NASA

SECTION 21
Subject: FW: STS-107 Debris Analysis Team Meeting
Date: Wednesday, January 29, 2003 2:50 PM
From: CAMPBELL, CARLISLE C., JR (JSC-ES2) (NASA)
<carlisle.c.campbell@nasa.gov>
To: "LAW, HOWARD G. (JSC-EG) (NASA)" <howard.g.law@nasa.gov>,
"jhoman@mail.arc.nasa.gov" <jhoman@mail.arc.nasa.gov>

-----Original Message-----
From: ROCHA, ALAN R. (RODNEY) (JSC-ES2) (NASA)
Sent: Thursday, January 23, 2003 7:59 AM
To: SHACK, PAUL E. (JSC-EA42) (NASA); SERIALE-CRUSH, JOYCE M. (JSC-EA) (NASA); KRAMER, JULIE A. (JSC-EA4) (NASA); CAMPBELL, CARLISLE C., JR (JSC-ES2) (NASA); MILLER, GLENN J. (JSC-EG) (NASA)
Subject: FW: STS-107 Debris Analysis Team Meeting

FYI.

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); LÉVY, 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) (LMO); 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; RÖCHA, 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-I, 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
FYI—Meeting Monday with Benz.

Vincent M. Levy
EG/Aeroscience & Flight Mechanics
Shuttle Division Chief Engineer
281-483-0874 (w)
281-483-1245 (fax)

--Original Message--

From: SERIALE-GRUSH, JOYCE M. (JSC-EA) (NASA)
Sent: Wednesday, December 11, 2002 6:33 PM
Subject: STS-107 Quick Look Summary - "Final"

DCEs and Task Owners:

PLEASE LIMIT DISTRIBUTION OF THIS EMAIL DUE TO STS-107 LAUNCH INFO ENCLOSED

Here is the "finalized" STS-107 Quick Look Summary package. Thanks for all of your inputs. I did not receive an input from EC-ECLS or EV-Software, so I "wrote" something up myself (i.e., pulled words from previous presentations). Also, EB did not respond, so Penny Saunders/EA2 helped me out there (thanks Penny), plus I got a verbal from John Saiz. If you three groups could review the package to make sure I captured your topics correctly, I'd appreciate it. As stated, we go to Frank Benz and Lauri Hansen on Monday, Dec 16th at 9:15 AM and I'm scheduled to be off on Thursday and potentially Friday (sigh). I'll try and get in early on Monday to correct anything you folks see as being in error. Also, I will check my email from home.

Jordan Metcalf/EC - please fill in the "X" on page 9 (or remove the sentence totally - I was working from my memory here).

Glen Branch/EB - if you wish to add anything for your hardware, please let me know (I'm assuming at this time you have no inputs).

Roderick Rodriguez/EA2 - please let me know if you want me to slip in your normal GFE summary for the meeting on the 16th. If so, just email it to me before Monday.
Subject: Look at that Spaceship: STS-107 Sightings
Date: Monday, January 27, 2003 4:12 PM
From: NASA Science News <snglist@snglist.msfc.nasa.gov>
Reply-To: "NASA Science News" <snglist@snglist.msfc.nasa.gov>
To: NASA Science News <snglist@snglist.msfc.nasa.gov>


The space shuttle Columbia (STS-107), which is on a 16-day mission dedicated to scientific research, will make a lovely series of morning passes over the United States this week.

FULL STORY at
http://science.nasa.gov/headlines/y2003/27jan_dejavu.htm?list776292

You are currently subscribed to snglist as: howard.g.law1@jsc.nasa.gov

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To UNSUBSCRIBE, or CHANGE your address on this service, go to
http://science.nasa.gov/news/subscribe.asp?e=howard.g.law1@jsc.nasa.gov
or send a blank email to leave-snglist-776292@snglist.msfc.nasa.gov.

NASA is looking for Teachers to be Astronauts! Are you the right person, or do you know someone who might be?
Check out http://edspace.nasa.gov/education.nasa.gov for information.

If you need to get in touch with us directly, please go to
http://science.nasa.gov/comments

Home page: http://science.nasa.gov
Hi David,

I talked to Carlisle a bit ago and he let me know you guys at MOD were getting into the loop on the tile damage issue. I'm writing this email not really in an official capacity but since we've worked together so many times I feel like I can say pretty much anything to you. And before I begin I would offer that I am admittedly erring way on the side of absolute worst-case scenarios and I don't really believe things are as bad as I'm getting ready to make them out. But I certainly believe that to not be ready for a gut-wrenching decision after seeing instrumentation in the wheel well not be there after entry is irresponsible. One of my personal theories is that you should seriously consider the possibility of the gear not deploying at all if there is a substantial breach of the wheel well. The reason might be that as the temps increase, the wheel (aluminum) will lose material properties as it heats up and the tire pressure will increase. At some point the wheel could fail and send debris everywhere. While it is true there are thermal fuses in the wheel, if the rate of heating is high enough, since the tire is such a good insulator, the wheel may degrade in strength enough to let go far below the 1100 psi or so that the tire normally bursts at. It seems to me that with that much carnage in the wheel well, something could get screwed up enough to prevent deployment and then you are in a world of hurt. The following are scenarios that might be possible...and since there are so many of them, these are offered just to make sure that some things don't slip thru the cracks...I suspect many or all of these have been gone over by you guys already:

