NASA

SECTION 4

Need As-Flown ATL

Presenter:
Eric Christiansen

Date:
February 5, 2003

- Need as-flown attitude timeline to complete analysis

- We need the following MSID output from the ODRC:

- V90U2240C
- V90U2241C
- V90U2242C
- V90U2243C
- V90W2310C
- V90U2641C
- V90U2642C
- V90U2643C
- V90U2644C

- For previous as-flown assessments, we used JMEWS to fetch the data in 300 second intervals from Mission Event "A20" (OMS 2 cut/off) throug "D01" (APU activation)

Hypervelocity Impact
Technology Facility
Human Exploration Science
Office SX

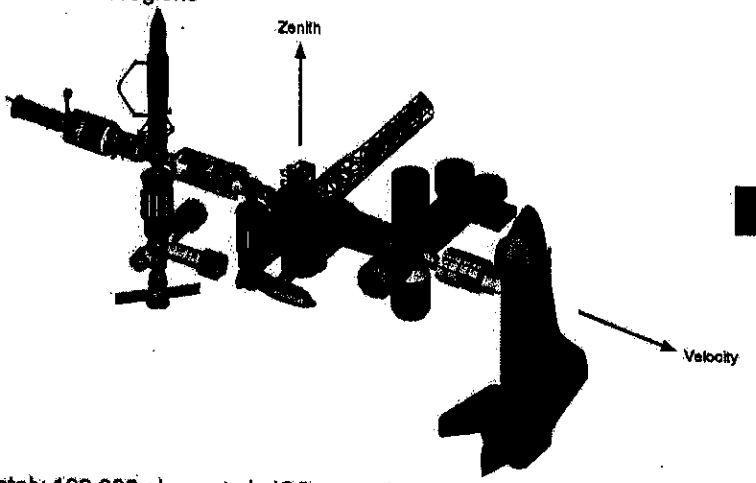
Backup Slides

a facility of the Johnson Space Center

NASA/JSC BUMPER-II Meteoroid/Debris Threat Assessment Code

Spacecraft Configuration (I-DEAS Finite Element Model)

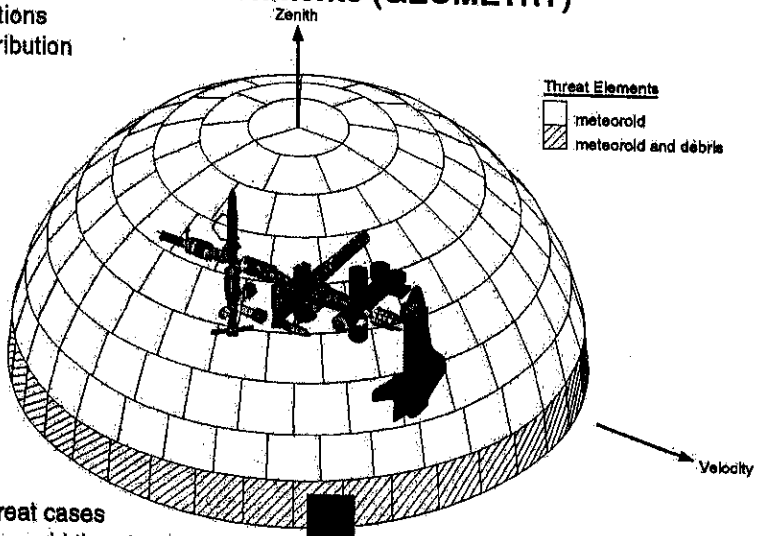
- Describes spatial relationships of spacecraft components
- Defines spacecraft orientation (velocity and zenith directions)
- Defines M/OD shield regions



- Approximately 120,000 elements in ISS assembly complete mated configuration FEM

Meteoroid & Debris Environments (GEOMETRY)

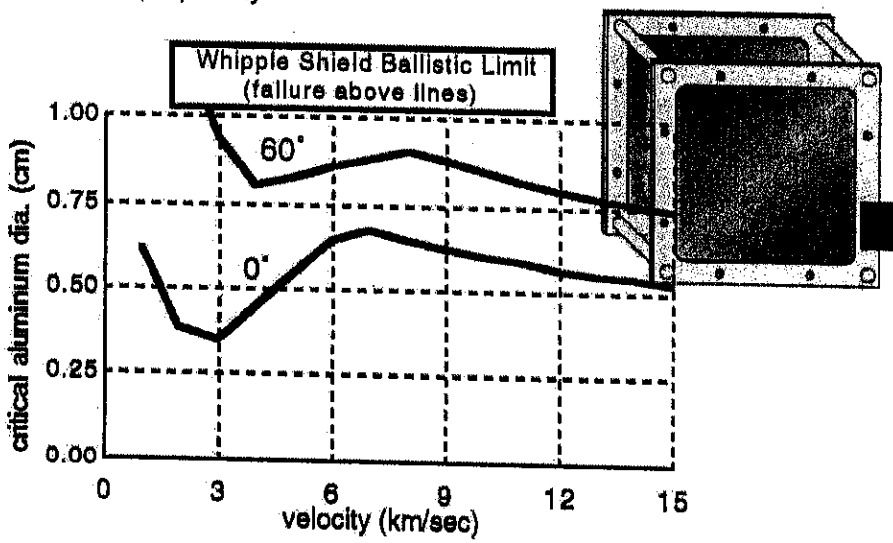
- Threat directions
- Velocity distribution
- Shadowing



- 90 debris threat cases and 149 meteoroid threat cases assessed for each element in the FEM

Critical Particle Diameter Calculation (RESPONSE)

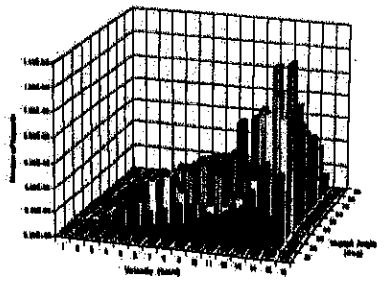
- Protection capability

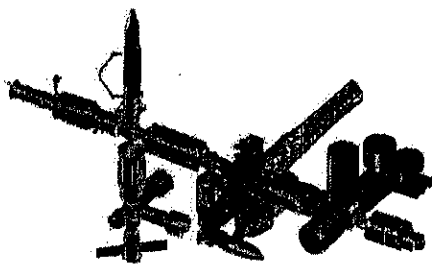


Computation of Penetrating Flux and PNP (SHIELD)
Graphical Interpretation of Results (EXCEL & I-DEAS)

