Film Review - Post-Launch***	• No significant issues
• ***Orbiter Tile Damage***	• Lower surface hits forward of the MLG

	STS-109	*Average*
• Diameter > 1"	7	5
• Total	34	29

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Mission/External Tank Highlights

STS-110/ET-114

Mission	***STS-110***
Launch	***04/04/2002***
• Window	5:31 p.m. ET (5 minute window)
• Pad	39-B
• Orbiter	Atlantis (OV-104)
• 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) 13th flight (8A) • Integrated Truss Structure (ITS) S0 – The center segment of the 91-meter (300-foot) station truss • Mobile Transporter - Creates a movable base for the station's mechanical arm, allowing it to travel along the station truss after delivery of the Mobile Base System
Landing	***04/15/2002***
External Tank	***ET-114***
DD250 Acceptance	06/18/2001
Shipped to Launch Site	08/30/2001

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Agenda

Overview

Prior Mission Performance Summary

- STS-109/ET-112

Mission/External Tank Highlights

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

Changes: *No significant items*

Senior Management Review NCDs: *None*

SRM&QA Assessment

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Mass Properties Status

STS-110/ET-114

ET-114 Weighing

- ET-114 was weighed at MAF on June 14, 2001 using the Weigh Tronix weighing system

– Predicted Weight	58,350 lbs.
– As-weighed	58,471 lbs.
– Delta to Predicted	+ 121 lbs.

Mission Planning

- MMC-ET-SE40, ET Project - Mass Properties Weight and Balance Report, was submitted June 18, 2001 to support mission planning
- Coordination with Level II on March 5, 2002 indicates approximately 1,576 lbs. performance margin for STS-110

Agenda

Overview

Prior Mission Performance Summary

- STS-109/ET-112

Mission/External Tank Highlights

Mass Properties Status

Changes: *No significant items*

Senior Management Review NCDs: *None*

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

KSC Processing

Verification/Certification

Mission Unique Assessment

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SRM&QA Assessment

as of 03/11/2002

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	ET-114 cleared - Feedline foam meets engineering requirements

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LO2 Feedline Foam Debond (CAPS T-068)

Issue

- Suspect foam debond condition exist on LO2 feedline sections sprayed with BX-250
  - All line sections on ET-114/STS-110 sprayed with BX-250

Background

- During foam closeout of the first straight section of the ET-118 LO2 feedline at MAF, a technician visually noticed a "bump" in the foam approximately 17 in. long and 360° around circumference of the 20 foot line section
- Suspect condition has been isolated to lines with BX-250 foam and to the area at forward end of straight feedline sections near support brackets
  - This area has a thicker initial layer of foam due to the spray start-up process
- No concern for other BX-250 foam applications on the ET due to process differences
- Additional data required establish integrity of feedline foam

Rationale for Flight

- Performed plug pull tests on line sections installed on ET-114
  - Feedline foam meets engineering requirements (35 psi min.)

Station	*Minimum value (psi)*
1129	88.3
1377	68.9
1623	42.5
1871	58.3

Agenda

Overview

Prior Mission Performance Summary

- STS-109/ET-112

Mission/External Tank Highlights

Mass Properties Status

Changes: *No significant items*

Senior Management Review NCDs: *None*

SRM&QA Assessment

➡ ***KSC Processing*** — ***Scott Otto***

Verification/Certification

Mission Unique Assessment

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KSC Processing

as of 03/11/2002

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 03/11/2002

Changes	***STS-110/ET-114***
• ET modifications	
- Mod Kits	0
- DC&R	0
- Bldg 45	0
- FECs *	2
• Conathane repair of suspect burst discs	KET-0078
• Inconel bellows probe on 7" vent disconnect	KET-0083
- OMRSD	0
- LCC	0
- Facility	0
- Software	0

SIM Launch (S0044)	*03/08/2002*
SIM Load (S0056)	*03/21/2002*

* *Previously implemented on STS-109*

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Agenda

Overview

Prior Mission Performance Summary

- STS-109/ET-112

Mission/External Tank Highlights

Mass Properties Status

Changes: *No significant items*

Senior Management Review NCDs: *None*

SRM&QA Assessment

KSC Processing

➡ ***Verification/Certification*** — ***Dawn Diecidue***

Mission Unique Assessment

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Verification/Certification

as of 03/11/2002

Item	**Status**
NSTS 07700, Volume X, Book 1, Baseline	**Complete - No issues**
• Revision M, Change 281	
Certification Documentation	**No new items**
• Certificates of Qualification (COQ)	
• Hardware Certification Sheets (HCS)	
Deviations/Waivers	**No new items**