1. People talk about landing with two flat tires...I did too until this came up. If both tires blew up in the wheel well (not talking thermal fuse and venting but explosive decomp due to tire and/or wheel failure) the overpressure in the wheel well will be in the 40 + psi range. The resulting loads on the gear door (a quarter million lbs) would almost certainly blow the door off the hinges or at least send it out into the slip stream...catastrophic. Even if you could survive the heating, would the gear now deploy? And/or also, could you even reach the runway with this kind of drag?
2. The explosive bungies...what might be the possibility of these firing due to excessive heating? If they fired, would they send the gear door and/or the gear into the slipstream?
3. What might excessive heating do to all kinds of other hardware in the wheel well...the hydraulic fluid, uplocks, etc? Are there vulnerable hardware items that might prevent deployment?
4. If the gear didn't deploy (and you would have to consider this before making the commitment to gear deploy on final) what would happen control-wise if the other gear is down and one is up? (I think Howard Law and his community will tell you you're finished)
5. Do you belly land? Without any other planning you will have already committed to KSC. And what will happen during derotation in a gear up landing (trying to stay away from an asymmetric gear situation for example) since you will be hitting the aft end body flap and wings and pitching down extremely fast a la the old X-15 landings? My guess is you would have an extremely large vertical decel situation up in the nose for the crew. While directional control would be afforded in some part by the drag chute...do you want to count on that to keep you out of the moat?
6. If a belly landing is unacceptable, ditching/bailout might be next on the list. Not a good day.
7. Assuming you can get to the runway with the gear deployed but with two flat tires, can the commander control the vehicle both in pitch and lateral directions? One concern is excessive drag (0.2 g's) during TD throughout the entire saddle region making the derotation uncontrollable due to saturated elevons...resulting in nose gear failure? The addition of crosswinds would make lateral control a tough thing too. Simulating this, because it is so ridiculously easy to do (sims going on this very minute at Ames with load-persistence) seems like a real no-brainer.

Admittedly this is over the top in many ways but this is a pretty bad time to get surprised and have to make decisions in the last 20 minutes. You can count on us to provide any support you think you need.

Best Regards,
Bob
Rodney- as we left the meeting with Ms. Hansen and Mr. Benz EG took an action to evaluate Entry Flight Control and Aerothermal impacts due to this Body Flap corrosion issue. Mark Hammerschmidt (Entry Expert) and Steve Derry (Aerothermal Expert) are working this activity. Conclusions from Flight Control should come from EG not EP. EA 4 needs to provide better integration among disciplines. As soon as Mr. Hammerschmidt completes his sim work we will share results with the community.

Vincent M. Levy
EG/Aeroscience & Flight Mechanics
Shuttle Division Chief Engineer
281-483-0874 (w)
281-483-1245 (fax)

---Original Message---
From: ROCHA, ALAN R. (RODNEY) (JSC-ES2) (NASA)
Sent: Wednesday, December 11, 2002 9:40 AM
To: MILLER, GLENN J. (JSC-EA) (NASA)
Subject: RE: Jammed Actuator

I did not agree with Gene Grush's statement to EA this morning. The EG story for aero-thermal heating increases (to BF and elevons, which are being worked more in jam scenario) and impacts to flight control, constrained pilot techniques, and a new tail scrape attitude at main gear touch-down have not been reviewed and assessed. Depending on the jammed BF position (zero position or else some commanded down non-zero position), the elevons would have to do more duty and thus experience more heating, more heating to the elevon seals (same as BF seals), more heating to the underlying structure, elevons counteracting the down-stuck BF or else do all the trim work of a zero-stuck BF.

Note to EG folks: When can we have a review on these subjects?

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
Thanks,
Joyce

Joyce M. Seraile-Grush
Shuttle Engineering Office/EA42
Phone: 281-483-4542
Fax: 281-483-2965
First Extended Duration Orbiter (EDO) Mission since STS-90 (April 17, 1998)

- Only 1 additional LWT remains in inventory
- Last Flight with a Lightweight Tank was STS-99 (February 1, 2000)
- LWT ET-93 Manifested on STS-107
- Performance Enhancements (PE) Flight with a Lightweight Tank (LWT)

Performance Enhancements (PE) Flight with a Lightweight Tank (LWT)

Second Flight of the Following:

- OMS Assist of 7000 lbs. (previous maximum of 4,000 lbs.)
- 2 Advanced Master Events Controllers (AMECs)
- Low Power Transceiver (LPT)
- Mediterranean Israeli Dust Experiment (MIDEEX)
- Research (FREESTAR) Crossbody Hitchhiker Platform
- Fast Reaction Experiments Enabling Science, Technology, Applications and
  Experiments Enabling Science, Technology, Applications and
- Spacelab as the Spacelab Research Double Module (SHRDM)