Space Station Orbital Debris Threat Assessment

Station Region	Impact Risk From 1mm Ø Debris: Probability No Impact	Impact Risk From 1mm Ø Debris: Odds of Impact	Debris Penetration Risk: Probability No Penetration	Debris Penetration Risk: Odds of Penetration
FGB	0.995338	1/214	0.996541	1/224
Service Module	0.999335	1/1505	0.999796	1/4912
Node 2	0.999465	1/1105	0.999998	1/825000
Hab Module	0.995074	1/29	0.999923	1/928
Lab Module	0.995522	1/89	0.999022	1/1023
CRV	0.997443	1/391	0.999639	1/2223
TOTALS	0.934622	1/15	0.993132	1/146



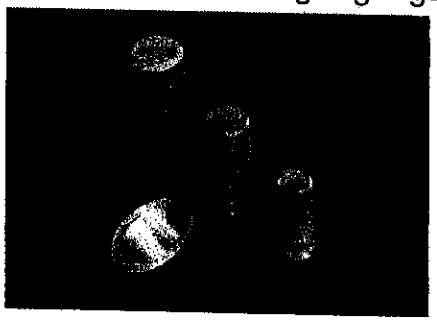


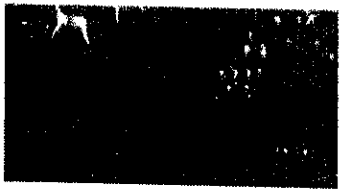
Software Verification

Presenter:
Eric Christiansen

Date:
February 5, 2003

JSC WSTF Two stage light-gas gun.





SWRIs Inhibited Shaped Charge Launcher.

- Testing provides data to develop and verify ballistic limit equations used in BUMPER code
  - Two stage light-gas guns are used to accelerate projectiles to velocities up to 7 km/s
  - Inhibited shaped charge launcher used to accelerate projectiles to velocities in excess of 11 km/s
  - High quality diagnostic equipment
    - high speed laser shadowgraph cameras
    - flash x-ray systems
      - used to verify the projectile's integrity and velocity before and during target impact

Hypervelocity Impact
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Human Exploration Science
Office SX

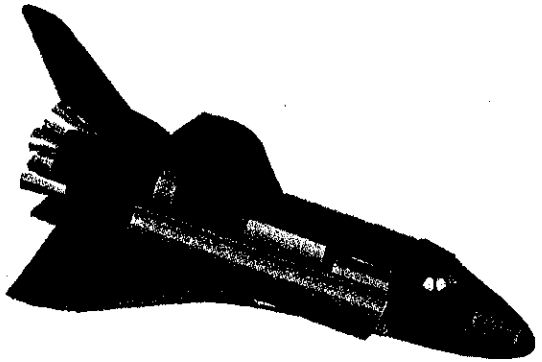
STS-107 Flight Readiness Review METEOROID/ORBITAL DEBRIS ASSESSMENT

18 December 2002

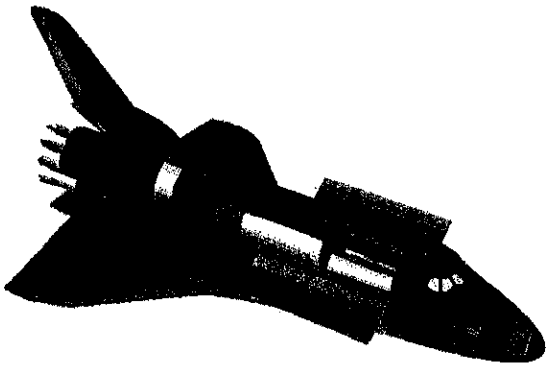
Jim Hyde
Mark Matney

a facility of the Johnson Space Center

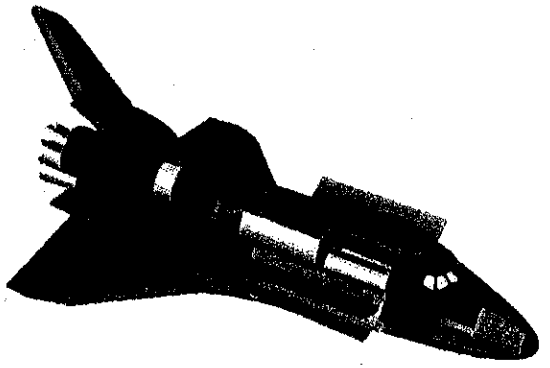
- Launch: January 16, 2003
- 16 Day Attitude Timeline provided by Andrew Lalich/DO4
- 150 Finite Element Model / attitude combinations
- BUMPER-Shuttle code w/ORDEM2000 debris environment model



Both Rads Stowed



Port Rad Deployed



Both Rads Deployed

Collision Avoidance Maneuvers

Presenter:
Eric Christiansen

Date:
February 5, 2003

- Current Satellite Catalogue analyzed to estimate maneuver probability using the 2x14x14 km "yellow" box
- Probability of 1 or more maneuver alerts is 1 in 5.7 (1 in 6 is typical)

Breakups

Presenter:
Eric Christiansen

Date:
February 5, 2003

- **Satellite 19122, 1988-040B**
  - Ariane 2 rocket body
  - broke up July 9 in a 535 km x 35,445 km, 7.0 deg orbit
- **1% increase in debris penetrating flux is required.**

Meteoroid/Orbital Debris Risk Assessment Results

Presenter:
Eric Christiansen

Date:
February 5, 2003

	STS-107 Risk	Shuttle Guideline
Odds of critical penetration	1 in 370	1 in 200
Probability of no critical penetration	0.9973	0.9950
Odds of radiator leak *(both rads DEPLOYED)*	1 in 315	1 in 61
Probability of no radiator leak	0.9968	0.9837
Expected number of window replacements	2.1	
Window replacement risk	88%	