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Mission Unique Assessment

as of 03/11/2002

	STS-110/ET-114
• Review of MRB actions using updated loads - New loads or environments requiring assessment	None identified
• MPS Preflight Prediction Package	ECD 03/22/2002

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Readiness Statement

The External Tank, ET-114, is certified and ready for STS-110 flight pending completion/closure of open and planned work

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LOCKHEED MARTIN

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: None
- 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

Change	Background / Reason	Basis for Certification
ET-114 and subs, Revised TMO4K-B to add tolerances for 50/500 VDC IR voltage stimulus levels (+/- 5 %) (B02068-001)	Documentation • Inconsistency in documentation – TM01 requires that test stimulus tolerances are included in TMO4k-B • ET has been tested to these +/- 5 % requirements since program start	Similarity
ET-114 and subs, Revised TMO4k-B (B02068-002) • Perform the electrical bonding test made between the GUCP pyro bolt insert to the -Y thrust fitting earlier in the build cycle • Clarify wording of paragraph	• Producibility – Better access to perform the test • Documentation - Prevent misinterpretation of the specific bonding location to be measured	Similarity
ET-114 and subs, Added BX-250 foam to manhole cover and LH2 recirc line assemblies as an alternate foam usage (J31205) • Revise SLA thickness on LH2 recirc line to satisfy environments	• Manufacturing rights for SS-1171 had been sold to another company – Continued use of SS-1171 would require re-qualification of the material • SLWT environments with BX-250 resulted in a potential for SLA debond	Thermal analysis

Minor Changes

Change No.	Discipline	Description	Effectivity
H35809-897A	Structure	Producibility enhancement – Relaxed requirements to allow max stiffener tooling wrinkles of .025 and removal of max of 2 plies by sanding in seal area around the Intertank access door. Allowed contour inspection in restrained condition. Seal performs as required	ET-114 & subs
H35809-944	Structure	Drawing error (CAD data base load) - Corrected fastener location pitch dimension on angle drawing. Supplier matched holes within allowable tolerances on prior builds. No hardware impact	ET-114 & subs
H36809-044	Propulsion	Producibility enhancement - Increase the allowable clocking tolerance on the LH2 feed line internal siphon from +/- 0 degrees 15 minutes to +/- 0 degrees 30 minutes to enable manufacturing to more easily process the installation and avoid NCDs	ET-114 & subs
H36809-122	Structure	Drawing error - Corrected drawing sheet numbers and changed diameter to a reference dimension on the LO2 tank dome cap assembly drawing. No hardware impact	ET-113 & subs
H36809-245	Structure	Drawing error - Added missing dimensions to Intertank panel #3 frame installation drawing. Prior builds used common typical dimensions on all Intertank frame installations	ET-113 & subs
H36809-248	Structure	Producibility enhancement - Delete holes in the inner chord of the Sta 941 frame segment assembly that were previously used for the RSS	ET-113 & subs
H36809-279	Structure	Drawing error - Corrected fastener location Intertank on Main Frame Assembly drawing. Drawing created from LWT drawing and views were translated incorrectly. Fasteners installed correctly per Manufacturing MPP	ET-113 & subs

Minor Changes

Change No.	Discipline	Description	Effectivity
H36809-312	Structure	Producibility enhancement - Deleted countersink diameter from LO2 dome mechanical assembly drawing. Fasteners now meet csk and flushness requirements of STP2003, Class 1. Prior builds met faying surface flushness and gapping requirements	ET-113 & subs
H36809-341	Structure	Producibility enhancement - Revised vibrator mark line to scribe line on forward ogive gore assembly drawing. Vibrator marked lines are too wide and inconsistent, making alignment within .03 difficult. Alignment of parts was achieved on prior builds	ET-113 & subs
H36809-388	Structure	Producibility enhancement - Revise datum on LO2 dome mechanical assembly drawing to facilitate use of the existing tool for fastener locations in all stiffeners common to the chord, regardless of stiffener width. Prior builds were made per this requirement	ET-114 & subs
H36809-403	Structure	Producibility enhancement - Added note to allow lug adjustment up to .200 after welding on the LO2 Tank to achieve required lug spacing per the drawing requirements	ET-113 & subs
H36809-420	Structure	Producibility enhancement - Added note to drawing to allow addition of lines/notations (per STP4501) to the LO2 tank to indicate +Z at the O1, O2 and O5 welds, on the primary weld lands, for placement of NDE location tape to assure that NDE inspection is done in the correct location	ET Project
H36809-423	Structure	Producibility enhancement - Locate start/stop LH2 tank dome body weld zones from a physical weld intersection instead of from a theoretical axis	ET-113 & subs
H36809-435	Structure	Drawing error - Corrected pictorial of hole pattern in frame 2058 segment installation drawing to agree with pattern in sub-assembly drawing where the holes are drilled	ET-114 & subs

