To:
From: Wilson Harkins <wharkins@hq.nasa.gov>
Subject: Re: Columbia
Cc:
Bcc:
Attached:

Thanks for the note. If we end up needing anything we'll let you know. You are right about how many people are affected by these types of things. It turns out that grew up in Arlington and attended the same church I now attend. Many of the older parishioners knew him well.

v/r

Wil

At 12:22 PM 2/3/2003, you wrote:

> I know this is a tough time for you guys; if there is anyway we can help, we're standing by.
> My next door neighbor had trained this crew on payloads for a long time, you're always surprised how many people are affected by something like this happens.
> Keep your heads up.

X-Originating-IP: [147.139.3.9]
From:
To: <bill.loewy@hq.nasa.gov>
Subject: Root Cause Analysis
Date: Tue, 4 Feb 2003 11:03:43 -0500
X-Mailer: MSN Mail 8.00.0022.3100
X-OriginalArrivalTime: 04 Feb 2003 16:03:44.0030 (UTC) FILETIME=[FE0583E0:01C2CC66]

<?xml:namespace prefix="v" /><?xml:namespace prefix="o" />
Hello Bill,

I am writing this to you because I don't know who else to send it to and if you are not the appropriate person you would probably know who to pass it on to. First off I can't tell you how sad I am as an individual over the tragic turn of events for the Columbia. My thoughts and prayers go out to the family and friends of the Astronauts and to all of you in the NASA organization.

Second as an Engineer it really bugs me when something like this happens and it stays in my sub-conscious until I hear a good explanation for it. The media coverage of the accident has helped us to understand some of the dynamics of the situation and the footage of the external fuel tank foam insulation striking the left wing of the orbiter must certainly be a prime candidate for analysis of the root cause of the failure. I have heard speculation that an oblique impact on a tile may have caused it to dislodge completely from the isolation material. If this occurred in a critical area such as the wheel well door, this would explain the heating abnormality, loss of further tiles and so on.

Something else bothered me as I watched the footage of the foam strike from the ground camera. I noticed that most of the foam (and or ice) material was pulverized when it struck the wing. I cannot determine from the footage how much of the material was deflected or if any of the tiles came off at that time. I wondered if some of the foam might have embedded itself in the gaps around the individual tiles? The material struck the wing with enough force to embed itself with considerable force over an area that might have encompassed more than 1 tile. If the foam in the inter-tile spaces had prevented the tile from expanding to fill the gaps, the built up forces might have caused the tiles to buckle, become detached and so on.

I just wanted to give you this input. I know you must have a million theories from ten times as many people. Thanks for hearing me out!
Best regards,

Performance Technologies
205 Indigo Creek Drive
Rochester, NY 14623

From:
To: <bill.loewy@hq.nasa.gov>
Subject: Shuttle Safety
Date: Sat, 1 Feb 2003 13:47:31 -0500
X-Mailer: Microsoft Outlook Express 5.00.2615.200

If someone truly believed they had a logical way to prevent further tragedy in the U.S Space program. Would you be interested? I beleive I know a way. Please send my family's condolences to all of the grieving families.

If interested please contact me @

Respectfully,

X-Originating-IP: [216.8.6.88]
From: [redacted].com>
To:
Subject: News !?!!
Date: Sun, 02 Feb 2003 21:24:34 +0000
X-OriginalArrivalTime: 02 Feb 2003 21:24:34.0840 (UTC) FILETIME=[7B928180:01C2CB01]

A few people die in an airplane crash and thats supposed to be news!?!!

What about all the rest of the people that were killed today what about them !
What about all the people killed in car crashs today what about them!

How about all the childern that were starved to death today so pope johnny could make money off all of their pain and suffering by pope johnny demanding everyone overpopulate the world to death and then have the local priests stand up and say look at all that starvation over there everybody Quickly give me money.

How come we haven't heard about them on the news, I guess they only talk about them on sunday morings in church so the priests can make money!!!

WHAT ABOUT THEM !

Date: Mon, 03 Feb 2003 12:23:13 -0400
From:
Subject: Space walk?
To: bill.loewy@hq.nasa.gov
X-Mailer: Microsoft Outlook Express 6.00.2800.1106

We are sorry to hear of the great loss of crew on the Columbia. It is a good thing that no one on the land was hurt as well.

I was just wondering if Commander Rick Husband knew that the Foam from he fuel tank hit the Orbitor's left wing on take-off?

If so, would it have been possible to take a spacewalk while they were out there and check things out?
Would repairs have been able to be made at the space station?

Our prayers are with all.

Nova Scotia, Canada

To:
From: Eric C Raynor <eraynor@hq.nasa.gov>
Subject: Fwd: Re: Hypothesis regarding mechanism of Columbia loss.
Cc:
Bcc:
Attached:

I've just learned that NASA has set up a means for persons such as yourself to provide any information you might have that could assist with the Columbia accident investigation...you may:

1) address email to: public-inquiries@hq.nasa.gov
2) address paper mail to: Code CIC, NASA Headquarters, Washington DC 20546.

- Eric Raynor

Date: Mon, 10 Feb 2003 15:20:12 -0500
To:
From: Eric C Raynor <eraynor@hq.nasa.gov>
Subject: Re: Hypothesis regarding mechanism of Columbia loss.

I would suggest that you contact either of the following offices at NASA HQ for further assistance:

1) The NASA Office of Public Affairs (which is responsible for public relations coordination and the coordination of incoming information from the public regarding the Columbia accident) at 202-358-1898
or
2) the NASA Office of Space Flight (which has direct managerial and technical oversight of the shuttle program) at 202-358-2015

- Eric Raynor, NASA Office of Safety and Mission Assurance

At 02:34 PM 2/7/2003 -0800, you wrote:
Mr. Raynor:

I have come up with an hypothesis for the loss of Columbia. Said hypothesis explains the effects of the minor wheel well and fuselage heating, as well as the loss of certain sensors that have been mentioned.

Reports or information supplied to your office are supposed to be done by employees of either NASA or NASA contractors. I am not employed either by NASA or any of its contractors and therefore do not know what

the proper channel might be for disclosure of the type information mentioned. It should also be noted that the hypothesis does not involve any classified or priveleged information, and neither does it involve any activity of wrong doing by anyone. The information to be provided is purely of a technical nature.

You as the "NSRS Chairman" appear to be the proper conduit for such information. In this regard, please advise the proper office or individual with whom to discuss such information, and the mechanism by which to make the contact.

Sincerely,

From: Baker Robert P Maj AFSC/SEPP <Robert.Baker@kirtland.af.mil>
To: "'jlemke@hq.nasa.gov'" <jlemke@hq.nasa.gov>
Subject: Condolences
Date: Mon, 3 Feb 2003 20:32:45 -0000
X-Mailer: Internet Mail Service (5.5.2653.19)

John,

My condolences on your loss. You and the NASA family are in our thoughts and prayers.

V/R,

Bob

ROBERT P. BAKER, Major, USAF
Chief, Air Force System Safety Policy
AF/SEPP

Air Force Safety Center

To:
From: jlemke <jlemke@hq.nasa.gov>
Subject: RE: Are you in?
Cc:
Bcc:
Attached:

If it was covered with ice from the cryogenics in the tank--it would weigh enough to harm the fragile foam on the orbiter.

At 11:11 AM 2/3/2003 -0500, you wrote:
I think of foam as weighing about nothing, so how could something like that falling on wing do any damage at all?

John Lemke
Manager, System Safety Engineering
NASA HQ, Code QS
202-358-0567 FAX 358-3104
jlemke@hq.nasa.gov
"Mission success stands on the foundation of our unwavering commitment to safety"
Administrator Sean O'Keefe January 2003

X-Authentication-Warning: spinoza.public.hq.nasa.gov: majordom set sender to owner-code-q using -f
X-Sender: jlloyd@mail.hq.nasa.gov
X-Mailer: QUALCOMM Windows Eudora Version 4.3.2
Date: Fri, 07 Feb 2003 14:25:55 -0500
To: smadir@hq.nasa.gov
From: James Lloyd <jlloyd@hq.nasa.gov>
Subject: Fwd: Code Q Documents
Cc: code-q@lists.hq.nasa.gov
Sender: owner-code-q@lists.hq.nasa.gov

Dear SMA Director,

Be advised concerning the single string nature that this attached guidance creates. We are pulling together THE safety oriented Q&As for the Administrator. It is crucial we do the best we can -- as always.

Thanks,

X-Sender: jmannix@mail.hq.nasa.gov
X-Mailer: QUALCOMM Windows Eudora Version 4.3.2
Date: Fri, 07 Feb 2003 12:22:42 -0500
To: bruce.anderson-1@ksc.nasa.gov, k.a.kurke@larc.nasa.gov,
smauldin@mail.arc.nasa.gov, david.samuels@mail.dfrc.nasa.gov,
John.Sikora@lerc.nasa.gov, mwinchel@ems.jsc.nasa.gov,
Lawrence.f.Watson@gsfc.nasa.gov, thowell@nmo.jpl.nasa.gov,
William.a.hicks@msfc.nasa.gov, ken.human@ssc.nasa.gov
From: "John G. Mannix" <jmannix@hq.nasa.gov>
Subject: Code Q Documents
Cc: ppastore@hq.nasa.gov, rstephen@hq.nasa.gov, jlloyd@hq.nasa.gov

I am coordinating the hearing preparation with Jim Lloyd, who is acting head of Code Q. The Code Q folks at the field centers are being pulled in a lot of directions to get information to the investigation teams and Code Q HQ. On the telecon last night we discussed having you look into material at your center. For the time being, please do not ask your Code Q people at the center to provide materials to you. We will depend on Code Q HQ to get us all the information that we need for the Wed hearings. If there is material you have access to without getting the Code Q field personnel involved then please look at it.

Jim

To: "Schilder, Craig, Mr, OSD-ATL" <Craig.Schilder@osd.mil>
From: jlemke <jlemke@hq.nasa.gov>
Subject: Re: Assessing the Odds of Catastrophe.htm
Cc:
Bcc:
Attached:

At 08:40 AM 2/6/2003 -0500, you wrote:

February 6, 2003

Assessing the Odds of Catastrophe

Craig:

Thanks.

johnl

Laura Giza, 12:43 PM 2/8/2003 -0500, Congressional hearings - safety and mishap investigation

X-Sender: lgiza@mail.hq.nasa.gov
X-Mailer: QUALCOMM Windows Eudora Version 4.3.2
Date: Sat, 08 Feb 2003 12:43:16 -0500
To: jlemke@hq.nasa.gov, wfrazier@hq.nasa.gov
From: Laura Giza <lgiza@hq.nasa.gov>
Subject: Congressional hearings - safety and mishap investigation policies

John and Wayne,

I believe Dan Thomas may have already mentioned this to you, but it is likely that questions at the hearings on Wednesday will ask about NASA's safety policies with respect to the shuttle (our policies to prevent mishaps) as well as our policies on investigations conducted after mishaps occur. Code Q should be pulling this stuff together, as well as summaries on these policies to help prepare the Administrator for the hearings.

To: "Wayne R. Frazier" <wfrazier@hq.nasa.gov>
From: jlemke <jlemke@hq.nasa.gov>
Subject: Fwd: Question from Paul Pastorek:
Cc:
Bcc:
Attached:

Date: Mon, 10 Feb 2003 11:55:03 -0500
To: "Wayne R. Frazier" <wfrazier@hq.nasa.gov>
From: jlemke <jlemke@hq.nasa.gov>
Subject: Question from Paul Pastorek:
Cc: Pete Rutledge <prutledg@hq.nasa.gov>

John Lemke
Manager, System Safety Engineering
NASA HQ, Code QS
202-358-0567 FAX 358-3104
jlemke@hq.nasa.gov
"Mission success stands on the foundation of our unwavering commitment to safety"
Administrator Sean O'Keefe January 2003

John Lemke
Manager, System Safety Engineering
NASA HQ, Code QS
202-358-0567 FAX 358-3104
jlemke@hq.nasa.gov
"Mission success stands on the foundation of our unwavering commitment to safety"
Administrator Sean O'Keefe January 2003

To: "Wayne R. Frazier" <wfrazier@hq.nasa.gov>
From: jlemke <jlemke@hq.nasa.gov>
Subject: Fwd: Question from Paul Pastorek:
Cc:
Bcc:
Attached:

Date: Mon, 10 Feb 2003 11:55:03 -0500
To: "Wayne R. Frazier" <wfrazier@hq.nasa.gov>
From: jlemke <jlemke@hq.nasa.gov>
Subject: Question from Paul Pastorek:
Cc: Pete Rutledge <prutledg@hq.nasa.gov>

John Lemke
Manager, System Safety Engineering
NASA HQ, Code QS
202-358-0567 FAX 358-3104
jlemke@hq.nasa.gov
"Mission success stands on the foundation of our unwavering commitment to safety"
Administrator Sean O'Keefe January 2003

John Lemke
Manager, System Safety Engineering
NASA HQ, Code QS
202-358-0567 FAX 358-3104
jlemke@hq.nasa.gov
"Mission success stands on the foundation of our unwavering commitment to safety"
Administrator Sean O'Keefe January 2003

X-Sender: hcat@mail.hq.nasa.gov
X-Mailer: QUALCOMM Windows Eudora Version 4.3.2
Date: Sun, 09 Feb 2003 21:07:40 -0500
To:
From: HCAT <hcat@hq.nasa.gov>
Subject: Shuttle Underwing Tile Separation
Cc: bloewy@hq.nasa.gov

Mr. Whitford,

Your message regarding Shuttle underwing tile separation was forwarded to this office by Mr. Loewy. To expedite getting information of this sort to the proper team in the field, please call 1 800 203-7001. This is a toll free number. Those that receive your message will direct it to the team working issues in this discipline.

NASA thanks you for your willingness to assist in this important matter.

From: "
To: "'bill.loewy@hq.nasa.gov <bill...oewy@hq.nasa.gov>
Subject: COLUMBIA
Date: Thu, 6 Feb 2003 10:45:02 -0500
X-Mailer: Internet Mail Service (5.5.2653.19)

Sir,

I share in grief felt by all in the loss of Columbia. I have watched most of the coverage with keen interest. I know you have the smartest people working on finding the cause of the accident, but one thought came to mind that has not been covered so far, and I wanted to offer it.

In the past day, I understand that NASA does not believe that the fuel tank insulation caused enough damage to the heat shield tiles to cause the accident. However, is it possible that the insulation jarred the landing gear door loose/open even a small amount? This might account for the increase in drag on the left side during re-entry that has been referred to in the press, as well as the rise in temperature in the landing gear area. Although the tiles on the skin would dissipate the heat, the breach in the skin would have allowed a small amount of heat through enough to cause the temperature increase, and then a rapid increase once the inside of the door gave way.

Thank you. I apologize if I have wasted your time. I appreciate the space program and the work you all perform.

From:
To: <bill.loewy@hq.nasa.gov>
Subject: Tile adhesives
Date: Thu, 6 Feb 2003 22:38:30 -0700
X-Mailer: Microsoft Outlook Express 6.00.2800.1106

To whom it may concern,

I was just wondering if the tile adhesive used is variably hygromorphic in a temperature dependant function. If this function of hygromorphism was inversely proportional to the temperature, then cold storage in humid environments could allow for adhesive-vapor storage. Intense heat directly afterwards would cause rapid vapor expansion, creating pressure within the adhesive. Basically, if enough pressure builds up, the tiles could be released as the adhesive is compromised.

Just curious what you might think,

From:
To: <bill.loewy@hq.nasa.gov>
Subject: Shuttle Saftey
Date: Thu, 6 Feb 2003 03:09:57 -0500
X-Mailer: Microsoft Outlook Express 5.50.4522.1200

TO: All involved with the Space Program, and the families who have suffered loss, I wish to send my deepest sympathy and many prayers. The tragic loss of the seven astronauts who so willingly gave of their lives for the advancement of space must be remembered , not in shutting the program down, but in pressing on with the job to be done.

I'm sure that you are flooded with all sorts of suggestions at this time, but I wonder if you would consider this thought I have had. If this is not your area of responsibility, could you pass it on to the department that could consider it.

It would seem to me to be possible, and at little cost to have the Shuttle after launch make its way to the area of the Space Station. Then have the vehicle turn itself around so that all parts of the Shuttle are visible and have the Space Station crew video the Shuttle. These videos could be sent down to an appropriate NASA group for immediate review, so that if there was any launch damage to the craft, it could be spotted early and provide extra time for possible rescue plans to be put in place.

This idea may be completely wacky and impossible to carry out, but I feel if there is one chance in a thousand of something happening that can be detected ahead of time, then this might be it.