NOTE:

Odds of radiator leak *(both rads STOWED)*	1 in 334
Probability of no radiator leak	0.9970

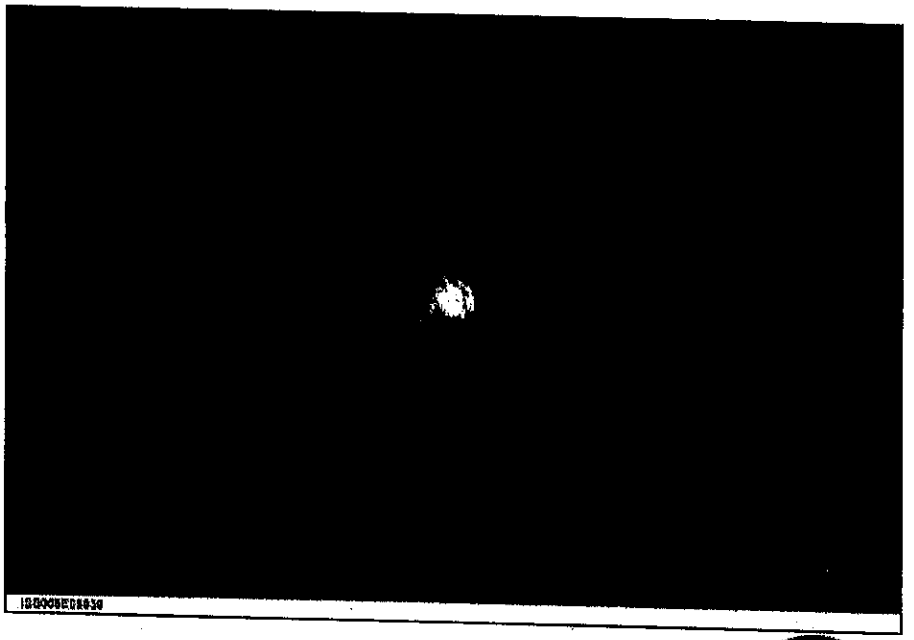
Recent Flights

Presenter:
Eric Christiansen

Date:
February 5, 2003

- **STS-112 (9A)**
  - Launch: 10/07/02
  - 0 Collision Avoidance Maneuvers
  - Radiator Panel L4 – 0.4mm (0.016in) diameter hole in facesheet
- **STS-113 (11A)**
  - Launch: 11/23/02
  - 0 Collision Avoidance Maneuvers

W11 Impact →
Crater diam = 2.2mm (0.088in)
Crater depth = 0.3mm (0.013in)
Internal fracture = 4.0 mm (0.156in)



Meteoroid Showers

Presenter:
Eric Christiansen

Date:
February 5, 2003

- **Meteor shower activity will increase the meteoroid critical penetrating flux over background by 5.3%**

- **Meteor shower activity will increase the meteoroid window and radiator damaging flux over background by 2.8%**

Shower	Peak	Approximate Zenith Hourly Rate
Delta Cancrids	Jan 19	11
Alpha Leonids	Jan 29	7

Summary

Presenter:
Eric Christiansen

Date:
February 5, 2003

- Assessment indicates that the Orbiter is within guidelines for critical penetration risk.
- Assessment indicates that the Orbiter is within guidelines for radiator leak risk.
- There is a 1 in 5.7 probability that one or more collision avoidance maneuver warnings will occur.
- SX2 will be on-call during the mission to assess additional attitudes or satellite breakup events.

Michele Lewis

rom: HAMILTON, DAVID A. (DAVE) (JSC-EA) (NASA)
Sent: Tuesday, February 25, 2003 5:06 PM
To: OLIVAREZ, STEPHANIE J. (JSC-EA4) (NASA)
Subject: FW: STS-107 Landing Weight Exceedance

MER
Briefing.ppt

-----Original Message-----
From: SCHOMBURG, CALVIN (JSC-EA) (NASA)
Sent: Tuesday, February 25, 2003 1:02 PM
To: HAMILTON, DAVID A. (DAVE) (JSC-EA) (NASA)
Subject: FW: STS-107 Landing Weight Exceedance

-----Original Message-----
From: Alexander, Ed C [mailto:ed.c.alexander@boeing.com]
Sent: Thursday, January 23, 2003 7:34 PM
To: CHANG, YUAN-CHYAU, PHD (HARRY) (JSC-ES3) (NASA); ROCHA, ALAN R. (RODNEY) (JSC-ES2) (NASA); LEVY, VINCENT M. (JSC-EG) (NASA); EXT-Madera, Pamela L; EXT-White, Doug; Dunham, Michael J; SCHOMBURG, CALVIN (JSC-EA) (NASA)
Subject: STS-107 Landing Weight Exceedance

Attached is the landing weight briefing to be presented at the MER on Friday, Jan. 24.

<<MER Briefing.ppt>>

STS-107 Landing Weight Limit Exceedance

Presenter: Pam Madera
Organization/Date: Orbiter/01-24-03

Concern: The projected STS-107 EOM landing weight of 233,700 lbs. exceeds the NSTS 07700, Vol. X and Flight Rules Orbiter vehicle landing weight maximum of 233,000 lbs.

Action Required: STS-107 mission specific assessments are required to demonstrate that the Orbiter will perform within its capability for an EOM landing weight above 233,000 lbs.

1. Flight Control
2. Thermal Landing Gear & Tire
3. Stress
4. Landing Gear & Tire

STS-107 Landing Weight Limit Exceedance

Presenter: Pam Madera
Organization/Date: Orbiter/01-24-03

Discussion: Mission Specific Assessments

Flight Control: No concern for 1000 lbs. exceedance of the 233k EOM limit

- Covered by abort certification

Thermal: There are no TSEP violations for the following landing conditions (233,700 lb. 1,078.8 in. at T/D)

XR	Approach	Description
8	DL	Nominal EOM
770	DL	Maximum crossrange capability for DL
630	DR	Maximum attainable DR crossrange for 39 deg inclination
383	DL	Intermediate DL crossrange
356	DR	Intermediate DR crossrange

Note: Ascending approaches are more benign

Detailed thermal/structural evaluation is not required if TSEP results are within EOM limits

STS-107 Landing Weight Limit Exceedance

Presenter:	Pam Madera
Organization/Date:	Orbiter/01-24-03

Discussion: Mission Specific Assessments

Stress: Stress is acceptable for higher landing weights by similarity to heavier abort weights as long as thermal conditions are within EOM TSEP limits.