Minor Changes

Change No.	Discipline	Description	Effectivity
H36809-583	Structure	Producibility enhancement - Added requirement to install new fastener hardware in the event of bipod to yoke joint disassembly. Eliminated need to perform running and breakaway torque on reassembly	ET-113 & subs
H36809-586	Propulsion	Enhancement - Added note to add primer to bare metal on the GO2 and GH2 press. line support bracket top surface at Sta 1082.	ET-113 & subs
H36809-592	TPS	Producibility – Revise post build acceptance documents to allow exemption from Shore "A" hardness test requirement on inaccessible foam repair surfaces providing all foam rind has been removed	ET-114 & subs
H36809-594	Structure	Producibility enhancement - Added parallelism and flatness requirement to ball fitting tang that interfaces with a tie plate on assembly. This requirement added to assure quality workmanship by the supplier in order to meet shimming requirement on the assembly	ET-114 & subs
H36809-741 H50001-823	Structure	Drawing clarification – Added note to state that flaws (surface defects) should not be considered in surface texture measurements. Flaws should be evaluated independently	ET Project
H36809-742	TPS	Producibility enhancement - Revised post build acceptance criteria document to allow for exceptions to the cure time requirement for hardness testing of PDL repairs. NSRA 4110-02-009 submitted to/approved by MSFC S&E	ET-113 & subs
H50001-807	Electrical	Producibility enhancement - Revise Electrical Interconnection Diagram to reflect the revised length of the cable of the ground measurement harness that mates to the GUCP. Cable routing changed at SLWT	ET-114 & subs

Minor Changes – STD/STM/STP/AVL

Change No.	Document	Description
H36809-701	C30B, MC Collector MCS F417 App	Updated company name and address for supplier of Tape, PTFE Enameled Glass Lacin
H36809-704	C30B, MC Collector MCS J463 App	Updated company name and designation for supplier of Polyimide pressure sensitive tape
H36809-708	C30B, MC Collector MCS 1701 App MCS 1702 App MCS 1703 App	Changed supplier name, with mill locations for supplier of Al Alloy, 2219, 2024 7075 plate and sheet based on verification of heat treat and aging practices
H36809-717	MCS M667 App	Updated procurement information for Adhesive, polyurethane and primer
H36809-726	C30B, MC Collector MCS Y968 App	Updated addresses for suppliers of Purified wiping cloth, cotton
H36809-728	C30B, MC Collector MCS E659 App	Updated company name and address for supplier of Cable, electrical, shielded and unshielded
H36809-729	C30B, MC Collector MCS K370 Add	Clarified material and material test terminology under retests for the Coating & Primer (catalyst)
H36809-730	H693 App	Updated company address and supplier material designation for for supplier of Graphite/Epoxy, Preimpregnated
H36809-736	STP2501	Replaced penetrant sensitivity testing per AMS 2644 with ASTM E 1417