First Flight of the Following:

STS-107 Mission Highlights

Summary
STS-107 Quick Look
Engineering Directorate

Dec 16, 2002
Shuttle/Crush
Engineer Office

Johnson Space Center - Houston, Texas
Perform 3 Detailed Supplementary Objectives (DSOS)

Perform 2 Development Test Objectives (DTO)

Rain Burn Observation (RAMBO)

Shuttle Ionospheric Modification with Pulsed Local Exhaust Experiment (SIMPLEX)

Crew Compartment Payloads

Orbital Acceleration Research Experiment (OARE)

Low Power Transceiver (LPT)

Space Experiment Module (SEM)

Solar Constant Experiment-3 (SOLCOM-3)

Critical Viscosity of Xenon-2 (CVX-2)

Shuttle Ozone Limb Sounding Experiment-2 (SOLVE-2)

Mediterranean Israeli Dust Experiment (MIDEX)

Fast Reaction Experiments Enabling Science, Technology, Applications and Research (FREESTAR)

Spacehab Research Double Module (SHRM)

Perform Attached Cargo Operations

STS-107 Mission Objectives

Summary

STs-107 Quick Look

Engineering Directorate

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Shuttle Engineering Office

(Provided by Boeing/USA Integration)

Johnson Space Center - Houston, Texas
Note: Launch/landing times not to be released to General Public until 24 hrs prior to planned event.

2/1/03 KSC NOMINAL LANDING, 8:49 AM EST (Saturday), Daylight
Planned Mission Duration: 16 + 0 (ops b/u day) + 2 (confinement/weather avoidance);
39 Degree Incidence - Direct Insertion / 150 nm
150 minute WINDOW
1/16/03 LAUNCH, 10:39 AM EST (Thursday), Pad/MLP 39A/1 - Daylight

MISSION

No scheduled EVAs planned

Crew

Payload Specialist - Ellen Ramon (1st fl)
Payload CDR - Michael P. Anderson (2nd fl)
PLT - William "Willie" McCool (1st fl)
CDR - Rick D. Husband (2nd fl)
7 Member Crew - Dual Shift

VEHICLE AND CONFIGURATION

Summary
STS-107 Quick Look
Engineering Directorate

Mission Overview
Sheak/S-Crush
Shuttle Engineering Office

Dec 16, 2002

(provided by Boeing/ISS Integration)
1007 Engineering Directorate
Johnson Space Center - Houston, Texas
continued

SESS (fly two [2]) units for STS-107 came due their g-year periodic overhead in Jan 2003 and Feb 2003. These units had only a few, "hard open" dates for hardware access.

Since previous CEE SSN's transition of Shuttle CEE, it was still listed as CEE-PG for Spec hard. A delay in message transmission from H everyone (current SSN received the message in mide/September) was also received by the previous CEE SSN, later than expected.

Due to multiple launch scrub's, a message was sent on STS-107's original launch date.

SESS units were provided for STS-107 in early CY2002 to support STS-107's original launch date.

CEE-SESS: Overhead wavier

EC-CEE

EC2

E2A-STS-107 Shuttle / CEE CFE Upright Summary

E4A - STS-107 Payload Safety Assessment

There are 4 STS-107 payloads with 3 being re-flightable - No payload safety issues exist (see backup). The 4th STS-107 payload has not yet been reviewed.

E4A - STS-107 Payload Safety Assessment

Shuttle C-Grush

Shuttle Engineering Office

Dec 16, 2002

Summary

STS-107 Quick Look

Endorsement Directorate

Engineering Directorate

Johnson Space Center - Houston, Texas
This waiver is being submitted to remove the previous delinquency agreed to expire; however, EC did not correctly process a waiver to document and secure M's approval.

The predecessor to the previous CEE SSN did have a discussion with ES (G. Ecorc), at that time, it was pressure tested (which is required in accordance with the SHEB PRD).<br>

During historical research of the above waiver, it was discovered that all SHECs until were NOT proof CEE - SEBS: Pool pressure waivered.

Inspected for pressure quantity (this was successfully accomplished and cylinders were verified light). Additional six (6) months or one (1) Shuttle mission (whichever is shorter); if SHEBs units at KSC can be re-proved, technical coordination with ES, MABP, OE, and SAEVA, it was agreed that overhaul can be waived for overview consists of "good replacements" (o-rings, diaphragms), re-proof, pressure, and re-press CEE - SEBS: Overhaul waived (cont'd).

EC - CEE (continued):

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The delay of the Increment 6 EVA has provided the team more time to evaluate the input from all organizations. Initial results indicate that the current design does not pose a credible risk.