Landing Gear & Tire:

- Landing gear and tires are certified up to abort weight limits.
- On-orbit thermal conditioning will be performed to protect tire pressure limits
  - Expected MLG limit change from carpet plots is small (< 2 psia, or 3 DegF based on 233000 to 235000 lbs, 1079 +/-1 inch cg)
    - If limits lower, no impact
    - If limits higher, additional bottom-sun conditioning may be required
      - Approximately 10-hr bottom sun prior to 10-hr – ZLV+YVV EOM thermal conditioning
  - TCS will update ATL recommendation when new tire limits are available

STS-107 Landing Weight Limit Exceedance

Presenter:	Pam Madera
Organization/Date:	Orbiter/01-24-03

Discussion: Next PLS/Early Mission Termination

- NSTS 07700 Volume X and Flight Rules state that Unplanned Payload Return (UPR) landing opportunities should be evaluated to minimize descent thermal effects
  - Under EOM thermal limits if possible
  - Volume X states no waiver required for UPR downweight exceedances
- Next PLS/early mission termination would also result from anomalous conditions
  - Same process should apply but is not explicitly stated in both documents

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STS-107 Landing Weight Limit Exceedance

Presenter: Pam Madera

Organization/Date: Orbiter/01-24-03

Discussion: Past Experience

- Landing weight has exceeded EOM landing weight limit for two missions

Mission	Vehicle	Weight at T/D	Xcg at T/D
STS-83	OV-102	235,286	1079.8
STS-87	OV-102	233,089	1082.9

- STS-83 exceeded limit due to early mission termination

- STS-87 exceeded limit due to less than expected RCS usage
  - Second flight of Wrap Around Digital Auto Pilot
  - Landing weight prediction prior to deorbit burn was below limit

STS-107 Landing Weight Limit Exceedance

Presenter:
Pam Madera

Organization/Date:
Orbiter/01-24-03

Recommendation:

- Waiver required if nominal EOM weight exceeds 233,000 lbs limit
- Rationale for waiver exists for STS-107 landing weight exceedance if TSEP results are below EOM limits

STS-107 Landing Weight Limit Exceedance

Presenter: Pam Madera
Organization/Date: Orbiter/01-24-03

Discussion: Past Experience

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Presenter:
Pam Madera

Organization/Date:
Orbiter/01-24-03

Recommendation:

- Waiver required if nominal EOM weight exceeds 233,000 lbs limit
- Rationale for waiver exists for STS-107 landing weight exceedance if TSEP results are below EOM limits

Michele Lewis

From: MAGILL, ANITA L. (JSC-MV) (LM)
Sent: Tuesday, January 28, 2003 8:35 AM
To: SWAN, BOBBIE G. (JSC-CA) (NASA); MAYEAUX, BRIAN M. (JSC-ES4) (NASA); KRUMREY, CAROLYN M. (JSC-ES6) (NASA); CSRDESK; WHITTLE, DAVID W. (JSC-MA2) (NASA); HENDERSON, EDWARD M. (MACK) (JSC-MA) (NASA); BENZ, FRANK J. (JSC-EA) (NASA); OUELLETTE, FRED A. (JSC-MV6) (NASA); GAYLOR, STEPHEN G. (STEVE) (JSC-MT3) (NASA); GRUSH, GENE R. (JSC-EP111) (NASA); 'Gernand, Joseph'; GALBREATH, GREGORY F. (GREG) (JSC-ES2) (NASA); LANGE, GREGORY A. (JSC-DA8) (NASA); KAUPP, HENRY J. (JSC-ER3) (NASA); GREENE, JAY H. (JSC-AG) (NASA); HARBOUR, JEFF P. (JSC-MV) (LM); 'John Mulholland'; SERIALE-GRUSH, JOYCE M. (JSC-EA) (NASA); 'LiLi Moore'; 'Mike Fuller'; 'Oswald, Stephen'; ROE, RALPH R. (JSC-MV) (NASA); DITTEMORE, RONALD D. (JSC-MA) (NASA); CREAMER, TIMOTHY J. (TJ) (JSC-CB) (NASA); HILL, VERNON C. (JSC-MV) (LM); LEVY, VINCENT M. (JSC-EG) (NASA); GUY, WALTER W. (JSC-ER) (NASA); GERSTENMAIER, WILLIAM H. (BILL) (JSC-OA) (NASA)
Subject: CORRECTION 12th Daily Report


DAY12.DOC

Michele Lewis

From: ROCHA, ALAN R. (RODNEY) (JSC-ES2) (NASA)
Sent: Wednesday, January 22, 2003 4:13 PM
To: SHACK, PAUL E. (JSC-EA42) (NASA)
Cc: SERIALE-GRUSH, JOYCE M. (JSC-EA) (NASA); KRAMER, JULIE A. (JSC-EA4) (NASA); MILLER, GLENN J. (JSC-EA) (NASA)
Subject: FW: STS-107 Debris Analysis Team Meeting

Rodney Rocha
Structural Engineering Division (ES-SED)

- **ES Div. Chief Engineer (Space Shuttle DCE)**
- **Chair, Space Shuttle Loads & Dynamics Panel**