Thanks for your consideration, and again my sympathies,

Yours truly

From:
Date: Thu, 6 Feb 2003 09:41:49 EST
Subject: Enhanced Safety
To: bill.loewy@hq.nasa.gov
X-Mailer: AOL 8.0 for Windows US sub 230

Suggest you fabricate a cuff for the leading edge of the Shuttles wing during launch to insertion into orbit. The leading edges of the wing because of their angle are the most vulnerable part of the shuttle from impact damage. Cuffs could be light weight, and be jettisoned once the shuttle is in orbit. Kevlar cuffs, Yeah, that's the ticket.

From:
Date: Thu, 6 Feb 2003 09:46:32 EST
Subject: Improving Shuttle Safety
To: bill.loewy@hq.nasa.gov
X-Mailer: AOL 8.0 for Windows US sub 230

I suggest that you put cuffs on the leading edges of the shuttles wing to protect that area from launch to orbit insertion. This area, the leading edge of the wings, because of its angle to the fuselage is most vulnerable to impact damage. Once in orbit, the cuffs could be released, or jettisoned. Kevlar cuffs like deicer boots. Yeah that's the ticket.

From:
To: "'bill.loewy@hq.nasa.gov.'" <bill.loewy@hq.nasa.gov>
Cc:
Sub
Date: Wed, 5 Feb 2003 15:37:34 -0800
X-Mailer: Internet Mail Service (5.5.2650.21)

Gentlemen and Women of NASA

I am a total supporter of our nations space efforts . As such ...speaking to the observed insulation's wing impact and ensuing NASA conclusions drawn ...This is not for purposes of blame but of future remedy..... motivated by my own sense of grief , I humbly submit the following perhaps redundant perhaps "civilian" ideas...

1)Does there not need to be.? .....an over the side EVA capability(teathered /untethered)for inspection purposes when there is an issue that needs to be unambiguously resolved or as an SOP protocol prior to re-entry .It's unacceptable to me that that capability is not built in to every flight ; as I heard NASA state ,Saturday .

Also .....

2) use of the International Space Station as contingency inspection station with life boat capability(docking/transfer) as necessary .

Respectfully yours,sharing in the sorrow I am....

KQED-TV Operations
San Francisco

From:
To: <bill.loewy@hq.nasa.gov>
Subject: Could ice be part of the insulation that hit wing?
Date: Tue, 4 Feb 2003 12:24:13 -0500
X-Mailer: Microsoft Outlook Express 5.50.4133.2400
X-Virus-Scanned: by AMaViS and CyberSoft VFind

The spray from the wing looked partly like shattering ice.
Is it possible to spectro analyze from pictures?

From: [redacted]
To: "'bill.loewy@hq.nasa.gov'" <bill.loewy@hq.nasa.gov>
Subject: Tiles
Date: Wed, 5 Feb 2003 07:49:32 -0500
X-Mailer: Internet Mail Service (5.5.2653.19)

Until the disaster I had no idea that the tiles under the shuttle were so fragile. Not being an engineer, I was wondering why can't the under belly of the shuttle be coated with a plastic like recycled water and soda bottles to protect the tiles at launch? This coating would then burn up on re-entry.

From:
Date: Wed, 5 Feb 2003 08:00:23 EST
Subject: Flight Safty
To: bill.loewy@hq.nasa.gov
X-Mailer: AOL 8.0 for Windows US sub 230

Hi Bill,

My name is . I have always been in awe of the accomplisments of Nasa and the American heros that fly the missions. The engineers , and technicians that create and support the space program are Americas best. I have been to Cape Canaveral Several times and am always amazed and inspired by what I saw.

I have a Question about the safty of all space flights. After getting into orbit why isn't a tethered robotic self propelled camera used to send images of the entire ship to a monitor? Then the pilots could see if any damage has occurred from the flight into space. Pilots on the ground check planes before takeoff, and it just seems logical to check any space vehicle for damage before taking the trip back to earth.

My heart was broken when I heard the shuttle was lost. The best of the best have died.
Please do everything possible, to give future astonauts a every tool to secure their safty. Thank you.

Sincerly,

Date: Tue, 11 Feb 2003 13:54:34 -0800 (PST)
From:
Subject: Freeze Fracture of Tiles?
To: bryan.oconnor@hq.nasa.gov, william.readdy@hq.nasa.gov,
bill.loewy@hq.nasa.gov
Cc: osf@hq.nasa.gov

Dear Col O'Connor,

My name is I was stationed at Edwards as an Aerospace Physiologist during the time you were Commander of STS-40. I was USAF Liaison Officer for the postflight studies (SLS-1) at NASA Dryden. Basically a worker bee responsible for transportation, lodging of the scientists involved with SLS-1 experiments, or any problems that needed to be hammered out. It was an honor to be in the mix with so many great scientists and the astronauts of Columbia i.e. Rhae Seddon, Jim Baggian, Milly Fulford, Dr. John West, Dr. Ben Levine, etc.

I have a technical question that is out of my realm of expertise:

(A) If there was minor damage to the leading edge of the left wing from the insulation, resulting in minute cracks in the tiles, would the root cause of the catastrophic event be the following?

(B.) Water/ice from the outlet melting on the surface of the leading edge and "seeping" into the minute cracks in the tiles from the insulation impact during launch. The water then froze in the tiny cracks and then during re-entry thawed creating a freeze/fracture type of event such as that which might occur in geological structures (rock) i.e. fractured rrocks after years of freezing and thawing.

(C.) The Freeze/thaw cycle resulted in the de-lamination of tiles on the leading edge or panel/door to the left wheel well. De-lamination of the tiles during de-orbiting resulted in the catastophic event.

What do you think Dr. O'Connor?

Sincerely,

355th Medical Group/SGPZ

Davis-Monthan AFB, Tucson, AZ 85707

Date: Thu, 27 Feb 2003 00:59:49 -0500 (Eastern Standard Time)
X-Mailer: IncrediMail 2001 (1800838)
From:
X-FID: D0A712A4-BB7A-401B-8578-8046267F3558
X-FVER: 3.0
X-FIT: Letter
X-FCOL: Astronomy
X-FCAT: Nature
X-FDIS: Blue Horizon
X-Extensions:
SU1CTDEsNDYsgUmBSSiBJJ2FkSSJTTAwnSRNiYGFME3BjZ3BTcGBiZmRmZ04lY2NwUmBSYFJgSxJTUJM
MiwwLCxJTUJMMywwLCw=
X-BG: <667BFAFA-D1CE-4536-89B1-DC199CE678DD>
X-BGT: no-repeat
X-BGC: #000000
X-BGPX: center
X-BGPY: bottom
X-ASN: 3EC01550-4148-11D4-BA3D-0050DAC68030
X-ASNF: 0
X-ASH: 3EC01550-4148-11D4-BA3D-0050DAC68030
X-ASHF: 1
X-AN: 06F37D30-2BF8-11D4-BA28-0050DAC68030
X-ANF: 0
X-AP: 06F37D30-2BF8-11D4-BA28-0050DAC68030
X-APF: 1
X-AD: C3C52140-4147-11D4-BA3D-0050DAC68030
X-ADF: 0
X-AUTO: X-ASN,X-ASH,X-AN,X-AP,X-AD
X-CNT: ;
To: <j.h.starnes@larc.nasa.gov>
Cc: <bill.loewy@hq.nasa.gov>, <
Subject: Check Wheel Well Temperature during Columbia's Ascent
X-Authentication-Info: Submitted using SMTP AUTH at out006.verizon.net from [151.205.148.212] at Thu, 27 Feb 2003 00:01:06 -0600

To Whom It May Concern:

To verify if the breach occurred during lift-off, I recommend looking at the temperature indications on the left wing of COLUMBIA during its ascent into orbit. Then I would compare the results with previous Columbia ascents and even compare them with other orbiter ascents.

The reason is:

When the shuttle is launched, the air pressure and temperature in the wheel well compartment is approximately equivalent to sea pressure. During normal ascent with no breach, the pressure and temperature would stay the same or slightly increase until the orbiter reached altitude. The temperature and pressure would slowly begin to equalize with the coldness of the vacuum of space - approximately 12 to 24 hours due to convetive heat transfer.
However, if a breach occurred during lift-off as suggested, the temperature and pressure inside the wheel well would rapidly decrease as the orbiter increased in altitude. Once the orbiter reached its altitude, the temperature in the wheel well would equal the cold temperature of the vacuum of space. Therfore you would have temperature indications of a breach. Also, with the left wing depressurized and the right wing still

pressurized, the right wing would be slightly heavier. This would result in a weight shift in the orbiter requiring extra thrust to maintain attitude during final orbiter altitude. Recommend analyzing time and duration of orbital thruster firing. Longer firing of thrusters or extra firing of thrusters, however minor, compared to other orbiters of equal weight and altitude could also indicate a breach in the wing.

Finally, in regards to the tile found with the orange substance. The tile I believe was downstream and near the breach of the wheel well. The breach occurred in the seam of the wheel well at the aft end in the vicinity of the inside bulhead. As the hot plasma began to penetrate the wheel well it began to cut/melt the aft bulkhead of the wheel well. At the same time the breach grew in length along the bottom of the wing - forward to aft. The small breach passed under the tile that has the orange residue on it. As the plasma melted the bulkhead in the aft part of the wheel well, the aluminum became liquid metal. When the bulhead was penetrated with the hot plasma and liquid metal, the hydraulic lines and components failed releasing hydraulic fluid inside the wing. The liquid metal becomes contaminated with some of the hydraulic fluid. In regards to the tile mentioned earlier, the breach passes under the tile as a small cut but begins to expand in coverage further along the tile it goes. That is the reason the tile is able to stay attached to the wing. At the time the hydraulic fluid is released inside the compartment, the breach has expanded enough - port to stbd - to expose the bottom side of the tile to the liquid metal contaminated with hydraulic fluid. The liquid metal becomes embedded into the tile, hence a orangish color deposited onto the tiles.

V/R,

NASA
Public Relations Department

Dear Ladies and Gentlemen,

Concerning the recent tragic accident you have had on Feb.1st, I'm deeply disappointed regarding your safety checks before the return flight.

It seems obvious, as every pilot's job description and safety check procedure asks for, that mechanical integrity is visually checked before every flight . Very likely, lot of accidents have been avoided such, not only in aeronautical, but also in high process hazards industrial environment.

No excuse should avoid such procedure, even under the more difficult circumstances of space. Technical possibilities of a visual check must exist and be required to avoid re-occurrence of such deeply sad incident. The technical community is just expecting such minimum safety requirements from such a renown organisation as yours.

Disappointed regards,

From:
Date: Mon, 10 Feb 2003 17:35:30 EST
Subject: safety
To: bill.loewy@hq.nasa.gov
X-Mailer: AOL 8.0 for Windows US sub 230

Thank you so much for taking time out if your busy day to answer my question. My question is, in light of the disaster that just recently happened with the Columbia, what would you consider to be to worst disaster in NASA's history, and what things is your force doing to prevent such accidents in the future?

X-Sender: hcat@mail.hq.nasa.gov
X-Mailer: QUALCOMM Windows Eudora Version 4.3.2
Date: Sun, 09 Feb 2003 21:00:23 -0500
To: Bill Loewy <bloewy@hq.nasa.gov>
From: HCAT <hcat@hq.nasa.gov>
Subject: Re: Fwd: Shuttle Underwing Tile Separation

Bill,
Thanks for forwarding. A toll free number has been set up for this purpose 1-800-203-7001. Please refer folks to that number in the future, it will speed up the process of getting the information into the system. I will send Mr. Whitford this info tonight.

Thanks,

HCAT

At 08:19 AM 2/6/2003 -0500, you wrote:

From:
To: <bill.loewy@hq.nasa.gov>
Subject: Shuttle Underwing Tile Separation
Date: Wed, 5 Feb 2003 23:26:06 -0700
X-Mailer: Microsoft Outlook Express 6.00.2800.1106

I have went through the website in hopes of finding a direct link to HQ and the ongoing investigation of the Columbia tragedy. I have located your name on the website under safety and hope you may pass along the following comment of mine after my watching the video of the Columbia ascent.

Up to now, a piece of shuttle fuel tank protective foam has been considered as cause of possible underwing damage to the shuttle tile protective system. This hypothetical cause of damage is from the foam striking and "gashing" or possibly removing a small number of tiles during that event within the ascent phase of the flight. Re-entry is considered to then remove further tiles to the extent of core wing exposure causing left wing heat build up and possible extreme air pressure across the wing under surface area. This caused the craft to veer to the left and computor system corrections were unable to counteract the left torque; eventually exposing the craft to catastrophic wind forces.

Another possibility is that in fact the foam may have struck the underwing section but not gashed it;

- The foam piece may have struck the wing underside tile system, loosened it to the extent that a large block of tile came off and immediately disintegrated into small pieces. This would have left the wing underside area exposed during the ascent into the thinner upper atmosphere where little correction would be required or perhaps even noticed except upon further review of ascent telemetry. Of course as the craft underwent re-entry into denser atmosphere, the situation was completely the opposite and resulted in the loss of control and eventual destruction.
- Video of the ascent may have only concentrated on the foam strike with all cameras focused on the craft itself. There may be no video on the ascent trail behind the craft after the foam strike event. If there is video of that trail, it should contain the image of the foam section if not destroyed by motor exhaust from the SRBs. Any displaced and removed heat tile would be very difficult to spot even in high resolution video but it may be in the video record never the less. If some tile was displaced and it floats, it may likely be in a general area of the ascent track or washed up on shore if the weather conditions were correct.
- Again, all this may have already been considered, discussed at length and discarded in the days after the launch for good reasons.

As noted previously, this is only an opinion as there are many things I am not aware of; however, if it has not been considered, then it may be some food for thought.

With sympathy for your loss,

****
Bill Loewy
NASA Headquarters
Code QS
Office of Safety and Mission Assurance
Washington DC 20546
Bill.Loewy@hq.nasa.gov
****

"Mission success starts with safety"

</x-html>

X-Sender: hcat@mail.hq.nasa.gov
X-Mailer: QUALCOMM Windows Eudora Version 4.3.2
Date: Mon, 10 Feb 2003 15:24:52 -0500
To:
From: HCAT <hcat@hq.nasa.gov>
Subject: Re: Fwd: Re: Columbia
Cc: bill Loewy <bloewy@hq.nasa.gov>

Thank you for your email below. Please send your comments to columbiaimages@nasa.gov.

Thank you,
B. Adde

.rom:
To: "Bill Loewy" <bloewy@hq.nasa.gov>
Subject: Re: Columbia
Date: Mon, 10 Feb 2003 13:32:27 -0500
X-Mailer: Microsoft Outlook Express 6.00.2600.0000
X-Authentication-Info: Submitted using SMTP AUTH LOGIN at f
from [24.103.83.16] using at Mon, 10 Feb 2003 13:35:10 -0500

Thanks for reponding. The 800 number you have provided is not useable from Canada. Could you provide an email address or in the alternative confirm that you've forwarded it to the appropriate people.

Thanks

----- Original Message -----
From: <mailto:bloewy@hq.nasa.gov>Bill Loewy
To:
Sent: Monday, February 10, 2003 9:50 AM
Subject: Re: Columbia

To expedite getting information of this sort to the proper team in the field, please call 1 800 203-7001. This is a toll free number. Those that receive your message will direct it to the team working issues in this discipline.

NASA thanks you for your willingness to assist in this important matter.

At 06:43 PM 2/7/2003 -0500, you wrote:
To Whom It May Concern;

I've been searching the NASA site with the hope of finding somewhere to pass on my query. Hopefully you will pass this info to those who may find it of some use.

Considering the fact that it's winter and Columbia sat on the pad for twenty eight days might the following be possible? Long prior to liftoff water became trapped between various tiles freezing and thawing repeatedly? If so, might this form of thermal dynamics have the potential to cause cracking of either, the tiles themselves, and or the bond interface between the tiles and their respective bonding surface? During the vehicles ascent the foam impact may have imparted enough energy to the tiles to further weaken an already damaged structure? As re-entry began vehicle contact with the upper atmosphere may have initiated a tile shedding casscade or domino effect?