EC/ESW/SF are working together to identify if one of the EMU or cable materials could be ignited. EV has performed electrical testing to determine worst case energy for a "smart" short were to occur. No knowledge yet of how the cable was damaged; instead, the team has focused on determining whether or not a short occurred. Since EB owns the cable, EC owns the EMU and EV owns the radio, XA formed and is leading the investigation.

On-orbit inspection of a bio-med cable in the EMU post EVA revealed a broken outer shield. Damaged EMU Bio-Medical Cable

Requirements document will be modified so that zero-G sizing modifications will be performed as intended. ISS-6 and STS-107 sizing was checked by EC; no problems expected.

Investigation revealed that zero-G growth sizing change was performed improperly during processing. EVA #3 produced no compliants.

Post EVA #2, resizing/reconditioning was performed with EC help. Post EVA #1, resizing was performed without EC knowledge or input. During EVA #1 and 2 of STS-113, crewmember Lopez collected medical samples and numb feet.

Summary
STS-107 Quick Look
Engineering Directorate

Dec 16, 2002
Shuttle/Engineering Office

EC - EVA
Continued

All flex lines examined which exhibited fatigue cracking and associated damage on the line exterior. Also, all low frequency reverse bending fatigue failure analysis findings showed presence of cracks and fatigue striations in some flex hoses due to relatively similar configuration. Fatigue analysis was performed on all removed hoses.

Obtained secondary O2 and NZ flex hoses previously removed from OV-102, and MPS O2 flex hose of O2-103. Also, removed primary O2 hose from OV-102 and auxiliary O2 hose from OV-103.

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EC - ECSS

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Shack/Grush: Shuttle & Engineering Office

STS-107 Pre-Launch FRR Topics Summary (continued):

Summary

STS-107 Quick Look

Engineering Directorate

RMS-105 secondary NZ flex hose was R&R'd due to proximity and configuration similarities to secondary O2 hose and no indications of double overlapped leaking O2 hose was R&R'd. Fatigue analysis indicated presence of fatigue striations across fracture.

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STS-105 (130-150 ppm O2 - not surface zero), Troubleshooting isolated leak of approx 550 cfm to: Head $1/2"$ pinhole leak, P and R fluid supply line leak, Propellantisp and crew module

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STS-107 Pre-Launch ECSS PCS System 2 O2 Leak
The KSC troubleshooting is in place and scheduled for Dec. 1, 2002.

- The RBS troubleshooting was utilized with no further anomalies.
- The core flush procedure was performed.
- After attempts to restart on PRI B and then PRI A were unsuccessful, ice formation was suspected and the controller was shut down at 335/23:45:46 (GMT) during a Fees water dump on the PRIMARY B controller.

STS-13 Fees Failure Using Primary B Controller (IFN: STS-13-7-Y-03)

Requirements in place.

- Mps off 1/1. Hoses or similar design were adequately qualified and have sufficient inspection.

Probabilities of being a high environment problem, and (3) redundancy.

- Also, the program has exceeded problem and a low-high risk based on (4) PRCA history, (2) low

OV-102/STS-107 High Radiation: Secondary OZI2/Primary OZ2 have low cycle life (replaced X Flights

Review of ECSS Flex Hoses Qualification Conditions, did not adequately fulfill needs for this reliability low

- Frequent environment

- Frequent environment

- Root cause is unknown – most likely cause of low frequent bending is ground environment (traffic/landing

STS-13 Preliminary ECSS PCC System 2 O2 Leak (Continued)

EC - ECSS

EA STS-107 Pre-RRR Topics Summary (Continued):

| Shack/S-Crush | Dec 16, 2002 | Shuttle/Engineering Office |

Summary:
STS-107 Quick Look
Engineering Directorate
Feederline issues: Potential structural failure of line, binding/interference to articulating line, commonly to "2"
- BSTR4A ball dimensions = 2.75", L02/17 = 1.75", L22.2 = 1.75", H22.2 = 62
- BSTR4A material - "Stoody #2" (alloy of Co, Cr, W, Si, Fe, and Mo! Rockwell = 62

Flow stream by 3 mounting legs, with a ball located inside the hub. Each BSTR4A consists of 2 hubs, suspended in the articulating under cryo press, dynamic loading conditions. Total per order = 18. BSTR4A provides internal structural support to the feederline while allowing the line to move about the feederline flex joints - 77 feederline flex joints and all three feederline joints at OV-103/17

Borescope inspections (OMDP reqm) of OV-103/17 Ind. LO2 Feederline BSTR4A revealed a suspected crack in OV-103/17 LO2 Feederline BSTR4A Ball Cracks - OPEN ISSUE / FLIGHT CONSTRANT

- Final Resolution: TBD
- Inspections of available fleet hardware (e.g., OV-103)
- Flight resolution will be based on margin/analysis: Assessing implications to GNC, and possible removal
- Hydraulic actuator, RFT is working issue with stress/loads/analysis/GNC - Weekly status to MV
- Actuators on OV-102 may have similar condition
- Internal corrosion found inside body FGP (FG actuators being repaired at Hamilton Sundstrand (HS)
- Rotary Actuator Gear/Housing Corrosion - OPEN ISSUE / FLIGHT RESTRAINT

EP - Propulsion and Power

EA STS-107 Pre-RPK Topics Summary (continued):

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Resolution for Flight 1BD
ES and EG also supporting problem resolution activities.
For possible repair is highly unlikely.