Minor Changes – STD/STM/STP/AVL

Change No.	Document	Description
H36809-738	26L10	Corrected typographical errors made during previous revision; i.e. 1/4 inch oversize fastener diameter was changed from .274/.273 to .276/.274; the second Table II was renumbered to Table III; and several grip lengths in the inital Table II were eliminated because they are not made. No parts were bought to the incorrect revision.
H36809-739	C30B, MC Collector MCS J562 & App	Updated company name in Appendix and correct material designation for supplier of Tape, pressure sensitive poly
H36809-743	AVL 25L1, 25L3, 25L5, 25L6, 25L8, 25L9	Updated company name and added flag note to allow procurement of fasteners made from any manufacturing site and/or approved source representing the supplier (Hi-Shear, SPS Technologies or Fairchild Fasteners)
H36809-744	C30B, MC Collector MCS Y824 App	Updated company address for supplier for Leak test compound, LO2 compatible
H36809-746	32L5	Incorporated minor changes / updates requested by new supplier • Specified material for the identification band in flagnote • Updated specifications for the end fittings to reflect the SAE Standard AS1339 that replaced equivalent Military Standard • Permitted Everlube 620A to be used only on the swivel nut retaining wire • Added dimensions the illustration showing the vibration test set-up
H36809-748	STML1A2	Deleted density free foam test from RAP (Receiving Acceptance Plan) for Polyisocyanurate Foam, 3lb. Material is subsequently tested in actual production application conditions and verified during application to flight hardware

Minor Changes – STD/STM/STP/AVL

Change No.	Document	Description
H36809-750	74L4	Revised LO2 liquid level sensor Standard • Changed thermal shock test temperature from 70±5° to 80±15° • Revised minimum lead wire length from 36 inches to 48 inches to ensure consistent splice. Previous version of the STD provided for a minimum of 36 inch lead wire, some sensors were longer (longer allowed by spec since it only called out a minimum) and easier to splice
H36809-753	C30B, MC Collector MCS J1A1 App MCS Y1A1 App	Updated company addresses for Tape, high temperature sealing and Breather material, polyester and added note to allow procurement from any manufacturing site of the supplier listed
B02069B-025	1012	Revised STP to make the test specimen sectioning more generic to allow more suppliers to qualify as potential sources of Al 2297

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-114 DR/PR/OMRSD Waiver/Exceptions

as of 03/11/2002

System	Discrepancy	Problem	MRB Items	Exceptions/ Waivers
• Electrical	0	0	0	0
• Propulsion/ Pneumatics	0	1	1	0
• Structures	0	8	0	0
• Thermal (TPS)	0	11	1	0
• ET GSE	0	1	1	0
Total	0	21	3	0

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ET-114 PR/MRBs

as of 03/11/2002

PR No./Status	Title/Description	Disposition
ET-114-TS-0003	Low foam on –Y side of LO2 umbilical cable tray • Actual = 0.75" • Requirement = 0.80" min.	MRB approved to use as is • Thermal analysis – Remaining foam thickness provides adequate thermal protection • Subsequent drawing revision for ET-116 and subs reduced foam thickness requirement to 0.60" min.
ET-114-FP-0001	Gouge / nick in GH2 2" disconnect poppet stem	MRB approved to use as is • GFP hardware • Cosmetic defect only –No binding present when poppet is actuated
S78-0220-02-118-0001	Defects on GUCP 7" QD S/N 118 poppet stem • Violates minimum thickness dimensions	MRB approved to use as is • No raised metal – Defects will be blended per standard procedure • Form, fit and function of poppet unaffected

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ET-114 KSC Modification Summary/Status

as of 03/11/2002

Item	Title	Status
• FEC KET-0079	• Conathane repair of suspect burst discs	Complete
• FEC KET-0082	• Inconel bellows probe on 7" GH2 vent disconnect	FEC approved - Pending implementation

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ET-114 Limited Life Components

Cycle Sensitive

Description	Part No.	Serial No.	Limit	Required	Remaining
LH2 Manhole Cover Assy	80914081488-509	00001022950	14	2	14
LO2 Tank Mechanical Assy	80912002000-500	00001022550	14	2	14
LH2 Tank Mechanical Assy	80914002000-509	00001073580	14	2	14
LO2 Manhole Cover Assy	80911001205-509	00001058000	14	2	14
LO2 Fwd Ogive Cover Plate	80911001207-509	0000999260	14	2	14
LH2 Manhole Cover Assy -Aft	80911001444-509	00001022910	14	2	14

ET-114 Limited Life Components

Age Sensitive

Description	Part No.	Serial No.	Limit	Initiation	Expiration
External Tank	80901010000-509	00000107	6 Yrs	06/2001	06/2007

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	AAH	0001179	12/19/2001	12/19/2004
Cartridge Assy	PD5000020-030	AAH	0001316	12/19/2001	12/19/2004
Cartridge Assy	PD5000020-030	AAH	0001317	12/19/2001	12/19/2004

** Destructive Lot Acceptance Test*

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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