With Respect

Canada

****
Bill Loewy
NASA Headquarters
Code QS
Office of Safety and Mission Assurance
Washington DC 20546
Bill.Loewy@hq.nasa.gov
****
"Mission success starts with safety"

</BODY></HTML>

</x-html>

****
Bill Loewy
NASA Headquarters
Code QS
Office of Safety and Mission Assurance
Washington DC 20546
Bill.Loewy@hq.nasa.gov
****

"Mission success starts with safety"

From: "Prines, Xavier L" <PrinesXL@navair.navy.mil>
To: "'engineer@hq.nasa.gov" <engineer@hq.nasa.gov>,
"'bill.loewy@hq.nasa.gov" <bill.loewy@hq.nasa.gov>,
"'columbiaimages@nasa.gov" <columbiaimages@nasa.gov>
Subject: Potential factors being overlooked in STS-107 investigation
Date: Mon, 10 Feb 2003 13:49:38 -0500
X-Mailer: Internet Mail Service (5.5.2656.59)

All,
While I was watching video of the launch of STS-107 (http://www.spaceref.com/Columbia/post.launch.video.html) I immediately thought of two questions I would present if involved in an investigation.

1) Since there was no less than two pieces of insulation to hit the left wing, was the original analysis performed with the worst case in mind? The worst case being that both/all pieces of insulation hit the same area of the shuttle.

2) Will loose insulation allow for considerably larger pieces of ice to form in the new voids until it is actually the ice that breaks free and not simply a piece of insulation? The follow-up would be:

a. Does insulation disintegrate in large clouds as we see in the video aft of the wing edge from an impact at such a shallow angle or is it ice?

Due to my lack of knowledge in this area and without the answers, it would be too early to pose this as a safety of flight issue when considering re-entry and relating it to the following catastrophe.

I trust that I will be contacted if I provoke a valuable discussion on this topic. Thank you for you time during these incredibly busy hours.

Respectfully,

Xavier Prines

United States Navy, NAVAIR
Life Support Engineer and
Chemical, Biological, Radiological Defense Engineer

PrinesXL@navair.navy.mil

X-Sender: hcat@mail.hq.nasa.gov
X-Mailer: QUALCOMM Windows Eudora Version 4.3.2
Date: Sun, 09 Feb 2003 21:00:23 -0500
To: Bill Loewy <bloewy@hq.nasa.gov>
From: HCAT <hcat@hq.nasa.gov>
Subject: Re: Fwd: Shuttle Underwing Tile Separation

Bill,
Thanks for forwarding. A toll free number has been set up for this purpose 1-800-203-7001. Please refer folks to that number in the future, it will speed up the process of getting the information into the system. I will send Mr. Whitford this info tonight.

Thanks,

HCAT

At 08:19 AM 2/6/2003 -0500, you wrote:

From:
To: <bill.loewy@hq.nasa.gov>
Subject: Shuttle Underwing Tile Separation
Date: Wed, 5 Feb 2003 23:26:06 -0700
X-Mailer: Microsoft Outlook Express 6.00.2800.1106

I have went through the website in hopes of finding a direct link to HQ and the ongoing investigation of the Columbia tragedy. I have located your name on the website under safety and hope you may pass along the following comment of mine after my watching the video of the Columbia ascent.

Up to now, a piece of shuttle fuel tank protective foam has been considered as cause of possible underwing damage to the shuttle tile protective system. This hypothetical cause of damage is from the foam striking and "gashing" or possibly removing a small number of tiles during that event within the ascent phase of the flight. Re-entry is considered to then remove further tiles to the extent of core wing exposure causing left wing heat build up and possible extreme air pressure across the wing under surface area. This caused the craft to veer to the left and computor system corrections were unable to counteract the left torque; eventually exposing the craft to catastrophic wind forces.

Another possibility is that in fact the foam may have struck the underwing section but not gashed it;

- The foam piece may have struck the wing underside tile system, loosened it to the extent that a large block of tile came off and immediately disintegrated into small pieces. This would have left the wing underside area exposed during the ascent into the thinner upper atmosphere where little correction would be required or perhaps even noticed except upon further review of ascent telemetry. Of course as the craft underwent re-entry into denser atmosphere, the situation was completely the opposite and resulted in the loss of control and eventual destruction.
- Video of the ascent may have only concentrated on the foam strike with all cameras focused on the craft itself. There may be no video on the ascent trail behind the craft after the foam strike event. If there is video of that trail, it should contain the image of the foam section if not destroyed by motor exhaust from the SRBs. Any displaced and removed heat tile would be very difficult to spot even in high resolution video but it may be in the video record never the less. If some tile was displaced and it floats, it may likely be in a general area of the ascent track or washed up on shore if the weather conditions were correct.
- Again, all this may have already been considered, discussed at length and discarded in the days after the launch for good reasons.

As noted previously, this is only an opinion as there are many things I am not aware of; however, if it has not been considered, then it may be some food for thought.

With sympathy for your loss,

****
Bill Loewy
NASA Headquarters
Code QS
Office of Safety and Mission Assurance
Washington DC 20546
Bill.Loewy@hq.nasa.gov
****

"Mission success starts with safety"

</x-html>

Date: Wed, 05 Feb 2003 17:58:53 -0500
From:
User-Agent: Mozilla/5.0 (Windows; U; Win98; en-US; rv:1.0.2) Gecko/20021120 Netscape/7.01
X-Accept-Language: en-us, el, fr, it, de-de, ru, u
To: bill.loewy@hq.nasa.gov
Subject: Contact fRequested for the STS-107's Space Shuttle Mishap Interagency Investigation Board
X-ELNK-Trace:
ef0804440324e77f223321b494de702558004a783000c4d12c2a08cfe917b27e707c0f52c8eaf847350badd9bab72f9c350badd9bab72f9c350badd9bab72f9c

Subject: Contact Requested for the STS-107's Space Shuttle Mishap Interagency Investigation Board

Could you kindly provide me with a telephone number, and contact, and address if possible for the newly appointed STS-107's Space Shuttle Mishap Interagency Investigation Board, head by Retired U.S. Navy Admiral Harold W. Gehman, Jr.

Below is the NASA Public Release announcement.

Thank You,

Northboro, MA

---

http://spaceflightnow.com/shuttle/sts107/030202gehman/

NASA announces Columbia accident investigation board
Posted: February 2, 2003

Retired U.S. Navy Admiral Harold W. Gehman, Jr., to lead investigation board. Photo: Navy

NASA Administrator Sean O'Keefe today announced the members of the Space Shuttle Mishap Interagency Investigation Board, which will provide an independent review of the events and activities that led up to the tragic loss of the seven astronauts Saturday on board the Space Shuttle Columbia.

The board's first meeting is scheduled for tomorrow at Barksdale Air Force Base in Louisiana.

Retired U.S. Navy Admiral Harold W. Gehman, Jr., who co- chaired the independent commission that investigated the attack on the U.S.S. Cole in Aden, Yemen, Oct. 12, 2000, and once served as the commander-in-chief of U.S. Joint Forces Command, will chair the panel.

"While the NASA family and the entire world mourn the loss of our colleagues, we have a responsibility to quickly move forward with an external assessment to determine exactly what happened and why," said Administrator O'Keefe. "We're honored to have such a dist[illegible] Admiral Gehman."

Other members of the investigative board includes:

* Rear Admiral Stephen Turcotte, Commander, U.S. Nav[illegible]

Center, Norfolk, Va.
* Major General John L. Barry, Director, Plans and Programs, Headquarters Air Force Materiel Command, Wright-Patterson Air Force Base, Ohio
* Major General Kenneth W. Hess, Commander, U.S. Air Force Chief of Safety, Kirtland Air Force Base, N.M.
* Dr. James N. Hallock, Aviation Safety Division Chief, U.S. Department of Transportation, Cambridge, Mass.
* Steven B. Wallace, Director of Accident Investigation, Federal Aviation Administration, Washington
* Brigadier General Duane Deal, Commander 21st Space Wing, Peterson Air Foce Base, Colo.

Several senior NASA leaders also will be a part of the panel, including G. Scott Hubbard, Director, NASA Ames Research Center, Moffett Field, Calif. Bryan D. O'Connor, NASA Associate Administrator and former astronaut, Office of Safety and Mission Assurance, Headquarters, will serve as Ex- Officio Member, and Theron Bradley, Jr., NASA Chief Engineer, NASA Headquarters, Washington, will be Executive Secretary.

"We need to be responsible, accountable, and extremely thorough in this investigation," added Administrator O'Keefe. "This panel is charged with a most difficult task, but I am confident in their ability, their integrity, and their dedication to doing what's right. Their findings will help push America's space program successfully into the future."

"Currently, NASA is beginning an internal investigation, drawing on the extensive expertise throughout the agency. Public officials for NASA, the Federal Emergency Management Agency, and other federal, state, and local entities are coordinating talents to help find the cause of this tragedy," concluded Administrator O'Keefe.

Subject: Contact Requested for the STS-107's Space Shuttle Mishap Interagency Investigation Board

Could you kindly provide me with a telephone number, and contact, and address if possible for the newly appointed STS-107's **Space Shuttle Mishap Interagency Investigation Board**, head by Retired U.S. Navy Admiral Harold W. Gehman, Jr.

Below is the NASA Public Release announcement.

Thank You,

Northboro, MA

---

http://spaceflightnow.com/shuttle/sts107/030202gehman/

NASA announces Columbia accident investigation

Viability of crew escape system at 12,500 mph or greater:

It is technically feasible to design a spacecraft crew escape system for deployment at any phase of a spacecraft's mission. However, Space Shuttle crew escape system studies have limited their designs to an operating range no greater than 210,000 feet in altitude (which roughly equates to 12,500 mph) due to weight and CG restrictions. Design of crew escape systems above this altitude would require structural and thermal protection system configurations that drive bulk and weight beyond these restrictions. The crew escape system altitude limitations correlate directly to orbiter velocity during ascent and descent.

Level of risk accepted by today's military:

No distinct risk level has been identified by the military regarding crew survivability in the event of a fixed wing, high performance aircraft failure. Ejection seats provide the ability to safely egress the aircraft from 0 to 600 knots and from 0 to 50,000 feet which encompasses a significant portion of military fixed-wing aircraft operating envelopes. As with the Shuttle, the military accepts crew escape risks in areas of aircraft operating envelopes because of the trade-off between weight and performance.

STS-113 MSFC SPACE SHUTTLE CONTINGENCY WORKING GROUPS
FEBRUARY 2, 2003

EXTERNAL TANK WORKING GROUP

TITLE/AREA OF RESPONSIBILITY	NAME	MSFC ORG	PHONE (AS REQUIRED)
ACTING CHAIRPERSON	P. MUNAFO	ED30	OFC 256-544-2566
ALTERNATE	N. OTTE	MP31	OFC 256-544-7231
SUPPORT MEMBERS			
STRUCTURAL	P. ROGERS	ED22	OFC 256-544-4632
	ALT: W. GREGG	ED22	OFC 256-544-5501
MATERIALS	S. GENTZ	ED35	OFC 256-544-2570
S&MA	K NEMECEK	QS20	OFC 435-863-2926
THERMAL	D. BRYAN	ED25	OFC 256-544-4265
ELECTRICAL	J. RATLEY	ED12	OFC 256-544-3448
DYNAMICS/ENVIRONMENTS	L. FOSTER	TD50	OFC 256-544-1589
PHOTO ENG ANALYSIS	T. RIECKHOFF	TD53	OFC 256-544-7677
EX-OFFICIO	S. BRETTEL	MP31	OFC 504-257-0700
EX-OFFICIO	J. SMELSER	MP31	OFC 256-544-4082
INTEGRATION	R. CLAYTON	JSC/MS2	OFC 281-483-7117
MATERIALS	S. SPARKS	ED34	OFC 256-544-2670
ORBITER	C. CURTIS	KSC	OFC 321-861-8278
PROJECT/TPS	S. HOLMES	MP31	OFC 256-544-8713
SECRETARY	J. TEREK	ED02	OFC 256-544-6817
PROPULSION	J. HONEYCUTT	TD52	OFC 256-961-1964

SOLID ROCKET BOOSTER ACTING WORKING GROUP			
TITLE/AREA OF RESPONSIBILITY	**NAME**	**MSFC ORG**	**PHONE (AS REQUIRED)**
ACTING CHAIRPERSON	P. RODRIGUEZ	ED20	OFC 256-544-7006
ALTERNATE	J. LUSK	MP41	OFC 256-544-1907
SUPPORT MEMBERS			
STRUCTURAL	J. GENTRY	ED23	OFC 256-544-6591
ELECTRICAL & INSTRUMENTATION	M. MEADOWS	ED15	OFC 256-544-3248
S&MA	R. TUCKER	QS20	OFC 256-544-0640
SYSTEMS ANALYSIS	J. TOWNSEND	ED21	OFC 256-544-1499
THERMAL	D. DAVIS	ED25	OFC 256-544-7257
TVC	B.PAGAN	TD55	OFC 256-544-7144
MATERIALS	T. MALONE	ED33	OFC 256-544-2593
PHOTO ENG ANALYSIS	T. RIECKHOFF	TD53	OFC 256-544-7677
BSM'S	G. STORY	TD51	OFC 256-544-7618
PYRO	J. DAVIS	MP41	OFC 256-544-7019

REUSABLE SOLID ROCKET MOTOR ACTING WORKING GROUP			
TITLE/AREA OF RESPONSIBILITY	**NAME**	**MSFC ORG**	**PHONE (AS REQUIRED)**
ACTING CHAIRPERSON	P. McCONNAUGHEY	ED20	OFC 256-544-1599
ALTERNATE	D. MOORE	MP51	OFC 256-544-2598
	A. SCHORR	MP51	OFC 256-544-5837
SUPPORT MEMBERS			
STRUCTURAL	J. HAWKINS	ED22	OFC 256-544-2780
	ALT. V. RICHARD		OFC 256-544-7200
DYNAMICS	T. NESMAN	TD63	OFC 256-544-1546
SOLID PROPULSION	P. LAMPTON	TD51	OFC 256-544-6171
IRE/EXPLOSION	L. SEMMEL	ED34	OFC 256-544-3650
S&MA	C. CIANCIOLA	QS20	OFC 256-544-7744
PHOTO ENG ANALYSIS	T. RIECKHOFF	TD53	OFC 256-544-7677
MATERIALS	T. LAWRENCE	ED34	OFC 256-544-2660
	ALT: S. TILLERY	ED34	OFC 256-544-8651
LOADS	J. TOWNSEND	ED21	OFC 256-544-1499
THERMAL	L. CLAYTON	ED25	OFC 256-544-2322

SPACE SHUTTLE MAIN ENGINE ACTING WORKING GROUP			
TITLE/AREA OF RESPONSIBILITY	**NAME**	**MSFC ORG**	**PHONE (AS REQUIRED)**
ACTING CHAIRPERSON	H. McCONNAUGHEY	TD50	OFC 256-544-1165
ALTERNATE	R. TEPOOL	MP21	OFC 256-544-1224
SUPPORT MEMBERS			
DYNAMICS	T. FIORUCCI	TD63	OFC 256-544-1551
STRESS	P. AGGARWAL	ED22	OFC 256-544-5345
ENGINE SYSTEMS	L. MADDUX	TD51	OFC 256-544-4057
SOFTWARE AND CONTROLS	C. HORNE	ED14	OFC 256-544-3748
MATERIALS AND PROCESSES	R. LAMBDIN	ED35	OFC 256-544-4953
S&MA	R. PATRICK	QS20	OFC 256-544-5373
PHOTO ENG ANALYSIS	T. RIECKHOFF	TD53	OFC 256-544-7677

SPACE SHUTTLE SYSTEMS WORKING GROUP			
TITLE/AREA OF RESPONSIBILITY	**NAME**	**MSFC ORG**	**PHONE (AS REQUIRED)**
CHAIRPERSON	J. BRUNTY	ED21	OFC 256-544-1489
ALTERNATE	J. TOWNSEND	ED21	OFC 256-544-1499
SUPPORT MEMBERS			
DYNAMICS & CONTROL	C.Hall	TD54	OFC 256-544-1471
TRAJECTORY & THRUST RECONSTRUCT	G. DUKEMAN	TD54	OFC 256-544-5464
AERODYNAMICS	W. BORDELON (ALT) E. DASO	TD63 TD63	OFC 256-544-1579 OFC 256-544-6122
STRUCTURAL LOADS	J. ELDRIDGE	ED21	OFC 256-544-6266
TIMELINE RECONSTRUCTION	K. CHOJNACKI	TD52	OFC 256-544-5657
ATMOSPHERIC ENVIRONMENTS	D. JOHNSON	ED44	OFC 256-544-1665
S&MA	D. MULLANE (ALT) A.. DANIELS	QS20 QS20	OFC 256-544-8432 OFC 256-544-7939
PHOTO ENG ANALYSIS	T. RIECKHOFF	TD53	OFC 256-544-7677
MAIN PROPULSION SYSTEM	R. SHEPPARD	MP71	OFC 256-544-7198

Current flight rationale will not support STS-107 without
> further investigation. A detailed boroscope inspection of the BSTRA
> joints on OV-102 was last done prior to STS-109. No indications were
> recorded, but the video will be re-analyzed. Video of the BSTRAs from the
> summer 2002 flowliner investigation is inconclusive for evaluating the
> BSTRA balls on OV-102. Access to the BSTRA joints on OV-102 for further
> inspection is available on the pad, but inspections will be limited or
> difficult depending on which joint is being inspected. The inspections on
> OV-103 are ongoing, and no other anomalies have been found.
During today's Shuttle stand-up telecon:

1. The BSTRA crack issue investigation continues. OV-102 (on the pad) has inspection access through the ground umbilical but only about 25% of each BSTRA bearing can be seen. Existing close-out flow-liner photos of OV-102 are inconclusive. A related 1978 MPTA test report is being reviewed. There are no spare assemlies but discussions are underway with the vendor to see what can be done. The issue can only be resolved by either flying as-is or by replacement (probably the whole 17" line would have to be replaced).