- Rational for flight may hinge on testing to bound the failure and demonstrate "use-as-is" capability (access
- TT-weekly status meetings have been set up with MV
- MPTA T7 issues (LO2/LH2) under inspection at JSC-ESTA.
- Review al video is in work.
- OV-102 Bstra A inspections were completed with no anomalies found during test OMDP (prior to Flight 27)
- Borescope inspections of 104 and 106 are in work/planed. Constraint to 104 engine install (as 12/17/02).
- Fault tree in work by MPS PRT.
- Chief Engineers Team initiated to provide additional checks/balence/over Sight
- 10 Test Team
- 0 MRP Team
- 0 Build Data Team
- 0 Inspection History and inspection plan Team
- 0 Qualification and Test Team

Seven teams initiated by MV/USA/Boeing to work Issue (similar structure as was used for foamlier issue

- OV-103 17' LO2 Feedline Bstra A Ball Cracks (cont'd)
- EP - Propulsion and Power (cont'd)
- EAA STS-107 pre-RRR topics summary (cont'd)
Rationale for STS-107: Redundancy and successful ground checkout.

- LVDT failures have been observed before.

It is necessary that LVDTs be replaced by the vendor.

A3 KSC the trouble shooting will verify valve position during ball valve drain schedule for Dec 14, 2002. If A3 did eventually increase 96.8% during entry.

The ball valve 2 gave a consistent reading of 95.1% before, during, and immediately after the de-orbit burn.

Per the right rule, the right OMS may be used for de-orbit only.

Per the right rule, the right OMS dropped only 0.5% so that the current reading is 95.8% and should be 0%.

At the end of the OMS assist burn (ascend), the right OMS ball valve 2 continued to indicate open.

STS-13 Right OMS Engine B) Pre-Fire TPS Indicated Valve 2 Indicated Open (TPA: STS-13-V-02)

Propulsion and Power (cont'd)

EP - Propulsion and Power (cont'd)

Summary

STS-107 Quick Look

Pre-RRK Topics Summary (cont'd)

Full Summary

Shuttle/Engineering Office

Shuttle Engineering Office

Dec 16, 2002

Shuttle/Engineering Office

Johnson Space Center - Houston, Texas
Launches (requires LCC and File II OMRS/DP changes) – to be finalized at the 12-13-02 PSIC telecon

- Will probably require adjustment to GH2 pressurization control band set-points for STS-107 and subsequent minimum cracking pressure
- Elevated GH2 pressurization for block II SSMES was designed for essentially zero margin to ET relief valve
- Crackling pressure is 1.5 psi greater than previously accounted for
- Lockheed review of ET relief valve qualification test data indicates ET run-to-run variation in

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ICD waiver 5061/17 / IRN 10-1936 scheduled for 12-10-02 ICB approval

12-02-02 loads panel

Lockheed stress report: acceptable structural margins of safety with the predicted violations to the

and mound average SFR burn rate predictions (approved 11-04-02 ICB SR-1756)

STS-107 is first flight of lightweight ET with block II SSMES ET LO2 100.15% loading sensor LCC,

Flight specific prediction of ET GO2 pressurization performance indicates upper and lower

Flight pressure ICD violations

EP - Propulsion and Power (PSIC MPS Integration) (continued):
Reference previous EP summary - OPEN ISSUE / FLIGHT CONSTRAINT

- Impacts for different body Flap settings in the event of a body Flap actuator Jam/failure.
- The CNG Technical Panel and Entry Aerothermo group will provide feedback on assessment to entry flight control

Entry Aerothermo and GNC Flight Control Impacts due to Body Flap corrosion Issue

EC - Aerodynamics; Aero/Thermal; CNG

- Approved 1-07-02 PRGB 0565250M.

- Thermodynamic data and low resolution wind profiles for MSFC, SMG, and JSC entry analyses.

- Approved 1-07-02 IGB

- Boeing support facility moved from Huntington Beach to Houston - approved 1-19-02 IGB

- DOSB block update 2003.01 for STS-107

- Independent assessment by Boeing

- MOD personnel in the MCR are the prime operators for this activity

- Background: DOSB update guidance polynomials and max/A throttle bucket profile based on

- Day-of-launch load update (DOLLU II) Operations Support System (DOSS)

- EP - Propulsion and Power (SEP)

- EA STS-107 pre-PPR TOPICs Summary (continued):

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Flow Liner Weld Repair

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Reference previous EP summary - Open Issue / Flight Constraint

- ES is supporting the various teams: Loads & Stress, M&R, Test

OV-103 1T7 LOG Feeding BTA Ball Cracks

Reference previous EP summary - Open Issue / Flight Constraint

- ES and Boeing are re-investigating Hamilton Standard Stress analysis. Possible additional stress needed to

- ES is coordinating to EGs, GNC group and Aero-Thermal panel to assess jammed BP and implications.