Mail Code ES2 Phone 281-483-8889

-----Original Message-----
From: Madera, Pamela L [mailto:pam.l.madera@usahq.unitedspacealliance.com]
Sent: Wednesday, January 22, 2003 11:22 AM
To: CURRY, DONALD M. (JSC-ES3) (NASA); ROCHA, ALAN R. (RODNEY) (JSC-ES2) (NASA); LEVY, VINCENT M. (JSC-EG) (NASA); KOWAL, T. J. (JOHN) (JSC-ES3) (NASA); DERRY, STEPHEN M. (STEVE) (JSC-EG3) (NASA); Nagle, Scott M; Carlos Ortiz (E-mail); GOMEZ, REYNALDO J. (RAY) (JSC-EG3) (NASA); DISLER, JONATHAN M. (JON) (JSC-SX) (LM); Jacobs, William A
Cc: 'Scott Christensen V (E-mail)'; 'Norman Ignacio (Nacho) (E-mail)'; CHAO, DENNIS; Stoner-1, Michael D; 'Carlos Ortiz (E-mail)'; 'Michael J Dunham (E-mail)'; Sebesta, Stephen P; CORONADO, DIANA; "Craig Madden' (E-mail)'; Bell, Dan R.; Gordon, Michael P.; 'Paul A Parker (E-mail)'; ISHMAEL, MOHAMED I. (GEORGE) (JSC-NC) (SAIC); ALEXANDER, ED
Subject: STS-107 Debris Analysis Team Meeting

Rodney Rocha has conference room 221 in JSC Building 13 available for today's 1:00 PM telecon. Located on second floor. The dial in number is the same as below. I propose the following agenda:

Review of transport analysis (Carlos Ortiz - charts attached)
Discussion of appropriate Particle Size (Ortiz, Disler, all)
Review of Flight Design Plans for Assessing Options (Bill Jacobs)
Status of Impact Damage Assessment (P. Parker)
Status of Thermal Analysis (Norm Ignacio/Dennis Chao)
Approach for stress assessment (Dunham)
Discussion on Need/Rationale for Mandatory Viewing of damage site (All)

<<STS-107 Preliminary Debris Assessment - rev2.ppt>>

Pam Madera
Vehicle and Systems Analysis Subsystem Area Manager
Phone: 281-282-4453

-----Original Message-----

From: Madera, Pamela L

Sent: Monday, January 20, 2003 5:47 PM

To: CURRY, DONALD M; ROCHA, ALAN RODNEY; LEVY, VINCENT M; KOWAL, T JOHN; DERRY, STEPHEN M

Cc: 'Scott Christensen V (E-mail)'; 'Norman Ignacio (Nacho) (E-mail)'; CHAO, DENNIS; Stoner-1, Michael D; 'Carlos Ortiz (E-mail)'; 'Michael J Dunham (E-mail)'; Sebesta, Stephen P; CORONADO, DIANA; "Craig Madden' (E-mail)'; Bell, Dan R.; Gordon, Michael P.; Paul A Parker (E-mail)

Subject: STS-107 Debris Analysis Team Plans

The Boeing/USA team would like to meet with you Tuesday at 2:00 on meet-me-line number to discuss analysis plans for assessing the STS-107 Debris Impact.

Pam Madera
Vehicle and Systems Analysis Subsystem Area Manager
Phone: 281-282-4453

Michele Lewis

From: ROCHA, ALAN R. (RODNEY) (JSC-ES2) (NASA)
Sent: Monday, January 20, 2003 9:47 PM
To: SHACK, PAUL E. (JSC-EA42) (NASA); SERIALE-GRUSH, JOYCE M. (JSC-EA) (NASA)
Cc: KRAMER, JULIE A. (JSC-EA4) (NASA); MILLER, GLENN J. (JSC-EA) (NASA); RICKMAN, STEVEN L. (JSC-ES3) (NASA); MADDEN, CHRISTOPHER B. (CHRIS) (JSC-ES3) (NASA)
Subject: FW: STS-107 Debris Analysis Team Plans

FYI on forthcoming activity. From USA/Pam Madera and her talking to Boeing contacts:

- It appears that the image folks can only state the impactor is 20 inch max dimension plus/minus 10 inch. It has a max thickness of about 4 inch or so due to the known thicknesses of the ET insulation in the forward bipod area.
- Boeing Load/Stress group is researching if such insulation impacts are in the data base of previous impact tests on Orbiter TPS.

Rodney Rocha

- **Division Chief Engineer (DCE), ES-Structural Engineering Division**
- **Chair, Space Shuttle Loads & Dynamics Panel**
- **Mail Code ES2 x38889**

: Madera, Pamela L [mailto:pam.l.madera@usahq.unitedspacealliance.com]
Sent: Monday, January 20, 2003 5:47 PM
To: CURRY, DONALD M. (JSC-ES3) (NASA); ROCHA, ALAN R. (RODNEY) (JSC-ES2) (NASA); LEVY, VINCENT M. (JSC-EG) (NASA); KOWAL, T. J. (JOHN) (JSC-ES3) (NASA); DERRY, STEPHEN M. (STEVE) (JSC-EG3) (NASA)
Cc: 'Scott Christensen V (E-mail)'; 'Norman Ignacio (Nacho) (E-mail)'; CHAO, DENNIS; Stoner-1, Michael D; 'Carlos Ortiz (E-mail)'; 'Michael J Dunham (E-mail)'; Sebesta, Stephen P; CORONADO, DIANA; "Craig Madden' (E-mail)'; Bell, Dan R.; Gordon, Michael P.; Paul A Parker (E-mail)
Subject: STS-107 Debris Analysis Team Plans

The Boeing/USA team would like to meet with you Tuesday at 2:00 on meet-me-line number
to discuss analysis plans for assessing the STS-107 Debris Impact.

Pam Madera
Vehicle and Systems Analysis Subsystem Area Manager
Phone: 281-282-4453

Michele Lewis

From: HAMILTON, DAVID A. (DAVE) (JSC-EA) (NASA)
Sent: Tuesday, February 25, 2003 5:08 PM
To: OLIVAREZ, STEPHANIE J. (JSC-EA4) (NASA)
Subject: FW: Answer to Tile Questions

-----Original Message-----
From: SCHOMBURG, CALVIN (JSC-EA) (NASA)
Sent: Tuesday, February 25, 2003 2:00 PM
To: HAMILTON, DAVID A. (DAVE) (JSC-EA) (NASA)
Subject: FW: Answer to Tile Questions

-----Original Message-----
From: SCHOMBURG, CALVIN (JSC-EA) (NASA)
Sent: Sunday, February 16, 2003 10:24 AM
To: OUELLETTE, FRED A. (JSC-MV6) (NASA)
Subject: FW: Answer to Tile Questions

Another item-I had not sent you.