2. A Shuttle Upgrades safety strategy briefing is being given to Gen. Kostelnik on 12/13 here at HQ. The purpose of the meeting was for Kostelnik to provide guidance on prioritization of Shuttle Upgrades, including infrastructure. I have asked to attend.

3. Ron Dittemore announced that Linda Ham will lead a Risk Management Team to determine if the program is being "overly conservative" with its launch and landing risk management, given current improvements and system knowledge. The first report is expected in Mar-03.

Mark

<x-flowed>
Good Afternoon,

Attached please find the Code Q FRR-Edition Safety and Mission Assurance Report (SMAR) for STS-107.

If there are any questions, please give me a call.

Thanks,

Bill

William J. Bihner, Jr
NASA/QE
(202) 358-4441
</x-flowed>

Attachment Converted: "C:\Documents and Settings\mkowales\My Documents\Data\Attach\STS-107_SMAR_FRR1.doc"
<x-flowed>

</x-flowed>
<x-flowed>
Good Afternoon,

Attached please find the Code Q Pre-Launch Mission Management Team Edition of the Safety and Mission Assurance Report (SMAR) for STS-107.

NOTE that the only change to this document from the FRR version is the update to the BSTRA ball status based on a special PRCB meeting on Sunday, Janaury 12. OV-102 has been cleared to fly one additional mission,

STS-107. Actions assigned by the Shuttle Program Manager will determine the longer term solution(s) to the BSTRA issue.

If there are any questions, please give me a call.

Thanks,

Bill

William J. Bihner, Jr.
NASA/QE
(202) 358-4441
</x-flowed>

Attachment Converted: "C:\Documents and Settings\mkowales\My Documents\Data\Attach\STS-107_SMAR_PMMT.doc"
<x-flowed>

</x-flowed>
<x-flowed>
Good Afternoon,

Attached please find the Code Q Pre-Launch Mission Management Team Edition of the Safety and Mission Assurance Report (SMAR) for STS-107.

NOTE that the only change to this document from the FRR version is the update to the BSTRA ball status based on a special PRCB meeting on Sunday, Janaury 12. OV-102 has been cleared to fly one additional mission, STS-107. Actions assigned by the Shuttle Program Manager will determine the longer term solution(s) to the BSTRA issue.

If there are any questions, please give me a call.

Thanks,

Bill

William J. Bihner, Jr.
NASA/QE
(202) 358-4441
</x-flowed>

Attachment Converted: "C:\Documents and Settings\mkowales\My Documents\Data\Attach\STS-107_SMAR_PMMT1.doc"
<x-flowed>

</x-flowed>
<x-html>
<html>
The STS-107 mission is going very well.

SRB reported that the SRBs were slightly hotter than normal and that the foward skirt buckled on water impact. SRBs will be back to the port today and open assessment will start Monday.

Launch pad damage was nominal.

The crew is on the timeline for sleep periods and payload activity. The MER reported two issues/funnies that they are working and neither have mission impact so far:

During the pre-launch/post-insertion time period, AC2 phase B exhibited sluggish current increase during motor operation on three motors.

The first occurrence of the sluggish performance was noted at T-31 seconds, and the second and third occurrences were noted during the post-insertion activities. AC2 phases A and C would increase to their expected values, but phase B would increase only to about half of expected value, then recover to the expected value within about a second. The affected motors are: vent doors 8 and 9, Ku-band deploy motor 2, and port payload bay door open motor 2. There was no impact to motor drive times. There is no common circuit breaker/motor control assembly. All other motor signatures analyzed were nominal, some of which are powered from the same circuit breaker/motor control assemblies as the affected motors.

During Spacehab activation, the crew reported that transmissions from the Orbiter on the intercommunications (ICOM) B loop were not being heard in the Spacehab module. Communications on the ICOM A loop were satisfactory. This loss of redundancy should not affect the continuing mission operations.

The next MMT will be on Tuesday, January 21.

<x-tab>   </x-tab>Bill

</html>

</x-html>
<x-flowed>
Bryan,

Just FYI in case you have not heard about this. Will get an update on this when I go to this morning's MMT call.

Bill

>From: "ERMINGER, MARK D. (JSC-NC) (NASA)" <mark.d.erminger@nasa.gov>
>To: "JOHNSON, M. S. (SCOTT) (JSC-NC) (NASA)" <m.s.johnson@nasa.gov>
>Cc: "MAYER, FRED F. (JSC-NC) (SAIC)" <fred.f.mayer1@jsc.nasa.gov>,
> "H - Kowaleski Mark (E-mail)" <mkowales@mail.hq.nasa.gov>,
> "H - Bihner Bill (E-mail)" <wbihner@mail.hq.nasa.gov>
>Subject: FW: STS-107 Long Range Tracking Video Screening
>Date: Fri, 17 Jan 2003 12:57:45 -0600
>X-Mailer: Internet Mail Service (5.5.2653.19)
>
> > JSC STS-107 Launch Screening - Long Range Tracking Videos
> >
> > January 17, 2003
> >
> > JSC Image Science and Analysis Group Human Exploration Science Office / SX
> >
> > ANOMALY
> >
> > ET204, ET208, ET212 - During ascent at approximately 81 seconds MET, a
> > large light-colored piece of debris was seen to originate from an area
> > near the ET/Orbiter forward attach bipod. The debris appeared to move
> > outboard in a -Y direction, then fell aft along the left Orbiter fuselage,
> > and struck the leading edge of the left wing. The strike appears to have
> > occurred on or relatively close to the wing glove near the Orbiter
> > fuselage. After striking the left wing the debris broke into a spray of
> > white-colored particles that fell aft along the underside (-Z side) of the
> > Orbiter left wing. The spray of particles was last seen near the LSRB
> > exhaust plume.

> >
> > Still views and a movie loop of this event are being placed on our web
> > site for viewing at the following address:
> >
> >
> <http://sn-isag.jsc.nasa.gov/shuttleweb/mission_support/sts-107/launch_vid
> > eo/107launchvideo.shtml>
> >
> > The times of this event are as follows:
> >
> > Debris first seen near ET/Orbiter forward attach: 016:15:40:21.699 UTC
> > Debris contacted left wing:
> > 016:15:40:21.882 UTC
> >
> > Screening of the high speed and high resolution long range tracking films
> > that may show more detail of this event will begin on Saturday morning,
> > January 18th.
> >
> > Normal Observations Noted Included:
> >
> > Vapor off the SRB stiffener rings, recirculation, SRB plume brightening,
> > and slag debris after SRB separation.
> >
> > NOTES:
> >
> > The long range video tracking views had very soft focus possibly due to
> > clouds and haze.
> >
> > SRB separation occurred at approximately 016:15:41:06.558 UTC as seen on
> > camera ET208.
> >
> > Five long range tracking videos were received and screened. Timing data
> > was received on all of the videos received except ET207.
> >
> > The launch film screening will be conducted on Saturday and Sunday and a
> > report will be sent to distribution on Monday, January 20, 2003.
> >
> > Jon Disler / SX3-LM
> > Joe Caruana / SX3-LM
> > Eric Nielsen / SX3-HEI
> >
> >
> >

</x-flowed>
<html>
<blockquote type=cite cite>The STS-107 mission continues to go well. Research activities in the SpaceHab module. comprising 80+ experiments are going well. Consumables margins continue to exceed predictions and will contribute to a higher than expected landing weight.</blockquote>
<blockquote type=cite cite>Analysis of the landing weight determined that it may be very close to the 233,000-pound certification limit (expected to be near 233,600 lbs).   Ground controllers and the Mission Evaluation Room (MER) engineers will continue to monitor cryo consumption to better estimate end-of-mission landing weight.</blockquote>
At the MMT today they discussed the analysis that is taking place:
-Payload interfaces (OK) -Landing gear and tires (OK)   -Steering (OK)   -Thermal at bondline (TBD but expected to be OK)   -Reentry trajectory (OK) -Main engine nozzle loading (TBD but expected to be OK) - also, consumables during landing phase is being reassessed.

Prior history of high landing weights:
<x-tab>   </x-tab>STS-90 was right at 233K
<x-tab>   </x-tab>STS-87 at 233,090
<x-tab>   </x-tab>STS-83 at 235,286 (early mission termination due to fuel cell problem)

<blockquote type=cite cite>Evaluation of the debris seen in the video and film review determined that there may be significant tile damage; however, not to the extent that would result in burnthrough or catastrophic failure. The evaluation also determined that there should be no adverse effect to the RCC panels due to the angle (glancing) of potential impact predicted.</blockquote>
My thoughts: If the damage was any worse, we could have been looking at a real serious problem (rekindles the "on-orbit repair capability" discussion). We won't know the real extent of the damage until the orbiter comes back and we unload the detailed photographs. Leading theory is that the foam originated from the bipod ramp vicinity (this was issue for STS-112 and discussed at length at STS-113 FRR). If from bipod area, then this is 4th instance of major foam from that area (STS-112, 32, and 50). Build paper is being reviewed for the last few and next few tanks - nothing out-of-family has turned up with regard to foam application.

Mark
</html>
<x-html>
<html>

<u>Kennedy Space Center
Safety and Mission Assurance Weekly Notes
Week Ending January 24, 2003

RISK RELATED ITEMS

</u>1. ELV - Mars Exploration Rover (MER) Mission - Based on additional data provided by JPL, KSC NASA safety feels it is safe to perform the pyro firing at the Payload Hazardous Servicing Facility. Since the pyros are Category B NASA Standard Initiators, a safety variance is not required to perform the test. KSC NASA Safety will be on site to monitor the operation. Minimum risk.

2. ELV MER A Mission - MER A LOX Sump originally used in a qualification test tank. During the Mission Modification Review (MMR) for MER A it was mentioned that the LOX Sump used for this mission was removed from a qualification test tank. S&MA contacted Boeing Quality management to further discuss this concern. S&MA expressed concerns to Boeing Quality as to why the tank was not properly identified as a test unit. Using test hardware in production applications increases risk to the vehicle. Boeing has issued a Quality Bulletin to address this issue and all Engineering IPT Leads were advised to educate their engineers with this requirement. Risk level is high.

3. ELV - Delta Fleet - Mission: RS-27 Engine Lot Comparison Testing. A high pressure duct flexhose failed during a comparison test for a newly received lot. It was determined that cause of failure is due to the test setup and not related to any of the manufacturing process. A new technician was performing the test, also no safety precautions were taken. Testing will be continued with the new set from the same lot after the supplier complies with all safety requirements and the technician gets additional training.
Risk level is high.

4. SHUTTLE - STS-107 S0007 PMRB Items -
FCP-2-28-0408
Problem Description: Fuel Cell # 2, cells 4 & 5 exhibiting pin sharing. Update: Instrumentation indicated pin sharing between pins 4 and 5 on Fuel Cell # 2.
MR Disposition: Fuel cells containing the "crimped" connection are susceptible to a condition referred to as "pin sharing" in which an increased resistance in the crimp connections causes a voltage drop across the pin resulting in a low voltage reading for that cell on FCMS. This condition is well documented by the vendor (International Fuel Cells) and by the program. This "pin sharing" signature also can and has been (three instances) caused by a high resistance in the Orbiter FCMS wire harness (i.e. splices). Due to the intermittent nature of "pin sharing", it is difficult to trouble-shoot and isolate to verify the source of resistance. In either case (fuel cell or FCMS wire harness), this condition is an instrumentation problem only and does not affect fuel cell operation. Corrective action has been implemented, by the vendor, to replace all crimped pins with soldered pins (on an attrition basis, when the fuel cell is returned for overhaul or repair). Presently, only two fuel cells with crimped pins remain in the system (s/n 111, 106). Fuel cell (s/n111) has not exhibited pin sharing until now on pins 4 and 5. The criticality of this problem is 2R/3."

5. SPACE STATION - The Ground Safety Review Panel held the Phase II Japanese Equipment Module (JEM) Ground Safety Review Panel (GSRP) for Flight 2J/A on January 21-24, 2003. Flight 2J/A will consist of the JEM Experiment Logistics Module-Exposed Facility and the Experiment Logistics Module Pressurized Section. The JEM Inter-Orbit Communication System (ICS) was also evaluated during the review. All of the Hazard Reports were accepted and signed at the Phase II level. No increased risk.

<u>OTHER</u>

6. ELV Pegasus/SORCE Mission Safety and Mission Assurance personnel supported Pegasus Vertical Fin Installation and daily test team meetings associated with Pegasus/SORCE ground processing. The payload and launch vehicle has been transported to the hot pad for a planned 1/25/03 launch.

Note: Launch successfully completed on Jan 25

7. ELV SIRTF Mission - Boeing has determined that if SIRTF is delayed past MER-B, the SIRTF first stage booster will be used for MER-B, and that instrumenting the upper stages for first flight analysis of the upgraded heavy Delta II, is prudent. The current MER-B mission configuration does not have the full complement of first flight transducers. Boeing will determine impacts to the MER-B mission for both schedule and additional weight. The Pre-Vehicle On Stand Review is scheduled for February 13, 2003, in Huntington Beach.

8. SHUTTLE Payloads STS 107 Mission - Safety and Mission Assurance personnel are preparing for STS-107 landing activities at the Kennedy Space Center Shuttle Landing Facility (SLF) and at Dryden Flight Research Center.

Note: Landing is currently scheduled at KSC's SLF on Feb 1 at 9:17 AM EST.

9. SPACE STATION - ISS EXPRESS Rack Software Configuration

```
Management Independent Assessment&amp;nbsp; The Exit Briefing was
successfully presented to the KSC International Space Station/Payloads
Processing Directorate (UB), on January 24, 2003.&amp;nbsp; UB personnel
concurred with the findings and will provide a response.&amp;nbsp; The Final
Draft will be sent to the customer the week of January 27, 2003.<br>
<br>
<b>10.&amp;nbsp; INDEPENDENT VERIFICATION &amp;amp; VALIDATION (IV&amp;amp;V)&amp;nbsp;
</b>KSC's Software Assurance manager is serving on the Headquarters led
IV&amp;amp;V Independent Assessment team.<br>
<br>
<b>11.&amp;nbsp; INSTITUTIONAL</b> - Propellants North Independent
Assessment&amp;nbsp; Completed Exit-brief for JBOSC personnel on January 21,
2003, which addressed the propellant mobile equipment capability for both
current and planned Shuttle and ELV requirements.&amp;nbsp; The Final Report
has been issued.<br>
<br>
<br>
<br>
<br>
</html>

</x-html>
<x-flowed>
Bryan,

A new "assessment" on the potential for orbiter damage from ET foam
loss.  Bottom line is some orbiter structural damage predicted but no
safety of flight issue based on this report. Will keep you posted.

        Bill

>From: SR&QA MER Console <SRQAMer@ems.jsc.nasa.gov>
>To: "'srqa-mer listserver'" <SRQA-MER@vesuvius.jsc.nasa.gov>
>Subject: STS-107 Flight Day 12 Report
>Date: Tue, 28 Jan 2003 09:38:59 -0600
>X-Mailer: Internet Mail Service (5.5.2653.19)
>
>STS-107 Flight Day 12 Report
>GMT 028:15:30
>
>Shift Leads:  David Witwer, Brandon Dick, Mike Etchells
>Mission Engineer: Dan Zalit (OJT)
>
>The STS-107 mission continues nominally in a 154 x 140 nm orbit with all
>Orbiter subsystems performing satisfactorily.  No new Orbiter issues or
>anomalies have been reported in the previous 24 hours.
>
>Our MER Manager released the following update on the debris hit on the left
>wing last during ascent.  "Systems integration personnel performed a debris
>trajectory analysis to estimate the debris impact conditions and locations.
>This analysis was performed utilizing the reported observations from the
>ascent video and film.  It was assumed that the debris was foam from the
>external tank.  Based on the results of the trajectory analysis, an impact
>analysis was performed to assess the potential damage to the tile and
>reinforced carbon carbon (RCC).  The impact analysis indicates the potential
>for a large damage area to the tile.  Damage to the RCC should be limited to
>coating only and have no mission impact.  Additionally, thermal analyses
>were performed for different locations and damage conditions.  The damage
>conditions included one tile missing down to the densified layer of the tile
>and multiple tiles missing over an area of about 7 in by 30 in.  These
>thermal analyses indicate possible localized structural damage but no
>burn-through, and no safety of flight issue."
>
```

>Previous flight day reports discuss the eight MER anomalies listed below.
>
>MER Anomalies:
>MER-01 AC2 Phase B Sluggish Current Signature
>MER-02 No ICOM B in Spacehab
>MER-03 O2 Tank 7 Heater A Failed Off in Manual Mode (ORB)
>MER-04 70MM Hasselblad Camera Motor Drive Binds/Jams (GFE)
>MER-05 Suspect Fuel Cell Monitoring System (FCMS) Data Cable (GFE)
>MER-06 Loss of DR20 Tape Recording and Playback (GFE)
>MER-07 LH2 Prevalve Open B Indicator Failed Off
>MER-07A MDM FA4 CD-08 CH-00 Has Intermittent Data Hits (ORB)
>MER-08 70 mm Hasselblad Camera S/N 1012 Motor Drive Binds/Jams (GFE)

</x-flowed>
<x-flowed>
Bryan,

The item below was also discussed at yesterday's MMT meeting. The bottom line is that after early problems with pump 1, they switched to pump 2 and cooling in the Hab became a non-issue. Yesterday they reported a nearly doubling in the blockage with the pump 2 system over the last 48 hours and were concerned that they might need to shut pump 2 down and go back to pump 1. If we can't control cooling in the Hab, then we will definitely lose science. So, although we have consumables enough to support landing through Wed, Feb 5, if this becomes an issue, they may want to land earlier, even if it means an EDW landing. Right now its not an issue and landing first opportunity is still scheduled for Saturday around 0915 EST and weather looks favorable. Will keep you posted.