- Thermal heating to the BF, elevons, their seals, and underlying and proximate structure.

- Applicability to OV-102 remains TBD. If jamming potential exists and cannot be ruled out by inspection, valid

Body Flap (BF) Actuator Corrosion (discovered on OV-104)

ES - Transitioned Orbiter: Structures / M&R; Non-Transitioned Orbiter: TCS (cont'd)

EA STS-107 Pre-RRR Topics Summary (continued):

<table>
<thead>
<tr>
<th>Date</th>
<th>Event</th>
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<tr>
<td>Dec 16, 2002</td>
<td>Shuttle/S-Grush</td>
<td>Engineering Office</td>
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</table>

STS-107 Quick Look Engineering Directorate

Johnson Space Center - Houston, Texas
No Issues

Group:

Structures Working Group and On-Orbit Proximity Operations & Plume Impingement Joint Working Group

No Flight Constraints.

Flight Margins Assessment.

Several lift-off load screening indicators exceeded their respective calculation on Orbiter and other Elements, but all flight specific mass/stiffness properties of Shuttle made vehicle coupled to cargo elements were cleared by subsequent structural analysis demonstrating positive margins.

ES - Systems Integration, Technical Panel Support, Shuttle Loads & Dynamics Panel

EA STS-107 Pre-RRR Topics Summary (continued):

<table>
<thead>
<tr>
<th>Date</th>
<th>Location</th>
<th>Summary</th>
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<tbody>
<tr>
<td>Dec 16, 2002</td>
<td>Shuttle Engineering Office</td>
<td>STS-107 Quick Look Engineering Directorate</td>
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</table>

Johnson Space Center - Houston, Texas
NO software changes post STS-113 and no open issues at this time.

Fifth Flight of O-29 Software

The 35 mm ET TP5 camera and one ET Step camera have already been shipped and installed on OV-102/STS-107.

Need date at KSC: Week of Jan 6th for pad install. If unsuccessful, will fly without camera (done before).

Failed camera: Lintel II utilize of these two cameras for STS-107.

Cameras from STS-113 were received the week of Dec 9th, and one is being replaced for test along with rework of the

One of the two ET Step cameras for STS-107 have not passed acceptance leak test - no obvious leaks have been

GFE - ET Step Cameras

EV - Aeronics CFE / GFE / Software

EA STS-107 Pre-PRR Topics Summary

(continued)

<table>
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<tr>
<th>Shack/S-Crush</th>
<th>Shuttle Engineering Office</th>
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Summary
STS-107 Quick Look
Engineering Directorate

Johnson Space Center - Houston, Texas
NO RMS or SYS flying on STS-107

ER - RMS/SYS

Flight battery installation and programming for flight planned to occur one week prior to launch

12 Micro-Strain Gauge Units (SCU's) installed in all compartment

Extremely-Mounted Micro-WIS components

Standard PSC units for STS-107 - no new hardware

PSC (laptops):

EB - Bio-Medical Systems

Summary

STS-107 Quick Look

Shuttle Engineering Office

Dec 16, 2002

Shuttle Engineering Office

Johnson Space Center - Houston, Texas
Cargo Arrangement

Summary
STS-107 Quick Look
Engineering Directorate
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<td>Crew Module</td>
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<tr>
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<td>Mission Specialist</td>
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<tr>
<td>William M. Brown (1st)</td>
<td>William M. Brown (1st)</td>
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<tr>
<td>David M. Brown (2nd)</td>
<td>Rice D. Husband (2nd)</td>
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<tr>
<td>Ken J. Farmer (3rd)</td>
<td>John R. Kugler (3rd)</td>
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<td>16 + 0 + 2 days</td>
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<td>00:00 METE</td>
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<td>16:39 EST</td>
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**Summary**
STS-107 Quick Look
Enduring Engineering Directorate
Shuttle Engineering Office
Dec 16, 2002

**Flight Overview** (Provided by Boeing/USA Internation)
Launch/Landing Times not to be released to General

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Summary
STS-107 Quick Look
Engineering Directorate
Shuttle Engineering Office

Digital Launch Window

Dec 16, 2002
Shack-S-Gush

Launch/Window

Launch/Landing Times not to be released to General

Window Openings
Nominal Flight Duration = 162210 (D-H-M) MET

STS-107 FRD DIGITAL LAUNCH WINDOW

November 11, 2002
Can you all call-in and participate too? The agenda is "geared" toward the jam question.

Julie, I think you also want a 10:30 am CST discussion too, right? The basic issue for OV-102 is, does a jam scenario apply to OV-102 (STS-107) and, if so or cannot be ruled out, does the Shuttle Program want to consider special assessments (aero-thermal and flight control/stability) for STS-107? We have not been directed to do so (yet).