-----Original Message-----
From: MCCORMACK, DONALD L. (DON) (JSC-MV6) (NASA)
Sent: Wednesday, January 29, 2003 6:54 AM
To: CABANA, ROBERT D. (JSC-CB) (NASA); ROSS, JERRY L. (JSC-CB) (NASA)
Cc: SCHOMBURG, CALVIN (JSC-EA) (NASA)
Subject: Answer to Tile Questions

Bob, Jerry,
I've talked to Calvin Schomburg (NASA/JSC/Engineering) regarding your questions following Monday's MMT. As far as the "zipper effect", the folks did consider it and determined that for the type of damage we expect, it will not be an issue. The following is a summary of what I has told and if you need any more information we can talk again or I can have Calvin get in touch with you (Calvin, if you have any comments, please chime in).

As we discussed on Monday, the predicted worst case damage area is expected to be approximately 7" wide by 30" long. The shape of the area is expected to be "crater like" with a ramp leading in and a ramp leading out. The maximum depth will be perhaps down to the densified layer of the tile (that's what was thermally analyzed). So, there will still be approximately 0.1" of TPS material as well as the SIP and RTV left in the hole. The airflow over this damaged area should not impart sufficient aero loads (side loading) on the tiles to cause additional tiles to come off. At the most, we'd expect to erode away some additional tile material in the hole (the analysis accounts for this). Note also that the highest aero loads occur after peak heating. Also, the thermal analysis indicates that the bondline temperature will remain below the temperature at which the RTV begins to degrade (650F). Therefore, the strength of the RTV should not be compromised.

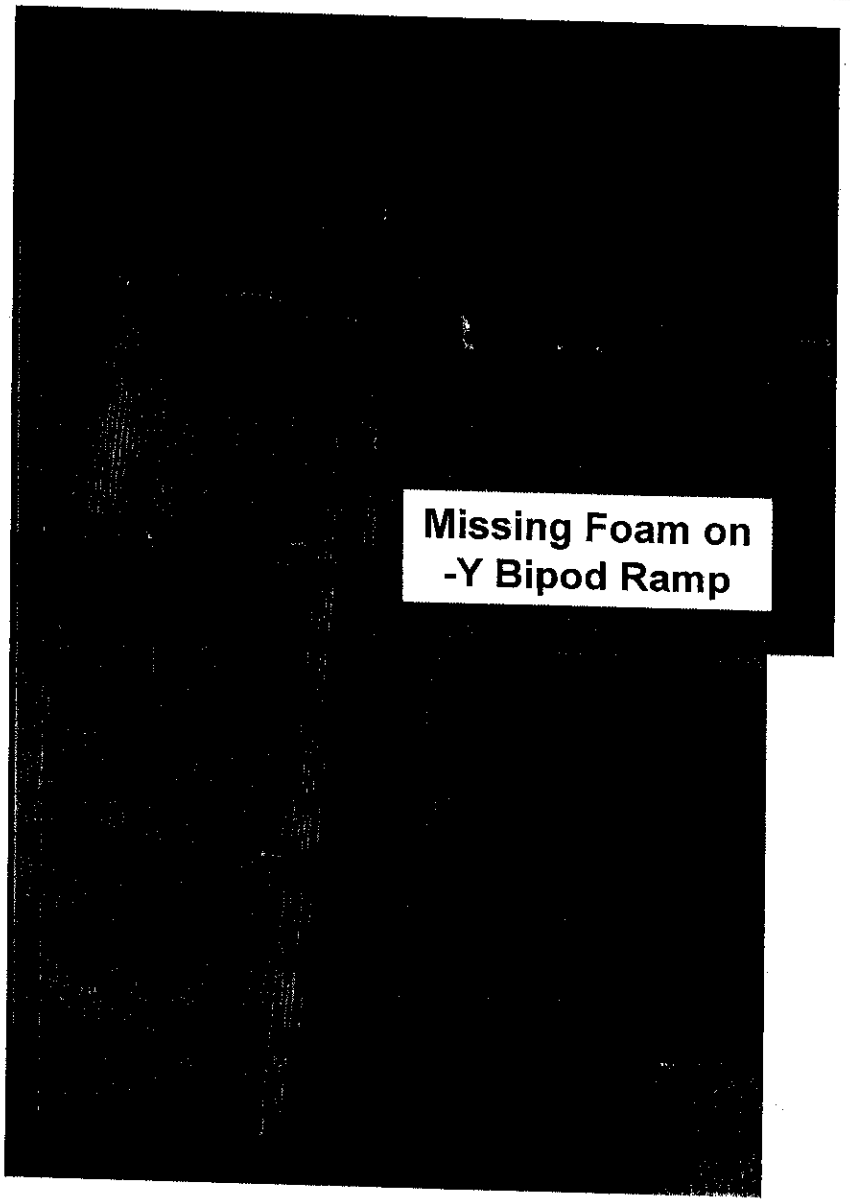
As for the age issue, Calvin said that the cert life has been extended to 30-years. The way in which they have been able to do this is to remove tiles from the bottom of the vehicle during OMDPs are test the strength of the RTV. He has no concerns about the age of the tile bonding of OV-102.