Bill

NEW: MER-009 (Spacehab Water Loop Flow Degradation ORB). The payload heat exchanger and total flow rates for the Spacehab water loop have been steadily decreasing throughout the mission; the Spacehab water pump outlet pressure is also decreasing; pump 2 was initially run but the switch to pump 1 was made early in the mission; t/s post-landing to determine if Orbiter hardware is the cause of the problem or has in any way been impacted by the problem; the hardware consists of the payload heat exchanger and the water lines leading to and from the interface panel.

</x-flowed>

Bill & Bobby,

Here are the two White House actions I hard-copied to you.

They address the COFR process and the PRACA process.

Methods of risk assessment is addressed in the dealing with flight constraints section of the PRACA write-up.

JSC SR&QA folks helped pull these responses together.

Mark

PS: Cheryl & Scott - thanks for your help.

```
<html>
Jim &amp; Pete,<br>
<br>
I gathered together all the STS-107 OSMA-related data that OSMA touched, saw, or
responded to.<br>
<br>
Jim:  As requested, I will hand it over to you when I see you in person.<br>
<br>
I asked Bill to provide copies of any email and launch day notes that he may
have.<br>
I'll add those to the binder when I get them.<br>
<br>
Here is the outline of the two-voluem data set:<br>
<br>
Mark<br>
<br>
<div align="center">
<font face="Arial, Helvetica">STS-107 OSMA mission related data products<br>
<br>
</font></div>
<font face="Times New Roman, Times"
size=4>1)<x-tab>      </x-tab></font><font
face="Arial, Helvetica">Volume I, STS-107 OSMA Data</font>
<dl><font face="Times New Roman, Times" size=4>
<dd>a)<x-tab>      </x-tab></font><font face="Arial,
Helvetica">Safety &amp; Mission Assurance Report</font>
<dl><font face="Times New Roman, Times" size=4>
<dd>i)<x-tab>      </x-tab></font><font face="Arial,
Helvetica">FRR version</font>
</dl>
</dl><font face="Times New Roman, Times"
size=4>ii)<x-tab>     </x-tab></font><font face="Arial,
Helvetica">PMMT version</font>
<dl><font face="Times New Roman, Times" size=4>
<dd>b)<x-tab>      </x-tab></font><font face="Arial,
Helvetica">Pre-flight Assessment Reviews (PFA)</font>
<dl><font face="Times New Roman, Times" size=4>
<dd>i)<x-tab>      </x-tab></font><font face="Arial,
Helvetica">RSRM-88 PFA</font>
</dl>
</dl><font face="Times New Roman, Times"
size=4>ii)<x-tab>     </x-tab></font><font face="Arial,
Helvetica">SRB - BI116 PFA (SR&amp;QA Review)<br>
</font><font face="Times New Roman, Times"
size=4>iii)<x-tab>    </x-tab></font><font face="Arial,
Helvetica">SSME PFA<br>
</font><font face="Times New Roman, Times"
size=4>iv)<x-tab>     </x-tab></font><font face="Arial,
Helvetica">ET-93 PFA</font>
```

```
<dl><font face="Times New Roman, Times" size=4>
<dd>c)<x-tab>      </x-tab></font><font face="Arial,
Helvetica">Preflight Assessment Review</font>
<dl><font face="Times New Roman, Times" size=4>
<dd>i)<x-tab>       </x-tab></font><font face="Arial,
Helvetica">PAR-5 Minutes  Topics (PAR Planning Notes from JSC)</font><font
face="Times New Roman, Times" size=4>
<dd>(1)<x-tab>     </x-tab></font><font face="Arial,
Helvetica">Jan 10, 2003</font>
</dl>
</dl><font face="Times New Roman, Times"
size=4>(2)<x-tab>    </x-tab></font><font face="Arial,
Helvetica">Jan 17, 2003<br>
</font><font face="Times New Roman, Times"
size=4>(3)<x-tab>     </x-tab></font><font face="Arial,
Helvetica">Jan 24, 2003</font>
<dl>
<dl><font face="Times New Roman, Times" size=4>
<dd>ii)<x-tab>     </x-tab></font><font face="Arial,
Helvetica">Pre-Flight Assessment Review</font>
</dl>
</dl><font face="Times New Roman, Times"
size=4>iii)<x-tab>    </x-tab></font><font face="Arial,
Helvetica">PFA - FRR Tag-up<br>
</font><font face="Times New Roman, Times"
size=4>iv)<x-tab>     </x-tab></font><font face="Arial,
Helvetica">PFA -  PMMT Tag-up<br>
</font><font face="Times New Roman, Times"
size=4>v)<x-tab>      </x-tab></font><font
face="Arial, Helvetica">Range Safety Data Package<br>
<br>
</font><font face="Times New Roman, Times"
size=4>2)<x-tab>      </x-tab></font><font
face="Arial, Helvetica">Volume II, STS-107 Email Exchange</font>
<dl><font face="Times New Roman, Times" size=4>
<dd>a)<x-tab>     </x-tab></font><font face="Arial,
Helvetica">Email Exchange</font>
<dl><font face="Times New Roman, Times" size=4>
<dd>i)<x-tab>      </x-tab></font><font face="Arial,
Helvetica">Email MER daily status reports</font>
</dl>
</dl><font face="Times New Roman, Times"
size=4>ii)<x-tab>     </x-tab></font><font face="Arial,
Helvetica">Email OSF status messages to Code Q<br>
</font><font face="Times New Roman, Times"
size=4>iii)<x-tab>    </x-tab></font><font face="Arial,
Helvetica">Email SR&amp;amp;QA Reports<br>
</font><font face="Times New Roman, Times"
size=4>iv)<x-tab>     </x-tab></font><font face="Arial,
Helvetica">Email Inter-office (OSMA)</font>
<dl><font face="Times New Roman, Times" size=4>
<dd>b)<x-tab>      </x-tab></font><font face="Arial,
Helvetica">Launch Operations Data (on-console)</font>
<dl><font face="Times New Roman, Times" size=4>
<dd>i)<x-tab>      </x-tab></font><font face="Arial,
Helvetica">Interim Problem Reports (Pre-tanking report)</font>
</dl>
</dl><font face="Times New Roman, Times"
size=4>ii)<x-tab>     </x-tab></font><font face="Arial,
Helvetica">ET Tanking Meeting SRB Special Topic<br>
</font><font face="Times New Roman, Times"
size=4>iii)<x-tab>    </x-tab></font><font face="Arial,
Helvetica">PMMT (L-1) and Launch Day Notes (Kowaleski)<br>
```

PMMT (L-1) and Launch Day Notes (Bihner)
</html>
Hi Folks,

As you know, Bryan O'Connor has asked for some specific information to be pulled together, mostly to arm him with topics to consider in the investigation.

I'll be looking to you folks for some help pulling the data together.

Soon, I'll be sending out some emails with specific questions.

If, by chance, someone from Code Q has already asked for the data, please let me know so that we don't double-dip.

Thanks in adance for you help.

I hope that you are all doing OK though this difficult time.

Mark
Hi Folks,

Here is the first round of questions:

1) Would someone please forward me the analysis that we did for the ET foam loss hit risk to Columbia's TPS?

I caught a glimpse of the package (about 20 pages) in Code M (Code M says they never saw it prior to this past weekend), but we never got it here in Code Q. This was to be presented at the STS-107 PAR, but we never got to it because of ITAR.

2) During STS-113, we discussed risk of bipod foam loss during STS-112. At that time we also mentioned bipod foam loss on STS-32 and ST-50.

Would you please send me any analysis you may have that was done for STS-112 (priority) and for STS-32 and 50.

3) I understand that the ET O2 feedline for STS-107 uses a unique foam (BX-265 ???).

4) I need an education on the different type of foams (if any) that are used for bipod and other close-out items when preparing the tank.
How have these foams types and their application process changed over time?

Many thanks for your support. More questions will follow.

I don't mind multiple submissions, we'll sort it out on this end.

Mark
Mark,

I saw beautiful launch of STS-107 under the blue sky from the entrance of the SSPF/KSC and I have never thought of such tragedy at the time. I am really sorry and feel anew the weightiness of working for safety. Flight crew always trusts us, all on ground. We must respond to them. We must go forward with the cherished desire of STS-107 crew.

NASDA is trying to contribute to overcome the tragedy and sent people to NASA Head Quarters. I know it is very small what NASDA can do, however we might be able to do something, such as checking Japanese manufacturer if exits. Also we must prepare for STS-114, next scheduled flight.

What kind of activity will NASA S&MA community do for STS-107? I ma sure NASA S&MA needs to play integral part. NASDA will be most grateful if NASA S&MA could allow us to be involved in your activity. Would you please talk

inside NASA S&MA? Based on your response, I would like Mr. Saki, NASDA counter part of Mr. O□$B!G□(BConnor, to write a letter to Mr. O□$B!G□(BConnor to this
effect.

Expressing heartfelt condolences-

Nobuo Takeuchi/ NASDA S&PA

Mark,

You need to work requests for information from JSC through the HCAT, unless it is a CAIB request. CAIB requests need to be worked thru the Task Force.

Bill Hill

<x-flowed>
No, we don't have it. If found, please provide a copy.
Thanks
barbara

At 10:08 AM 2/10/2003 -0500, you wrote:
>Has this report made it into the HCAT yet (STS-107 TPS Muli-Tile Loss
>Thermal Analysis)?
>
>Mark
>
>
>>Date: Mon, 10 Feb 2003 08:18:32 -0500
>>To: lham
>>From: Mark Kowaleski <mkowales@hq.nasa.gov>
>>Subject: Fwd: stress/thermal analysis request
>>Cc: stuart.l.mcclung@nasa.gov,boconnor,jlloyd,prutledge,merminger,ymarshall
>>
>>Hello Linda,
>>
>>I work for Bryan O'Connor as the HQ Shuttle Safety Manger in Code Q.
>>Stuart McClung said that I needed to request the STS-107 TPS Muli-Tile
>>Loss Thermal Analysis data package from you (see note below). I have
>>been trying to get this document for over a week and no one seems to
>>either want to part with it or locate it.
>>
>>We have the Foam Transport Assessment and the TPS Damage Assessment from
>>Boeing. The requested analysis is referenced in the conclusion of the
>>Boeing Orbiter TPS Assessment, dated 1-23-03.
>>
>>Would you please get me a copy of the thermal analysis? We need it for
>>the NASA Administrator's talking points for his testimony on Wednesday.
>>
>>Mark
>>
>>
>>>From: "MCCLUNG, STUART L. (JSC-MV6) (NASA)" <stuart.l.mcclung@nasa.gov>
>>>To: "'mkowales@mail.hq.nasa.gov'" <mkowales@mail.hq.nasa.gov>
>>>Subject: stress/thermal analysis request
>>>Date: Sat, 8 Feb 2003 17:41:18 -0600
>>>X-Mailer: Internet Mail Service (5.5.2653.19)
>>>
>>>Mark, cut and pasted the note I sent to Linda, and the guys on the affected
>>>team.
>>>
>>>stu

>>>
>>>
>>>We provided HQ/Mark Kowaleski with copies of the 1/23 and 1/24 presetations
>>>on the debris impact and Orbiter assessment. They have requested the
>>>thermal analysis that is referenced on the last page in the conclusion.
>>>I've talked with McCormack and Rodney and they walked me thru the review of
>>>the analysis, and noted that we do not have copies of the acutal analysis
>>>that Mike and his team performed. Normal routine, actually.
>>>
>>>HQ has requested copies of the analysis, and in my opinion, more for
>>>completeness than any of their own review. Fred told me that as of today,
>>>these type of requests need to go thru the MRT, so I'm going to direct Mark
>>>to make the request thru that route, but I'd suggest that Mike and co., be
>>>ready for the request.
>

</x-flowed>

<x-html>
<blockquote type=cite> From: "ERMINGER, MARK D. (JSC-NC) (NASA)"
<mark.d.erminger@nasa.gov>
To: "'Mark Kowaleski'" <mkowales@hq.nasa.gov>,
       "BALU, BRIAN K. (JSC-NC)
(SAIC)" <brian.k.balu1@jsc.nasa.gov>
Cc: "HUDSON, ROBERT H. (JSC-NC) (NASA)"
<robert.h.hudson@nasa.gov>
Subject: RE: runway improvements?
Date: Tue, 31 Dec 2002 21:39:30 -0600
X-Mailer: Internet Mail Service (5.5.2653.19)

Robert Hudson can answer this question when he gets back from vacation

-----Original Message-----
From: Mark Kowaleski [<a href="mailto:mkowales@hq.nasa.gov"
EUDORA=AUTOURL>mailto:mkowales@hq.nasa.gov]
Sent: Tuesday, December 31, 2002 6:58 AM
To: BALU, BRIAN K. (JSC-NC) (SAIC); ERMINGER, MARK D. (JSC-NC) (NASA)
Subject: runway improvements?

Hi,

For STS-107 there is a flight rule change negating the need to land at EDW

AFB for contingency conditions.   Part of the rationale
includes runway improvements at KSC (load bearing shoulders?). This was a

one-pager at the PAR.

I understand that this flight rule change includes consideration for NWS
failure supplemented by differential braking (I guess this is where the
need for wider shoulders comes into play).

What exactly was improved on the KSC runway? When was the work
done?

Thanks,

Mark
</blockquote></x-html>
<html>
Bill, it would be good if you CC'd me on any correspondence with Bryan (like I do
for you). I was not aware that you were sending him anything.

Mark

At 06:05 AM 1/2/2003 -0500, you wrote:
<blockquote type=cite cite>Mark,

I had already forwarded this to Bryan etc. on December 24. Let's talk about
how we should be sending this stuff out...they don't need to get it twice. If
you want to be the conduit to Bryan etc. just let me know and I will back
off.