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: Salvador, Lincoln J. [mailto:LJSalvad@xch-bsoc-06.ksc.nasa.gov]
Sent: Monday, December 16, 2002 3:08 PM
To: Salvador, Lincoln J.; EXT-Dahlke, Alan G.; DAKE, JANNA J. (JSC-DP52) (NASA); EXT-Alvar, Wayne S.; Rauch, Robert J.; BOLCH, LIONEL D. (DEVAN) (JSC-DP52) (USA); EXT-Brooks, Brian L; 'Carpenter, Susan HS-SNS';
EXT-Clancy, Anita M; Cabe, William L. (Butch); KRAMER, JULIE A. (JSC-EA4) (NASA); REGULA, KEVIN P. (JSC-CA) (USA); HERNANDEZ, FRANCISCO J. (JSC-EP) (NASA); GRUSH, GENE R. (JSC-EPL11) (NASA); Goodmark, Jeffrey A; 'Grow, Al HS-SNS'; Heino, Chip C; EXT-Heitzman, William J;
EXT-Hoffman, Patty A; EXT-Cipolletti, John P; Kagawa, Richard A;
'Keenan, Bill HS-SNS'; EXT-Knight, Dennis M; 'Larson, Tara HS-SNS';
EXT-Snyder, Michael J; 'Parker, Janet'; 'RADEWAN, JILL HS-SNS'; 'Ross, Susan HS-SNS'; EXT-Hydorn, Terril L; 'Tohlen, Dick HS-SNS'; 'Tollefson, Steve HS-SNS'; 'Valdez, Rudy HS-SNS'; 'Wahl, Brian HS-SNS'; 'Wells, Ken HS-SNS'; ROCHA, ALAN R. (RODNEY) (JSC-ES2) (NASA); EXT-Mosrie, Wan A;
Dunham, Michael J; Burghardt, Michael J; Mulholland, John P; Southwell, Scott L; Keyser, David S; Fuller, Mike J.; Seraphine, Alan C.;
Harrison, Steve; Rauch, Robert J.; Sheehan, Gerald; Merheb, Federico J.; McGurk, Brian; Park, Charles L; Diehl, James L.; Dye, Michael J; Moon, Darwin G; ZALIT, DANIEL L. (JSC-NC) (GHG); BASCI, TANSEL L. (JSC-NC) (SAIC); Ken Derleth (E-mail); Crawford, Johnny R.; McCorvey, Donald L; EXT-Hillier, Glen A; Danoff, Howard A.; Spalding, Richard M.; Wilson, Robert J.; 'Meesakul, Kathy'; 'Smith, Kevin'; 'Fekete, David'; 'Weiner, Debbie'; 'Gurecki, John'; LEVY, VINCENT M. (JSC-EG) (NASA); McDermott, Bill A; Pond, Charles L; EXT-Purkey, Vester; THIBODEAU, JOSEPH R. (JOE) (JSC-EG) (NASA); Lam, Loc T; SARAFIN, MICHAEL L. (JSC-DP6) (NASA);
LEGA, DAVID B. (DAVE) (JSC-DP611) (USA); GRUBER, DAVID J. (JSC-DP611) (USA); GONZALEZ, RAMON S. (JSC-DP611) (USA); Herrera, Linda; Peck, Don; Moore, Randy J; EXT-Beckwith, Richard E; HAMMERSCHMIDT, MARK M. (JSC-EG4) (NASA); RUPPERT, JOHN P. (JSC-EG) (NASA); LEVY, VINCENT M. (JSC-EG) (NASA); ALBRIGHT, JOHN D. (JSC-EP4) (NASA); MAYBAUX, BRIAN M.
There will be a PRT on the Body Flap Actuator Corrosion on Tuesday (17Dec02) at 9:30 AM EST.

The action item list will be updated. If one has an action please attend or designate someone who can support with resolutions.

Two specific items that need discussion are:

1. What is the chance of spalling material off the internal gears? Can the spalling result in jamming the actuator?

2. Scenarios resulting from a jammed actuator.

AUDIO ACCESS INFORMATION:

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PRODUCT TYPE: UNATTENDED
CALL TYPE: MEET ME

# OF LINES: Total=40 Dialout=0 Meet Me=40 Meet Me Toll=0
Entry Method: Silent Entry
CALL DATE: DEC-17-2002 (Tuesday)
CALL TIME: 09:30 AM EASTERN TIME
DURATION: 3 hr

LEADER: MR LINCOLN SALVADOR

FEATURES:
================================
Silent Entry

Link Salvador
Boeing Sub-System Manager
Mechanisms, Latches, MPM
NSLD, Cape Canaveral, FL
321.799.6836 (voice)
FYI and, of course, we need to do the "homework" as Glenn Miller calls it.