Hope this helps. If note, let me know.
Don

STS-112/ET-115 Bipod Ramp Foam Loss

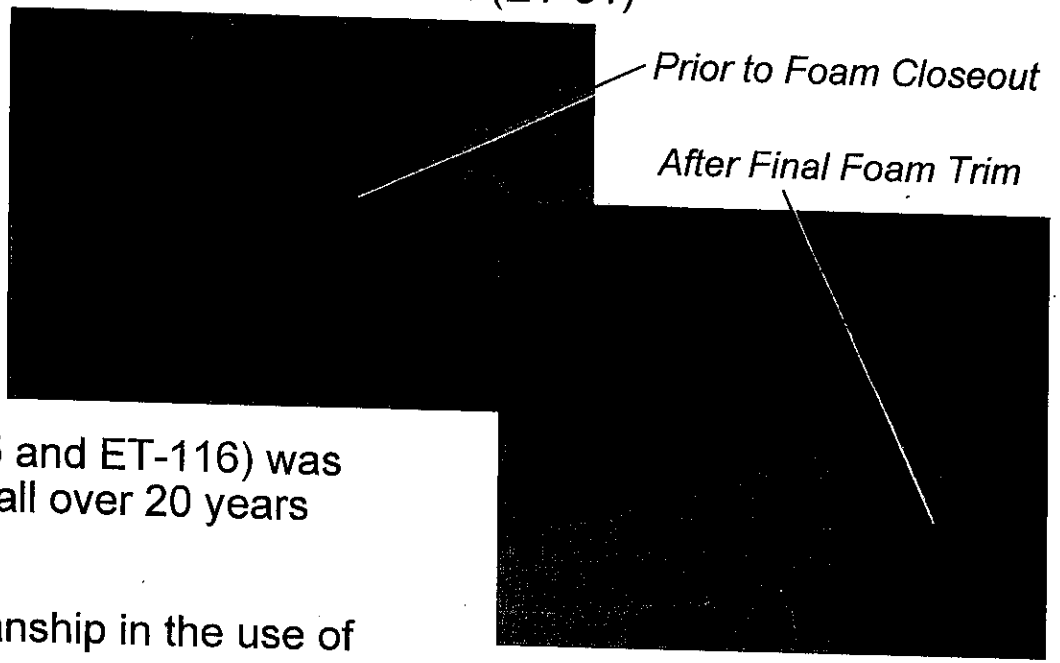
- **Issue**
  - Foam was lost on the STS-112/ET-115 -Y bipod ramp (≈ 4" X 5" X 12") exposing the bipod housing SLA closeout

- **Background**
  - ET TPS Foam loss over the life of the Shuttle Program has never been a "Safety of Flight" issue
  - More than 100 External Tanks have flown with only 3 documented instances of significant foam loss on a bipod ramp



STS-112/ET-115 Bipod Ramp Foam Loss

- **Rationale for Flight**
  - Current bipod ramp closeout has not been changed since STS-54 (ET-51)
  - The Orbiter has not experienced "Safety of Flight" damage from loss of foam in 112 flights (including 3 known flights with bipod ramp foam loss)
  - There have been no design / process / equipment changes over the the last 60 ETs (flights)
  - All ramp closeout work (including ET-115 and ET-116) was performed by experienced practitioners (all over 20 years experience each)
  - Ramp foam application involves craftsmanship in the use of validated application processes
  - No change in Inspection / Process control / Post application handling, etc
  - Probability of loss of ramp TPS is no higher/no lower than previous flights
  - ***The ET is safe to fly with no new concerns (and no added risk)***



Bipod Attach Fitting

- **Chair, Space Shuttle Loads & Dynamics Panel**
- **Mail Code ES2 x38889**

: Madera, Pamela L [mailto:pam.l.madera@usahq.unitedspacealliance.com]
Sent: Monday, January 20, 2003 5:47 PM
To: CURRY, DONALD M. (JSC-ES3) (NASA); ROCHA, ALAN R. (RODNEY) (JSC-ES2) (NASA); LEVY, VINCENT M. (JSC-EG) (NASA); KOWAL, T. J. (JOHN) (JSC-ES3) (NASA); DERRY, STEPHEN M. (STEVE) (JSC-EG3) (NASA)
Cc: 'Scott Christensen V (E-mail)'; 'Norman Ignacio (Nacho) (E-mail)'; CHAO, DENNIS; Stoner-1, Michael D; 'Carlos Ortiz (E-mail)'; 'Michael J Dunham (E-mail)'; Sebesta, Stephen P; CORONADO, DIANA; "Craig Madden' (E-mail)'; Bell, Dan R.; Gordon, Michael P.; Paul A Parker (E-mail)
Subject: STS-107 Debris Analysis Team Plans

The Boeing/USA team would like to meet with you Tuesday at 2:00 on meet-me-line number
to discuss analysis plans for assessing the STS-107 Debris Impact.

Pam Madera
Vehicle and Systems Analysis Subsystem Area Manager
Phone: 281-282-4453

Michele Lewis

From: HAMILTON, DAVID A. (DAVE) (JSC-EA) (NASA)
Sent: Tuesday, February 25, 2003 5:08 PM
To: OLIVAREZ, STEPHANIE J. (JSC-EA4) (NASA)
Subject: FW: Answer to Tile Questions

-----Original Message-----
From: SCHOMBURG, CALVIN (JSC-EA) (NASA)
Sent: Tuesday, February 25, 2003 2:00 PM
To: HAMILTON, DAVID A. (DAVE) (JSC-EA) (NASA)
Subject: FW: Answer to Tile Questions

-----Original Message-----
From: SCHOMBURG, CALVIN (JSC-EA) (NASA)
Sent: Sunday, February 16, 2003 10:25 AM
To: OUELLETTE, FRED A. (JSC-MV6) (NASA)
Subject: FW: Answer to Tile Questions

-----Original Message-----
From: ROSS, JERRY L. (JSC-CB) (NASA)
Sent: Wednesday, January 29, 2003 10:53 AM
To: MCCORMACK, DONALD L. (DON) (JSC-MV6) (NASA); CABANA, ROBERT D. (JSC-CB) (NASA)
Cc: SCHOMBURG, CALVIN (JSC-EA) (NASA)
Subject: RE: Answer to Tile Questions

Thank you!