<x-tab>   </x-tab>Bill

At 07:57 AM 12/30/2002 -0500, you wrote:
<blockquote type=cite cite>This is the latest status on the BSTRA situation.
We expect an answer next week after the holiday.


```
Mark<br>
<br>
<blockquote type=cite cite>BSTRA Status<br>
December 23, 2002<br>
<br>
Testing over the weekend went well.  Thus far they have not been able to get a
ball to initiate a crack through thermal cycling and thermal/mechanical load
cycling.  Plans are to look at increasing the loads by increasing the delta
temperature in the thermal cycling.<br>
<br>
Very Preliminary Results:<br>
<br>
Test #1 (file cabinet ball, with notch and strain gages) has been successful in
gathering data.  Six cycles have been performed  from room temperature to
LN2.  <u>A faint line was detected in notch; but not sure if it is a
crack.  Plan to increase the magnification and determine if there is a crack or
not.</u>  Strain information shows mild stresses.  If there is no crack,
plans are to increase the delta temperature by using hot water (~200-degrees F)
first, then shift to LN2 to induce higher stresses and induce a crack.<br>
Test 2a (spare ball with notch) thermal cycles have been completed, thermal and
mechanical cycle tests are in work.  No crack has been initiated as yet.<br>
<br>
Test 2b (spare ball with no notch) is through 32 of 35 thermal/mechanical cycles
with no crack initiation.  This test induced flight loads.<br>
<br>
MSFC thermal cycling from 200-degrees F to the alcohol/dry ice bath has been
unsuccessful in initiating a crack.  Plan to use an oven to increase the
temperature to ~400-degrees F and continue cycling into the alcohol/dry ice
bath.</blockquote></blockquote></blockquote></html>
<html>
Brian, thanks.  This is great!<br>
<br>
Mark<br>
<br>
At 03:08 PM 12/31/2002 -0600, you wrote:<br>
<blockquote type=cite cite>Mark:<br>
<br>
Reference the attached drawing, which for purposes of this discussion<br>
illustrates the MPS setup for both the LH2 &amp; LO2 propellant feed systems.<br>
<br>
The 17&quot; Feedline (lower right side of drawing) manifolds into three
12&quot;<br>
Feedlines (one 12&quot; Feedline per SSME).  Each 12&quot; Feedline is equipped
with a<br>
12&quot; Prevalve near the manifold (in the drawing one Prevalve is labeled<br>
&quot;TYP&quot;, i.e. typical for each 12&quot; Feedline).  The inlet side of
each Prevalve<br>
is equipped with a 1000 micron screen, which would act as filters for debris<br>
(&gt;1000 microns) generated by a 17&quot; BSTRA ball.  There are no
screens<br>
downstream of the Prevalves, so any debris generated by a 12&quot; BSTRA ball<br>
would be ingested by the corresponding SSME.  This is the same concern that<br>
we had during the Cracked Flowliner Issue, as FOD entering the SSME could<br>
result in a catastrophic SSME failure.<br>
<br>
Let me know if you have any other questions.  Thanks.<br>
<br>
Brian<br>
<br>
-----Original Message-----<br>
From: Mark Kowaleski [<a href="mailto:mkowales@hq.nasa.gov"
eudora="autourl">mailto:mkowales@hq.nasa.gov</a>]<br>
```

```
Sent: Tuesday, December 31, 2002 8:10 AM<br>
To: ERMINGER, MARK D. (JSC-NC) (NASA); BALU, BRIAN K. (JSC-NC) (SAIC);<br>
BROWNE, DAVID M. (JSC-NC) (NASA)<br>
Subject: MPS filter size?<br>
<br>
<br>
Hi, Happy New Year!<br>
<br>
Do either of you know what the MPS filter size is?  Is there any type of <br>
filter in the 17&quot; lines prior to hitting the 12&quot; lines?<br>
<br>
Thanks,<br>
<br>
Mark<br>
<br>
</blockquote></html>
<x-html><br>
<blockquote type=cite><div>From: &quot;ERMINGER, MARK D. (JSC-NC) (NASA)&quot;
&lt;mark.d.erminger@nasa.gov&gt;</div>
<div>To: &quot;MARSHALL, YOLANDA Y. (JSC-NA) (NASA)&quot;
&lt;yolanda.y.marshall@nasa.gov&gt;,</div>
<div>        &quot;H - O'Connor Bryan
(boconnor@mail.hq.nasa.gov)&quot;</div>
<div><x-tab>        </x-tab>
&lt;boconnor@mail.hq.nasa.gov&gt;</div>
<div>Cc: &quot;H - Kowaleski Mark (mkowales@mail.hq.nasa.gov)&quot;</div>
<div><x-tab>        </x-tab>
&lt;mkowales@mail.hq.nasa.gov&gt;,</div>
<div>        &quot;'H - Bihner Bill'&quot;</div>
<div><x-tab>        </x-tab>
&lt;wbihner@mail.hq.nasa.gov&gt;,</div>
<div>        &quot;JOHNSON, M. S. (SCOTT)
(JSC-NC) (NASA)&quot;</div>
<div><x-tab>        </x-tab>
&lt;m.s.johnson@nasa.gov&gt;,</div>
<div>        &quot;BROWNE, DAVID M. (JSC-NC)
(NASA)&quot;</div>
<div><x-tab>        </x-tab>
&lt;david.m.browne@nasa.gov&gt;,</div>
<div>        &quot;JOHNSON, GARY W. (JSC-NA)
(NASA)&quot;</div>
<div><x-tab>        </x-tab>
&lt;gary.w.johnson@nasa.gov&gt;,</div>
<div>        &quot;MARTINEZ, HUGO E. (JSC-NC)
(GHG)&quot;</div>
<div><x-tab>        </x-tab>
&lt;hugo.e.martinez1@jsc.nasa.gov&gt;</div>
<div>Subject: FW: BSTRA ball test status</div>
<div>Date: Thu, 2 Jan 2003 11:35:03 -0600 </div>
<div>X-Mailer: Internet Mail Service (5.5.2653.19)</div>
<div>X-MIME-Autoconverted: from quoted-printable to 8bit by bolg.public.hq.nasa.gov
id MAA26994</div>
<br>
<br>
<br>
<div>-----Original Message-----</div>
<div>From: MARTINEZ, HUGO E. (JSC-NC) (GHG) </div>
<div>Sent: Wednesday, January 01, 2003 12:23 PM</div>
<div>To: HATAMLEH, OMAR (JSC-NC) (SAIC); ERMINGER, MARK D. (JSC-NC) (NASA);</div>
<div>JOHNSON, M. S. (SCOTT) (JSC-NC) (NASA); BROWNE, DAVID M. (JSC-NC) (NASA)</div>
<div>Cc: CULBERTSON, FRANK L., JR (JSC-NA) (SAIC); CAZES, DAVID (JSC-NA)
(SAIC);</div>
<div>EVATT, GARVIN T. (GT) (JSC-NC) (SAIC); BALU, BRIAN K. (JSC-NC) (SAIC);
```

DYER,
KEITH W. (JSC-NC) (SAIC); AUGUSTYN, JOSEPH (JSC-REMOTE); TIPTON, MICHAEL R.
(JSC-NX) (SAIC); PRINCE, GORMAN W. (BILLY) (JSC-NC) (GHG); ISHMAEL, MOHAMED
I. (GEORGE) (JSC-NC) (SAIC); CLEMENTS, DANIEL L. (JSC-NC) (GHG); ALMASRI,
WALEED (JSC-REMOTE); AL-HAYEK, FAREED A. (JSC-NC) (SAIC)
Subject: RE: BSTRA ball test status

Testing at Huntington Beach and MSFC continues, as does the development of
thermal and stress models in an attempt to build flight rationale for
STS-107. The generation of FOD has not at all been alleviated after
branched cracking was detected on an MSFC ball subjected to extreme
temperature gradients.

Huntington Beach testing continues on the 3 balls in an effort to first
create cracks and then to show arrest (no surface growth) under a repeated
load profile. All testing described in the original email below is
complete, but no cracks have been created. Huntington Beach is adding steps
to their test procedure to incorporate crack initiation techniques developed
at MSFC: the use of a dry ice/alcohol bath (-100°F) which allows for quicker
quenching.

Test #1 Update: Since dunking the notched 2.24" cabinet ball in LN2 created
no cracks (nor did boiling water to ice water thermal shocks), the ball is
now being heated to an incrementally higher temperature and quenched at
-100°F dry ice/alcohol. This series of thermal shocks is in effort to
"sneak up" on the critical conditions required to crack a ball. The first
set of 5 thermal shock cycles began at 200°F, and subsequent sets beginning
at 225°F and 250°F yielded no cracks. As of December 30th, the set
beginning at 275°F was in work. Plans are to continue incrementing the
initial temperature by 25°F, running 5 cycles. Inspections are run visually
and with eddy current after the first and 5th cycles in each set.

Test #2a Update: Taking the notched 2.24" flight spares ball through a
series of flight-like thermal mechanical cycles described below yielded no
cracking. The same series of thermal shocks is being used on this ball as
in test #1 above, that is, purely thermal cycles, in an effort to crack it.
On 200°F cycles, saw an eddy current indication and again during 225°F
cycles deep in the notch. It appears to be growing about an 1/8th of an
inch on one edge of the notch but is not yet visible on the surface. Once
it is seen on the surface, testing will proceed to Phase II, testing for
crack arrest under flight-like thermal mechanical/loading. Eddy current and
visual inspections are being conducted after every cycle at this time.

Testing is now in the set of 5 cycles at 250°F, but so far no surface
cracks
have appeared.

Test #2b Update: Taking the second 2.24" flight spares ball (without
a
notch) through a series of flight-like thermal mechanical cycles
described
below yielded no cracking. In an effort to expedite the creation of
a
crack, two in-line notches are being EDM'd into the ball, approximately
0.050" between them. The ball with then be subjected to a total of
1000
rapid thermal cycles from boiling water to ice water in an effort to
crack
it before resuming flight-like thermal/mechanical cycling.

MSFC Status: Besides developing a technique for quicker quenching, MSFC
personnel have cracked both notched and pristine 2.24" balls using
severe
thermal cycles. In addition, they have cracked a flight spares ball (one
of
1.75" diameter, without a notch, that had pre-existing subsurface
flaws)
with nominal thermal cycles (from ambient to LN2 temperature). Because
of
the similarity between LN2 temperature and LO2's temperature (flight
temperature), cracking of the 1.75" ball lends credibility to the
theory
that the OV-103 ball might have had subsurface cracks which surfaced when
subjected to cryogenic cycles. Note however that the test does not
simulate
the thermal mass and mechanical loading seen on the flight vehicle during
loading and flight. Secondly, the fact that a flight spares ball
had
subsurface defects which propagated to a surface crack tends to indict
the
acceptance criteria.

The concern of particle liberation upstream of an SSME has been fueled by
the type of cracking detected on the severely cracked 2.24" balls.
Coordination with the SSME Project on the engine's tolerance to FOD is
being
conducted in an attempt to clear this concern.

Thermal modeling indicates that LN2 is not a good test fluid for balls in
LH2 service (1.25"). If liquid hydrogen is used to simulate
these
conditions, safety considerations will slow testing significantly.
Other
mediums, such as liquid helium and liquid neon, are being considered.
Note
that the thermal modeling so far has considered only the ball.
Model
development is in work on the inserts and adjoining hardware.

NDE of all flight spares is being conducted in an effort to find more
balls
with subsurface indications. These would then be put in test.
Finding no
indications in any of the flight spares might support the theory that
OV-103's ball was an outlier, i.e., that it had subsurface cracks when
installed in the line.

More to come.

Hugo

-----Original Message-----
From: HATAMLEH, OMAR (JSC-NC) (SAIC)
To: ERMINGER, MARK D. (JSC-NC) (NASA); JOHNSON, M. S. (SCOTT) (JSC-NC)
(NASA); BROWNE, DAVID M. (JSC-NC) (NASA)
Cc: CULBERTSON, FRANK L., JR (JSC-NA) (SAIC); CAZES, DAVID (JSC-NA)
(SAIC);
EVATT, GARVIN T. (GT) (JSC-NC) (SAIC); BALU, BRIAN K. (JSC-NC) (SAIC);
DYER,
KEITH W. (JSC-NC) (SAIC); AUGUSTYN, JOSEPH (JSC-REMOTE); MARTINEZ, HUGO
E.
(JSC-NC) (GHG); TIPTON, MICHAEL R. (JSC-NX) (SAIC); PRINCE, GORMAN W.
(BILLY) (JSC-NC) (GHG); ISHMAEL, MOHAMED I. (GEORGE) (JSC-NC) (SAIC);
CLEMENTS, DANIEL L. (JSC-NC) (GHG); ALMASRI, WALEED (JSC-REMOTE);
AL-HAYEK,
FAREED A. (JSC-NC) (SAIC)
Sent: 12/27/2002 6:10 PM
Subject: RE: BSTRA ball test status

Cryogenic load testing in Huntington Beach is continuing on three
separate 2.24" BSTRA balls in order to help build flight rationale.
Test
1, and 2a are still in progress with no crack indications so far.
Test
2b has been completed with no crack indications. Test 2b indicates
that
a flight ball, when subjected to a single mission's worth of cryo and
mechanical combined loading, does not crack.

In addition to the Huntington Beach testing, MSFC is working on a method
of cracking a ball thermally to be used in the event that a crack cannot
be initiated via the current Huntington Beach test procedure. MSFC
was
successful in cracking balls under severe conditions (300 F to -100 F in
one case and 400 F to -100 F in another case). The crack extends
about
280 degrees around on one ball, and a little less on another ball.
Another interesting feature was the production of intersecting cracks,
which could ultimately lead to FOD.

MSFC sectioned a 2.25" ball purchased from the Oregon vendor and found
a
large porosity site ("big enough to stick a pencil in") near the
center.
These Oregon balls were produced much later and have process
improvements which should help eliminate porosity. This data tends
to
indicate that porosity is probably to be found in most cast balls.
In
addition, metallurgy shows a finer grain structure in the middle and
coarser towards the surface.

Updates to the JSC activities will be provided in a separate email note.
The next meeting is scheduled for Monday at a time to be disclosed
later.

> -----Original Message-----
>From: <x-tab> </x-tab>MARTINEZ, HUGO E. (JSC-NC) (GHG)

>Sent:<x-tab> </x-tab>Monday, December 23, 2002 1:44 PM
>To:<x-tab>   </x-tab>BROWNE, DAVID M. (JSC-NC) (NASA); CULBERTSON, FRANK L., JR
>(JSC-NA) (SAIC); CAZES, DAVID (JSC-NA) (SAIC); EVATT, GARVIN T. (GT)
>(JSC-NC) (SAIC); DYER, KEITH W. (JSC-NC) (SAIC); JOHNSON, M. S. (SCOTT)
>(JSC-NC) (NASA); ERMINGER, MARK D. (JSC-NC) (NASA); ALMASRI, WALEED;
>BALU, BRIAN; CLEMENTS, DANIEL; HATAMLEH, OMAR; ISHMAEL, MOHAMED;
>jaugust0; PRINCE, GORMAN; TIPTON, MICHAEL
>Subject:<x-tab>   </x-tab>BSTRA ball test status
>
>Execute summary: Cryogenic load testing in Huntington Beach began
>Friday, December 20th on three separate 2.24" BSTRA balls in order to
>help build flight rationale. These three tests, which are being run in
>parallel, attempt to prove the theory that cracks will develop and then
>arrest prior to going completely through a ball. Partly into the tests
>this morning, no cracks have conclusively been observed, although one
>faint indication is being inspected further. In addition, another
>ball, a flight spares of a smaller size, was eddy current inspected and
>found to have subsurface indications not detetable with dye pen and
>visual checks. Testing will continue today and will resume on the
>evening of the 26th.
>
>Test #1:   2.24" ball, notch in ball, instrumented. Purpose is to help
>validate computer model by assessing residual stresses and thermal
>response. Have completed first 5 thermal cycles from ambient to LN2
>(-320F), and there appears a faint line or shadow in the notch near one
>end being inspected further to confirm or deny a crack. Continued with
>6th thermal cycles (this second set of 5 cycles is from 200 F to LN2)
>until a crack is confirmed. If no cracks develop at the conclusion of
>these 10 cycles, a more severe method of creating a crack will be
>developed. If a crack develops, the same temperature cycle will be
>repeated until the ball fails or the crack arrests. The more severe
>method, which is under development as a contingency, could use boiling
>water and an alcohol/dry ice bath to produce a much higher temperature
>gradient.
>
>Test #2a: 2.24" ball in flight-like cups, notch in ball, not
>instrumented*, mechanical load cycling while in LN2 bath: Purpose of
>test is to show crack growth and subsequent arrest while under
>flight-like thermal and mechanical loads. Briefly, the test is
>scheduled to:
>1. Simulate nominal loads seen during propellant loading (11,000 lbs
>applied and removed while in LN2 bath) for 5 cycles, then inspect.
>2. Simulate nominal loads seen during flight (41,000 lbs applied and