Rodney Rocha
Structural Engineering Division (ES-SED)
• ES Div. Chief Engineer (Space Shuttle DCE)
• Chair, Space Shuttle Loads & Dynamics Panel
Mail Code ES2 Phone 281-483-8869

---Original Message---
From: MILLER, GLENN J. (JSC-EA) (NASA)
Sent: Wednesday, December 11, 2002 9:18 AM
Cc: SHACK, PAUL E. (JSC-EA42) (NASA); KRAMER, JULIE A. (JSC-EA4) (NASA)
Subject: Jammed Actuator

Gene and Rodney,

On this mornings tagup it sounded like the technical community was about to declare a jammed actuator as acceptable because it was not required by flight control. The statement about flight control not needing the body flap is probably true, however I would be surprised if the structures story was mature enough at this time to be "umbrella'ed" by a positive V&C assessment.

In particular, I would be interested in hearing how the external loads on the body flap are "redistributed" due to a jammed actuator changing the stiffness at one of the four attach locations. It maybe that the stiffness four each attach location is controlled more by the local structure (spars, ribs, etc) rather than the gearing in a mechanism. But I would think at least a quick FEM assessment and internal load ratioing would be in order to feel comfortable that the surrounding structure (including attach linkage) still has positive margins.

I don't think corrosion is a next flight concern, I'm more concerned about the precedence of saying that a jammed actuator is acceptable. This kind of a "universal" statement can come back to haunt you in the future if you don't do all the homework upfront.

Thanks Glenn
The trim charts were updated to include a family of curves between the Thermal trim limit of 16.4 deg up elevon (7 deg down body flap) and the Aero trim limit of 12 deg down body flap, using the nominal Xcg - 2in. trim case (page 4).

This package will be presented at this afternoon's GNC panel meeting (2pm, B.16, R111)
Let me know if you have any questions.
Olman.
281-853-1561
Body flap hinge moment coefficients reach severe levels (structure issue).

Elevons stay at -35° down to Match 4 (healing issues).

Excess pitch might be controllable through RCS; however:

Trim impossible with full-down body flap.

Trim possible with nominal and full-up body flap.

Trim possible with nominal and full-up body flap.

Aerodynamic - only summary for longitudinal trim:

Results presented on following 7 charts.

- Aerodynamic trim attempted with only elevator.

- Using modified "trim" program.

- Pre-flight longitudinal trim analyses performed for body flap at -11.7° and +22.5° down (±22°) position.

- Program "trim" modified to work with body flap locked at full up (±11.7°) or full process.

Usual entry pre-flight longitudinal trim analyses performed using established flow.

Flap bounds

STS-107 Entry Longitudinal Aerodynamic Trim Analyses with Body
Nominal X-CG: Nominal Speedbrake
STS-107 Pre-Flight Entry Longitudinal Trim Predictions

Excess Pitch coefficient can be plotted separately

Steady-state trim limit is +1.2°
excess pitch coefficient can be plotted separately.

AFT X-CC (NOM + 2.7): NOMINAL SPEEDBREAK
ST2-107 PRE-FLIGHT ENTRY LONGITUDINAL TRIM PREDICTIONS

Dynamic trim limit +12°
aerodynamic trim limits at 13°

aerodynamic trim limits at 12°

FWD X-CG (NOM - 2") NOMINAL SPEEDBREAK
STS-107 PRE-FLIGHT ENTRY LATERAL TRIM PREDICTIONS
Georgi Ushkov

3/19/2003

Excess Pitch Coefficient (Cm)

Wmax (TAS/TAS/1000 ft)

Body Flap at +22.5 Deg

Excess Pitch Coefficient When Aerodynamic Trim Impossible

STS-107 Pre-Flight Entry Longitudinal Trim Predictions

Elevons fully up at -5 Deg

All excess pitch coefficient occurs when aerodynamic trim impacted at +13°
Body flap hinge moment coefficient.

Nominal X-CG

Body flap hinge moment coefficient.

STS-107 pre-flight entry longitudinal trim predictions.

Because of the higher lift at the 45-degree angle, the flap angle is basically unchanged.
Nominal X-CG: Nominal Speed Brake
Outboard Elevon Hinge Moment Coefficient
STS-107 Pre-Flight Entry Longitudinal Trim Predictions
Smith, J. M. (JSC-EG) (NASA)
Charts for today's Entry GN&C

Dec 17 at
2:00 CST in B16, Rm 111. The agenda with attached charts follows:

1. Status of Bodyflap Actuator Corrosion Analysis (all)
   (no charts)

2. TAL (OPS3) Qbar Envelope Expansion (Schottel/Reed)
   <TAL Target Line Entry QBAR Analysis.ppt>  <<TAL QBAR ENVELOPE
   .PANSION.ppt>

3. GRTLS Envelope Expansion Groundrules & Assumptions
   (Blankinship/Wilson)
For those in Houston, limited hardcopies will be available at the meeting. All charts should be viewable electronically during the meeting as well (overheads not required).

Thanks,

Jim Harder
281-226-8541
Entry GN&C/PC Analysis
Boeing NASA Systems