-----Original Message-----
From: MCCORMACK, DONALD L. (DON) (JSC-MV6) (NASA)
Sent: Wednesday, January 29, 2003 6:54 AM
To: CABANA, ROBERT D. (JSC-CB) (NASA); ROSS, JERRY L. (JSC-CB) (NASA)
Cc: SCHOMBURG, CALVIN (JSC-EA) (NASA)
Subject: Answer to Tile Questions

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Don

Michele Lewis

From: HAMILTON, DAVID A. (DAVE) (JSC-EA) (NASA)
Sent: Tuesday, February 25, 2003 5:07 PM
To: OLIVAREZ, STEPHANIE J. (JSC-EA4) (NASA)
Subject: FW: meteoroid/debris risks

-----Original Message-----
From: SCHOMBURG, CALVIN (JSC-EA) (NASA)
Sent: Tuesday, February 25, 2003 1:02 PM
To: HAMILTON, DAVID A. (DAVE) (JSC-EA) (NASA)
Subject: FW: meteoroid/debris risks

-----Original Message-----
From: CHRISTIANSEN, ERIC L. (JSC-SX) (NASA)
Sent: Wednesday, February 05, 2003 11:19 AM
To: SCHOMBURG, CALVIN (JSC-EA) (NASA)
Cc: PETETE, PATRICIA (TRISH) (JSC-MV) (NASA)
Subject: meteoroid/debris risks

Calvin,
Attached is the file on 107 meteoroid/debris risks (based on FRR ATL) with the charts I showed you this morning on meteoroid/debris risks. We'll finalize it after we get the as-flown ATL.

Risk_breakdown.ppt

Eric
281-483-5311

Hypervelocity Impact
Technology Facility
Human Exploration Science
Office SX

STS-107 Meteoroid/Debris Risk Breakdown Preliminary (Based on FRR ATL)

SX2/Eric L. Christiansen
LM/Jim Hyde, Tom Prior, Dana Lear

a facility of the Johnson Space Center

Critical Meteoroid/Debris Impact Risk

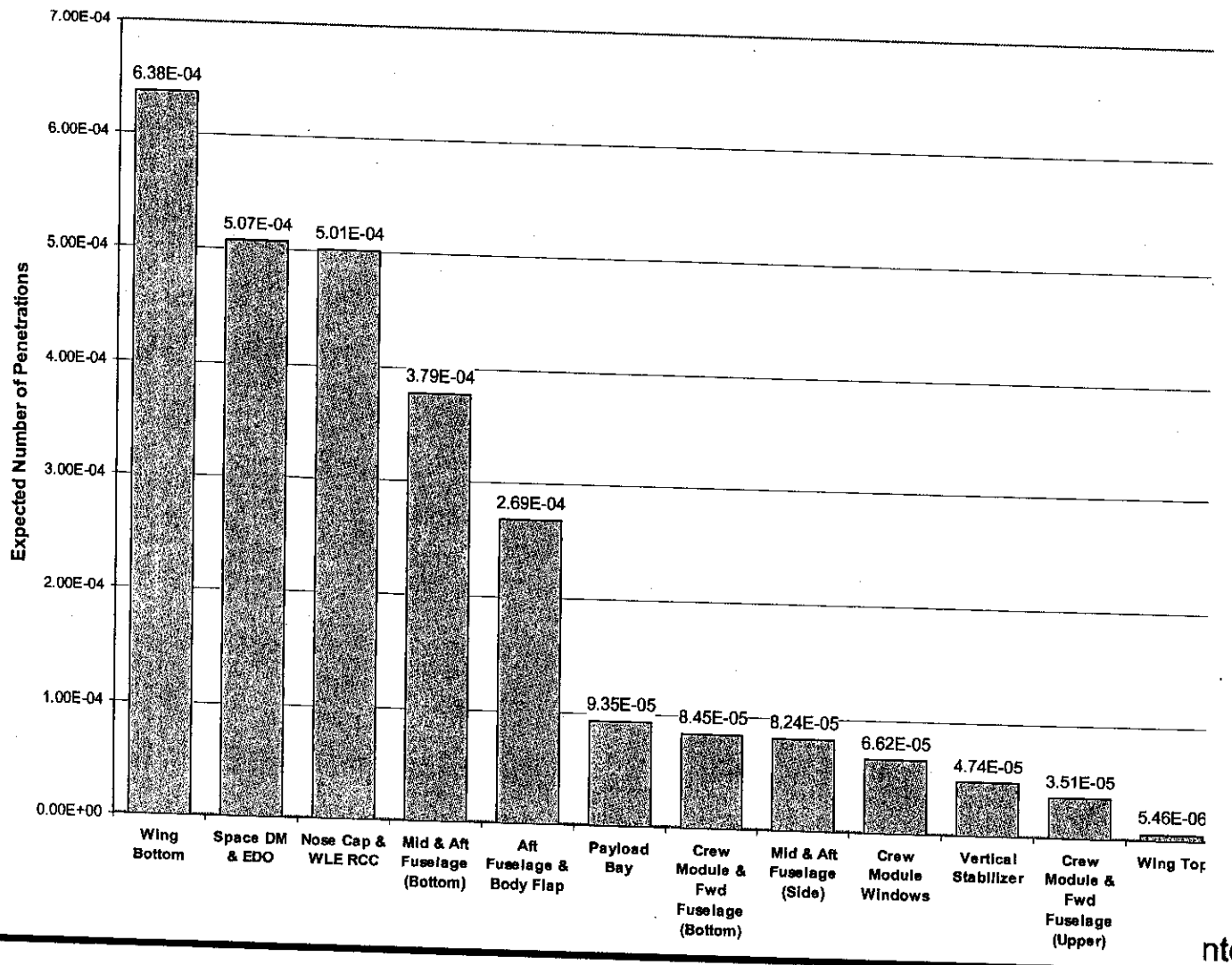
Presenter:
Eric Christiansen

Date:
February 5, 2003

- **Critical Impact risks assessed by BUMPER code**
  - Shuttle geometry model modified to determine risks for port and starboard wing zones (previously port/starboard risks combined)
  - Failure criteria and ballistic limit equations (based on hypervelocity impact data) defined for each zone of the vehicle
- **Based on FRR Attitude Timeline (ATL) critical impact risks:**

	Probability of No Critical Penetration	Odds of Critical Penetration
Overall Vehicle	0.9973	1 in 370
Port Wing only (WLE, bottom, top)	0.9996	1 in 2500
Starboard Wing only (WLE, bottom, top)	0.99958	1 in 2400

STS-107 Meteoroid & Orbital Debris Risk per Region



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