>removed while in LN2 bath) for 30 cycles, then inspect.
>3. Apply margin loads above nominal flight loads (49,000 applied and
>removed while in LN2 bath) for 5 cycles, then inspect.
>4. Apply margin loads above nominal flight loads (61,000 applied and
>removed while in LN2 bath) for 5 cycles, then inspect.
>5. Apply margin loads above nominal flight loads (71,000 applied and
>removed while in LN2 bath) for 5 cycles, then inspect.
>
>Currently, test #2a is 3 cycles into the 41,000 lbs testing, with no
>cracks visible after the 11,000 testing was completed. As in test #1,
>testing will continue until a crack develops / arrests. Inspections
>are visual after every cycle, and eddy current after every 5th cycle.
>*Instrumentation removed.
>
>Test #2b: Same as #2a, but without notch in ball: Purpose of test is
>to show crack initiation, growth and subsequent crack arrest while
>under flight-like thermal and mechanical loads, but on a pristine ball
>which more closely resembles flight balls. The test sequence is the
>same as in Test #2a:
>
>The 35 nominal cycles are complete (5 cycles at 11,000 lbs plus 30
>cycles at 41,000 lbs), and margin testing has commenced for a total of
>43 cycles so far. There are no indications of a crack via visual or
>eddy current at this time.
>
>MSFC activity:
>In addition to the Huntington Beach testing, MSFC is working on
>metallography of balls of various sizes in order to rationalize
>extrapolating these results to the different size balls used in the
>Orbiter (2.24", 1.75", and 1.25"). In addition, MSFC is working on a
>method of cracking a ball thermally to be used in the event that a
>crack cannot be initiated via the current test procedure. Finally,
>MSFC reports finding an eddy current indication in a flight spares ball
>(of 1.25" diameter), an indication which is invisible via visual and
>dye pen. This "crack" must be subsurface and may be a cluster of
>porosity. Since this ball was extracted from flight spares and may
>have a crack, this tends to indict the acceptance screening process.
>MSFC personnel believe that there are large variations in
>microstructure between individual balls. However, even with
>variations, the testing being conducted at Huntington Beach will likely
>show crack arrest regardless of initial crack existence.
>
>JSC Activity: Mike Tipton has been working closely JSC Engineering and
>shop support in the development of tools for inspecting 100% of the
>ball surface in an installed line. Ideally, both crack location (via
>eddy current) and depth (with Ultrasonic techniques, perhaps) can be

>achieved on the fleet feedlines without requiring removal of the lines.
>
>Testing will continue throughout the day today and will resume shortly
>after Christmas (on the evening of the 26th). The next test status
>will be presented Friday, December 27th at 3:00 pm.
>
>Hugo E. Martinez, PE
>Shuttle SR&QA Propulsion & Power Lead Engineer
>JSC NC62
>Phone: 281 244-1974
>Pager:
>Fax: 281 244-1849
>
>Providing for a safer tomorrow, today.
>
</blockquote></x-html>
<html>

<blockquote type=cite cite>From: "ERMINGER, MARK D. (JSC-NC) (NASA)"
<mark.d.erminger@nasa.gov>
To: "MARSHALL, YOLANDA Y. (JSC-NA) (NASA)"
<yolanda.y.marshall@nasa.gov>,
        "'H - O'Connor Bryan'"
<boconnor@mail.hq.nasa.gov>
Cc: "JOHNSON, GARY W. (JSC-NA) (NASA)"
<gary.w.johnson@nasa.gov>,
        "JOHNSON, M. S. (SCOTT) (JSC-NC)
(NASA)" <m.s.johnson@nasa.gov>,
        "'H - Kowaleski Mark'"
<mkowales@mail.hq.nasa.gov>,
        "H - Bihner Bill
(wbihner@mail.hq.nasa.gov)" <wbihner@mail.hq.nasa.gov>,
        "MARTINEZ, HUGO E. (JSC-NC)
(GHG)" <hugo.e.martinez1@jsc.nasa.gov>
Subject: FW: BSTRA ball test status
Date: Fri, 3 Jan 2003 05:57:14 -0600
X-Mailer: Internet Mail Service (5.5.2653.19)

-----Original Message-----
From: MARTINEZ, HUGO E. (JSC-NC) (GHG)
Sent: Thursday, January 02, 2003 6:16 PM
To: HATAMLEH, OMAR (JSC-NC) (SAIC); ERMINGER, MARK D. (JSC-NC) (NASA);
JOHNSON, M. S. (SCOTT) (JSC-NC) (NASA); BROWNE, DAVID M. (JSC-NC) (NASA)
Cc: CULBERTSON, FRANK L., JR (JSC-NA) (SAIC); CAZES, DAVID (JSC-NA) (SAIC);
EVATT, GARVIN T. (GT) (JSC-NC) (SAIC); BALU, BRIAN K. (JSC-NC) (SAIC); DYER, KEITH
W. (JSC-NC) (SAIC); AUGUSTYN, JOSEPH (JSC-REMOTE); TIPTON, MICHAEL R. (JSC-NX)
(SAIC); PRINCE, GORMAN W. (BILLY) (JSC-NC) (GHG); ISHMAEL, MOHAMED I. (GEORGE)
(JSC-NC) (SAIC); CLEMENTS, DANIEL L. (JSC-NC) (GHG); ALMASRI, WALEED (JSC-REMOTE);
AL-HAYEK, FAREED A. (JSC-NC) (SAIC)
Subject: RE: BSTRA ball test status

Cracks have finally been observed in 2 of 3 balls at Huntington Beach
using method developed at MSFC, but no conclusions can yet be drawn. FOD
continues to be a serious discussion topic. At the meeting today with Ralph
Roe, the Huntington Beach and MSFC test status was given, the status of the JSC
remote tool development was presented, and thoughts on flight rationale were
discussed.

Plans are for testing to conclude Jan 8th, although a PRCB will be held on the 6th to discuss preliminary FRR charts for STS-107. The team will not report to Ralph Roe until Monday the 6th at 9:00 am unless testing over the weekend fails (crack does not arrest or FOD is generated). In the meantime, the SSME Project will have an answer on FOD tolerance (not expected to be good). If a naturally cracked (vs. notched) ball generates FOD or does not arrest, we will have a problem necessitating the inspection of OV-102's balls. If any other ball generates FOD or does not arrest, the Test #2b ball with two in-line notches can be used to prove arrest and no FOD generation.

<u>Huntington Beach test status:
</u>
<u>Test #1</u> Update: Completed incremental thermal shock at 350 F without cracking. Abandoned this test (this is the test where they started at 200 F and quenched at -100 F, then incremented the initial temperature by 25 degrees each time and quenched again) and will crack with a wedge now.

<u>Test #2a Update:</u> During 275 F to -100 F incremental thermal shock, got multiple cracking about 320 degrees around. Will now subject it to flight-like thermal/mechanical per 4x testing. 4x testing repeats the nominal flight portion of test#2a three additional times in order to encompass 30 missions (OV-102 has seen 28 missions).

<u>Test #2b Update:</u> Had stopped testing and put in two series "thumbnail" notches and put into 212 F to 32 F rapid thermal cycles. Saw a crack between notches, detected via eddy current, not yet visible. Will then go into 4x testing.

<u>MSFC Status:
</u>
Both cracked 2.24" balls at MSFC are undergoing testing per HB's test #2 plan and no crack growth has been seen. Both of these balls were initially cracked using a severe thermal gradient. Similarly, 1.75" and 1.25" balls are undergoing testing per test #2. One 1.75" ball had cracked without a notch and without a severe thermal environment (see below) and has opened up a new crack via testing. The maximum length of a crack is 0.4 inches but shallow and stable, it appears. <u>
</u>
<u>JSC Remote Tool Development Update:
</u>
Developers claim they have "tremendous control" of ball. Some technical issues, such as needing more articulation, cleaning the device for use on the fleet, and establishing the vehicle BSTRA joint configuration are being worked. They are building an articulating joint at the end effector to address the first issue. The device will be ready this coming Sunday.

<u>Other:
</u>
SRQA got an action to perform a PRA on the potential for FOD generation. We will be working on the feasibility of this tomorrow (Jan 3rd). While we haven't coordinated with the PRA analysts yet, we feel that getting realistic numbers would not be possible with the available data.

Hugo

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

From: MARTINEZ, HUGO E. (JSC-NC) (GHG)

Sent: Wednesday, January 01, 2003 2:23 PM

To: HATAMLEH, OMAR (JSC-NC) (SAIC); ERMINGER, MARK D. (JSC-NC)

(NASA);

JOHNSON, M. S. (SCOTT) (JSC-NC) (NASA); BROWNE, DAVID M. (JSC-NC)
(NASA)

Cc: CULBERTSON, FRANK L., JR (JSC-NA) (SAIC); CAZES, DAVID (JSC-NA)

(SAIC); EVATT, GARVIN T. (GT) (JSC-NC) (SAIC); BALU, BRIAN K.
(JSC-NC)

(SAIC); DYER, KEITH W. (JSC-NC) (SAIC); AUGUSTYN, JOSEPH
(JSC-REMOTE);

TIPTON, MICHAEL R. (JSC-NX) (SAIC); PRINCE, GORMAN W. (BILLY)
(JSC-NC)

(GHG); ISHMAEL, MOHAMED I. (GEORGE) (JSC-NC) (SAIC); CLEMENTS, DANIEL
L.

(JSC-NC) (GHG); ALMASRI, WALEED (JSC-REMOTE); AL-HAYEK, FAREED A.

(JSC-NC) (SAIC)

Subject: RE: BSTRA ball test status

Testing at Huntington Beach and MSFC continues, as does the development
of thermal and stress models in an attempt to build flight rationale for
STS-107. The generation of FOD has not at all been alleviated after branched
cracking was detected on an MSFC ball subjected to extreme temperature
gradients.

Huntington Beach testing continues on the 3 balls in an effort to first
create cracks and then to show arrest (no surface growth) under a repeated load
profile. All testing described in the original email below is complete, but no
cracks have been created. Huntington Beach is adding steps to their test
procedure to incorporate crack initiation techniques developed at MSFC: the use of a
dry ice/alcohol bath (-100°F) which allows for quicker quenching.

Test #1 Update: Since dunking the notched 2.24" cabinet ball in
LN2 created no cracks (nor did boiling water to ice water thermal shocks), the ball
is now being heated to an incrementally higher temperature and quenched at -100°F
dry ice/alcohol. This series of thermal shocks is in effort to "sneak
up" on the critical conditions required to crack a ball. The first set of
5 thermal shock cycles began at 200°F, and subsequent sets beginning at 225°F and
250°F yielded no cracks. As of December 30th, the set beginning at 275°F was
in work. Plans are to continue incrementing the initial temperature by 25°F,
running 5 cycles. Inspections are run visually and with eddy current after the
first and 5th cycles in each set.

Test #2a Update: Taking the notched 2.24" flight spares ball
through a series of flight-like thermal mechanical cycles described below yielded no
cracking. The same series of thermal shocks is being used on this ball as in
test #1 above, that is, purely thermal cycles, in an effort to crack it. On
200°F cycles, saw an eddy current indication and again during 225°F cycles deep in
the notch. It appears to be growing about an 1/8th of an inch on one edge of
the notch but is not yet visible on the surface. Once it is seen on the
surface, testing will proceed to Phase II, testing for crack arrest under
flight-like thermal mechanical/loading. Eddy current and visual inspections
are being conducted after every cycle at this time. Testing is now in the set
of 5 cycles at 250°F, but so far no surface cracks have appeared.

Test #2b Update: Taking the second 2.24" flight spares ball
(without a notch) through a series of flight-like thermal mechanical cycles

described below yielded no cracking. In an effort to expedite the creation of a crack, two in-line notches are being EDM'd into the ball, approximately 0.050" between them. The ball with then be subjected to a total of 1000 rapid thermal cycles from boiling water to ice water in an effort to crack it before resuming flight-like thermal/mechanical cycling.

MSFC Status: Besides developing a technique for quicker quenching, MSFC personnel have cracked both notched and pristine 2.24" balls using severe thermal cycles. In addition, they have cracked a flight spares ball (one of 1.75" diameter, without a notch, that had pre-existing subsurface flaws) with nominal thermal cycles (from ambient to LN2 temperature). Because of the similarity between LN2 temperature and LO2's temperature (flight temperature), cracking of the 1.75" ball lends credibility to the theory that the OV-103 ball might have had subsurface cracks which surfaced when subjected to cryogenic cycles. Note however that the test does not simulate the thermal mass and mechanical loading seen on the flight vehicle during loading and flight. Secondly, the fact that a flight spares ball had subsurface defects which propagated to a surface crack tends to indict the acceptance criteria.

The concern of particle liberation upstream of an SSME has been fueled by the type of cracking detected on the severely cracked 2.24" balls. Coordination with the SSME Project on the engine's tolerance to FOD is being conducted in an attempt to clear this concern.

Thermal modeling indicates that LN2 is not a good test fluid for balls in LH2 service (1.25"). If liquid hydrogen is used to simulate these conditions, safety considerations will slow testing significantly. Other mediums, such as liquid helium and liquid neon, are being considered. Note that the thermal modeling so far has considered only the ball. Model development is in work on the inserts and adjoining hardware.

NDE of all flight spares is being conducted in an effort to find more balls with subsurface indications. These would then be put in test. Finding no indications in any of the flight spares might support the theory that OV-103's ball was an outlier, i.e., that it had subsurface cracks when installed in the line.

More to come.

Hugo

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

From: HATAMLEH, OMAR (JSC-NC) (SAIC)

To: ERMINGER, MARK D. (JSC-NC) (NASA); JOHNSON, M. S. (SCOTT) (JSC-NC) (NASA); BROWNE, DAVID M. (JSC-NC) (NASA)

Cc: CULBERTSON, FRANK L., JR (JSC-NA) (SAIC); CAZES, DAVID (JSC-NA) (SAIC); EVATT, GARVIN T. (GT) (JSC-NC) (SAIC); BALU, BRIAN K. (JSC-NC) (SAIC); DYER, KEITH W. (JSC-NC) (SAIC); AUGUSTYN, JOSEPH (JSC-REMOTE); MARTINEZ, HUGO E. (JSC-NC) (GHG); TIPTON, MICHAEL R. (JSC-NX) (SAIC); PRINCE, GORMAN W. (BILLY) (JSC-NC) (GHG); ISHMAEL, MOHAMED I. (GEORGE) (JSC-NC) (SAIC); CLEMENTS, DANIEL L. (JSC-NC) (GHG); ALMASRI, WALEED (JSC-REMOTE); AL-HAYEK, FAREED A. (JSC-NC) (SAIC)

Sent: 12/27/2002 6:10 PM

Subject: RE: BSTRA ball test status

Cryogenic load testing in Huntington Beach is continuing on three

<font size=2>separate 2.24" BSTRA balls in order to help build flight rationale. Test

```
</font><br>
<font size=2>1, and 2a are still in progress with no crack indications so far. 
Test<br>
</font><br>
<font size=2>2b has been completed with no crack indications.  Test 2b
indicates that<br>
</font><br>
<font size=2>a flight ball, when subjected to a single mission's worth of cryo
and<br>
</font><br>
<font size=2>mechanical combined loading, does not crack. <br>
</font><br>
<font size=2>In addition to the Huntington Beach testing, MSFC is working on a
method<br>
</font><br>
<font size=2>of cracking a ball thermally to be used in the event that a crack
cannot<br>
</font><br>
<font size=2>be initiated via the current Huntington Beach test procedure. 
MSFC was<br>
</font><br>
<font size=2>successful in cracking balls under severe conditions (300 F to -100 F
in<br>
</font><br>
<font size=2>one case and 400 F to -100 F in another case).  The crack extends
about<br>
</font><br>
<font size=2>280 degrees around on one ball, and a little less on another ball.<br>
</font><br>
<font size=2>Another interesting feature was the production of intersecting
cracks,<br>
</font><br>
<font size=2>which could ultimately lead to FOD.  <br>
</font><br>
<font size=2>MSFC sectioned a 2.25&quot; ball purchased from the Oregon vendor and
found a<br>
</font><br>
<font size=2>large porosity site (&quot;big enough to stick a pencil in&quot;) near
the center.<br>
</font><br>
<font size=2>These Oregon balls were produced much later and have process<br>
</font><br>
<font size=2>improvements which should help eliminate porosity.  This data
tends to<br>
</font><br>
<font size=2>indicate that porosity is probably to be found in most cast
balls.  In<br>
</font><br>
<font size=2>addition, metallurgy shows a finer grain structure in the middle
and<br>
</font><br>
<font size=2>coarser towards the surface.<br>
</font><br>
<font size=2>Updates to the JSC activities will be provided in a separate email
note.<br>
</font><br>
<font size=2>The next meeting is scheduled for Monday at a time to be disclosed<br>
</font><br>
<font size=2>later.  <br>
</font><br>
<font size=2>&gt; -----Original Message-----<br>
</font><br>
<font size=2>&gt;From:  MARTINEZ, HUGO E. (JSC-NC) (GHG)  <br>
```

```
</font><br>
<font size=2>&gt;Sent:  Monday, December 23, 2002 1:44 PM<br>
</font><br>
<font size=2>&gt;To:    BROWNE, DAVID M. (JSC-NC) (NASA); CULBERTSON,
FRANK L., JR<br>
</font><br>
<font size=2>&gt;(JSC-NA) (SAIC); CAZES, DAVID (JSC-NA) (SAIC); EVATT, GARVIN T.
(GT)<br>
</font><br>
<font size=2>&gt;(JSC-NC) (SAIC); DYER, KEITH W. (JSC-NC) (SAIC); JOHNSON, M. S.
(SCOTT)<br>
</font><br>
<font size=2>&gt;(JSC-NC) (NASA); ERMINGER, MARK D. (JSC-NC) (NASA); ALMASRI,
WALEED;<br>
</font><br>
<font size=2>&gt;BALU, BRIAN; CLEMENTS, DANIEL; HATAMLEH, OMAR; ISHMAEL,
MOHAMED;<br>
</font><br>
<font size=2>&gt;jaugust0; PRINCE, GORMAN; TIPTON, MICHAEL<br>
</font><br>
<font size=2>&gt;Subject:       BSTRA ball test
status<br>
</font><br>
<font size=2>&gt;<br>
</font><br>
<font size=2>&gt;Execute summary:  Cryogenic load testing in Huntington Beach
began<br>
</font><br>
<font size=2>&gt;Friday, December 20th on three separate 2.24&quot; BSTRA balls in
order to<br>
</font><br>
<font size=2>&gt;help build flight rationale.  These three tests, which are
being run in<br>
</font><br>
<font size=2>&gt;parallel, attempt to prove the theory that cracks will develop and
then<br>
</font><br>
<font size=2>&gt;arrest prior to going completely through a ball.  Partly into
the tests<br>
</font><br>
<font size=2>&gt;this morning, no cracks have conclusively been observed, although
one<br>
</font><br>
<font size=2>&gt;faint indication is being inspected further.  In addition,
another<br>
</font><br>
<font size=2>&gt;ball, a flight spares of a smaller size, was eddy current inspected
and<br>
</font><br>
<font size=2>&gt;found to have subsurface indications not detetable with dye pen
and<br>
</font><br>
<font size=2>&gt;visual checks.  Testing will continue today and will resume on
the<br>
</font><br>
<font size=2>&gt;evening of the 26th.<br>
</font><br>
<font size=2>&gt;<br>
</font><br>
<font size=2>&gt;Test #1:   2.24&quot; ball, notch in ball,
instrumented.  Purpose is to help<br>
</font><br>
<font size=2>&gt;validate computer model by assessing residual stresses and
```

```
thermal<br>
</font><br>
<font size=2>&gt;response.  Have completed first 5 thermal cycles from ambient
to LN2<br>
</font><br>
<font size=2>&gt;(-320F), and there appears a faint line or shadow in the notch near
one<br>
</font><br>
<font size=2>&gt;end being inspected further to confirm or deny a crack. 
Continued with<br>
</font><br>
<font size=2>&gt;6th thermal cycles (this second set of 5 cycles is from 200 F to
LN2)<br>
</font><br>
<font size=2>&gt;until a crack is confirmed.  If no cracks develop at the
conclusion of<br>
</font><br>
<font size=2>&gt;these 10 cycles, a more severe method of creating a crack will
be<br>
</font><br>
<font size=2>&gt;developed.  If a crack develops, the same temperature cycle
will be<br>
</font><br>
<font size=2>&gt;repeated until the ball fails or the crack arrests.  The more
severe<br>
</font><br>
<font size=2>&gt;method, which is under development as a contingency, could use
boiling<br>
</font><br>
<font size=2>&gt;water and an alcohol/dry ice bath to produce a much higher
temperature<br>
</font><br>
<font size=2>&gt;gradient.<br>
</font><br>
<font size=2>&gt;<br>
</font><br>
<font size=2>&gt;Test #2a: 2.24&quot; ball in flight-like cups, notch in ball,
not<br>
</font><br>
<font size=2>&gt;instrumented*, mechanical load cycling while in LN2 bath: Purpose
of<br>
</font><br>
<font size=2>&gt;test is to show crack growth and subsequent arrest while under<br>
</font><br>
<font size=2>&gt;flight-like thermal and mechanical loads.  Briefly, the test
is<br>
</font><br>
<font size=2>&gt;scheduled to:<br>
</font><br>
<font size=2>&gt;1. Simulate nominal loads seen during propellant loading (11,000
lbs<br>
</font><br>
<font size=2>&gt;applied and removed while in LN2 bath) for 5 cycles, then
inspect.<br>
</font><br>
<font size=2>&gt;2. Simulate nominal loads seen during flight (41,000 lbs applied
and<br>
</font><br>
<font size=2>&gt;removed while in LN2 bath) for 30 cycles, then inspect.<br>
</font><br>
<font size=2>&gt;3. Apply margin loads above nominal flight loads (49,000 applied
and<br>
</font><br>
```

>removed while in LN2 bath) for 5 cycles, then inspect.

>4. Apply margin loads above nominal flight loads (61,000 applied and

>removed while in LN2 bath) for 5 cycles, then inspect.

>5. Apply margin loads above nominal flight loads (71,000 applied and

>removed while in LN2 bath) for 5 cycles, then inspect.

>

>Currently, test #2a is 3 cycles into the 41,000 lbs testing, with no

>cracks visible after the 11,000 testing was completed. As in test #1,

>testing will continue until a crack develops / arrests. Inspections

>are visual after every cycle, and eddy current after every 5th cycle.

>*Instrumentation removed.

>

>Test #2b: Same as #2a, but without notch in ball: Purpose of test is

>to show crack initiation, growth and subsequent crack arrest while

>under flight-like thermal and mechanical loads, but on a pristine ball

>which more closely resembles flight balls. The test sequence is the

>same as in Test #2a:

>

>The 35 nominal cycles are complete (5 cycles at 11,000 lbs plus 30

>cycles at 41,000 lbs), and margin testing has commenced for a total of

>43 cycles so far. There are no indications of a crack via visual or

>eddy current at this time.

>

>MSFC activity:

>In addition to the Huntington Beach testing, MSFC is working on

>metallography of balls of various sizes in order to rationalize

>extrapolating these results to the different size balls used in
the

>Orbiter (2.24", 1.75", and 1.25"). In
addition, MSFC is working on a

>method of cracking a ball thermally to be used in the event that
a

>crack cannot be initiated via the current test procedure.
Finally,

>MSFC reports finding an eddy current indication in a flight spares
ball

>(of 1.25" diameter), an indication which is invisible via
visual and

>dye pen. This "crack" must be subsurface and may be
a cluster of

>porosity. Since this ball was extracted from flight spares
and may

>have a crack, this tends to indict the acceptance screening
process.

>MSFC personnel believe that there are large variations in

>microstructure between individual balls. However, even
with

>variations, the testing being conducted at Huntington Beach will
likely

>show crack arrest regardless of initial crack existence.

>

>JSC Activity: Mike Tipton has been working closely JSC
Engineering and

>shop support in the development of tools for inspecting 100% of
the

>ball surface in an installed line. Ideally, both crack
location (via

>eddy current) and depth (with Ultrasonic techniques, perhaps) can
be

>achieved on the fleet feedlines without requiring removal of the
lines.

>

>Testing will continue throughout the day today and will resume
shortly

<font size=2>>after Christmas (on the evening of the 26th). The next test
status

```
</font><br>
<font size=2>&gt;will be presented Friday, December 27th at 3:00 pm.<br>
</font><br>
<font size=2>&gt;<br>
</font><br>
<font size=2>&gt;Hugo E. Martinez, PE<br>
</font><br>
<font size=2>&gt;Shuttle SR&amp;QA Propulsion &amp; Power Lead Engineer<br>
</font><br>
<font size=2>&gt;JSC NC62<br>
</font><br>
<font size=2>&gt;Phone: 281 244-1974<br>
</font><br>
<font size=2>&gt;Pager:
</font><br>
<font size=2>&gt;Fax: 281 244-1849<br>
</font><br>
<font size=2>&gt;<br>
</font><br>
<font size=2>&gt;Providing for a safer tomorrow, today.<br>
</font><br>
<font size=2>&gt;</font></blockquote></html>
<html>
<br>
<blockquote type=cite cite>From: &quot;ERMINGER, MARK D. (JSC-NC) (NASA)&quot;
&lt;mark.d.erminger@nasa.gov&gt;<br>
To: &quot;MARSHALL, YOLANDA Y. (JSC-NA) (NASA)&quot;
&lt;yolanda.y.marshall@nasa.gov&gt;,<br>
        &quot;'H - O'Connor Bryan'&quot;
&lt;boconnor@mail.hq.nasa.gov&gt;<br>
Cc: &quot;JOHNSON, GARY W. (JSC-NA) (NASA)&quot;
&lt;gary.w.johnson@nasa.gov&gt;,<br>
        &quot;JOHNSON, M. S. (SCOTT) (JSC-NC)
(NASA)&quot; &lt;m.s.johnson@nasa.gov&gt;,<br>
        &quot;'H - Kowaleski Mark'&quot;
&lt;mkowales@mail.hq.nasa.gov&gt;,<br>
        &quot;H - Bihner Bill
(wbihner@mail.hq.nasa.gov)&quot; &lt;wbihner@mail.hq.nasa.gov&gt;,<br>
        &quot;MARTINEZ, HUGO E. (JSC-NC)
(GHG)&quot; &lt;hugo.e.martinez1@jsc.nasa.gov&gt;<br>
Subject: FW: BSTRA ball test status<br>
Date: Fri, 3 Jan 2003 05:57:14 -0600 <br>
X-Mailer: Internet Mail Service (5.5.2653.19)<br>
<br>
<br>
<br>
<font face="Tahoma" size=2>-----Original Message-----<br>
<b>From:</b> MARTINEZ, HUGO E. (JSC-NC) (GHG)<br>
<b>Sent:</b> Thursday, January 02, 2003 6:16 PM<br>
<b>To:</b> HATAMLEH, OMAR (JSC-NC) (SAIC); ERMINGER, MARK D. (JSC-NC) (NASA);
JOHNSON, M. S. (SCOTT) (JSC-NC) (NASA); BROWNE, DAVID M. (JSC-NC) (NASA)<br>
<b>Cc:</b> CULBERTSON, FRANK L., JR (JSC-NA) (SAIC); CAZES, DAVID (JSC-NA) (SAIC);
EVATT, GARVIN T. (GT) (JSC-NC) (SAIC); BALU, BRIAN K. (JSC-NC) (SAIC); DYER, KEITH
W. (JSC-NC) (SAIC); AUGUSTYN, JOSEPH (JSC-REMOTE); TIPTON, MICHAEL R. (JSC-NX)
(SAIC); PRINCE, GORMAN W. (BILLY) (JSC-NC) (GHG); ISHMAEL, MOHAMED I. (GEORGE)
(JSC-NC) (SAIC); CLEMENTS, DANIEL L. (JSC-NC) (GHG); ALMASRI, WALEED (JSC-REMOTE);
AL-HAYEK, FAREED A. (JSC-NC) (SAIC)<br>
<b>Subject:</b> RE: BSTRA ball test status<br>
</font><br>
<font size=2>Cracks have finally been observed in 2 of 3 balls at Huntington Beach
using method developed at MSFC, but no conclusions can yet be drawn.  FOD
continues to be a serious discussion topic.  At the meeting today with Ralph
Roe, the Huntington Beach and MSFC test status was given, the status of the JSC
```

remote tool development was presented, and thoughts on flight rationale were discussed.

Plans are for testing to conclude Jan 8th, although a PRCB will be held on the 6th to discuss preliminary FRR charts for STS-107. The team will not report to Ralph Roe until Monday the 6th at 9:00 am unless testing over the weekend fails (crack does not arrest or FOD is generated). In the meantime, the SSME Project will have an answer on FOD tolerance (not expected to be good). If a naturally cracked (vs. notched) ball generates FOD or does not arrest, we will have a problem necessitating the inspection of OV-102's balls. If any other ball generates FOD or does not arrest, the Test #2b ball with two in-line notches can be used to prove arrest and no FOD generation.

<u>Huntington Beach test status:
</u>
<u>Test #1</u> Update: Completed incremental thermal shock at 350 F without cracking. Abandoned this test (this is the test where they started at 200 F and quenched at -100 F, then incremented the initial temperature by 25 degrees each time and quenched again) and will crack with a wedge now.

<u>Test #2a Update:</u> During 275 F to -100 F incremental thermal shock, got multiple cracking about 320 degrees around. Will now subject it to flight-like thermal/mechanical per 4x testing. 4x testing repeats the nominal flight portion of test#2a three additional times in order to encompass 30 missions (OV-102 has seen 28 missions).

<u>Test #2b Update:</u> Had stopped testing and put in two series "thumbnail" notches and put into 212 F to 32 F rapid thermal cycles. Saw a crack between notches, detected via eddy current, not yet visible. Will then go into 4x testing.

<u>MSFC Status:
</u>
Both cracked 2.24" balls at MSFC are undergoing testing per HB's test #2 plan and no crack growth has been seen. Both of these balls were initially cracked using a severe thermal gradient. Similarly, 1.75" and 1.25" balls are undergoing testing per test #2. One 1.75" ball had cracked without a notch and without a severe thermal environment (see below) and has opened up a new crack via testing. The maximum length of a crack is 0.4 inches but shallow and stable, it appears. <u>
</u>
<u>JSC Remote Tool Development Update:
</u>
Developers claim they have "tremendous control" of ball. Some technical issues, such as needing more articulation, cleaning the device for use on the fleet, and establishing the vehicle BSTRA joint configuration are being worked. They are building an articulating joint at the end effector to address the first issue. The device will be ready this coming Sunday.

<u>Other:
</u>
SRQA got an action to perform a PRA on the potential for FOD generation. We will be working on the feasibility of this tomorrow (Jan 3rd). While we haven't coordinated with the PRA analysts yet, we feel that getting realistic numbers would not be possible with the available data.

Hugo

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

From: MARTINEZ, HUGO E. (JSC-NC) (GHG)

Sent: Wednesday, January 01, 2003 2:23 PM

To: HATAMLEH, OMAR (JSC-NC) (SAIC); ERMINGER, MARK D. (JSC-NC)
(NASA);

JOHNSON, M. S. (SCOTT) (JSC-NC) (NASA); BROWNE, DAVID M. (JSC-NC)
(NASA)

Cc: CULBERTSON, FRANK L., JR (JSC-NA) (SAIC); CAZES, DAVID (JSC-NA)

(SAIC); EVATT, GARVIN T. (GT) (JSC-NC) (SAIC); BALU, BRIAN K.
(JSC-NC)

(SAIC); DYER, KEITH W. (JSC-NC) (SAIC); AUGUSTYN, JOSEPH
(JSC-REMOTE);

TIPTON, MICHAEL R. (JSC-NX) (SAIC); PRINCE, GORMAN W. (BILLY)
(JSC-NC)

(GHG); ISHMAEL, MOHAMED I. (GEORGE) (JSC-NC) (SAIC); CLEMENTS, DANIEL
L.

(JSC-NC) (GHG); ALMASRI, WALEED (JSC-REMOTE); AL-HAYEK, FAREED A.

(JSC-NC) (SAIC)

Subject: RE: BSTRA ball test status

Testing at Huntington Beach and MSFC continues, as does the development
of thermal and stress models in an attempt to build flight rationale for
STS-107. The generation of FOD has not at all been alleviated after branched
cracking was detected on an MSFC ball subjected to extreme temperature
gradients.

Huntington Beach testing continues on the 3 balls in an effort to first
create cracks and then to show arrest (no surface growth) under a repeated load
profile. All testing described in the original email below is complete, but no
cracks have been created. Huntington Beach is adding steps to their test
procedure to incorporate crack initiation techniques developed at MSFC: the use of a
dry ice/alcohol bath (-100°F) which allows for quicker quenching.

Test #1 Update: Since dunking the notched 2.24" cabinet ball in
LN2 created no cracks (nor did boiling water to ice water thermal shocks), the ball
is now being heated to an incrementally higher temperature and quenched at -100°F
dry ice/alcohol. This series of thermal shocks is in effort to "sneak
up" on the critical conditions required to crack a ball. The first set of
5 thermal shock cycles began at 200°F, and subsequent sets beginning at 225°F and
250°F yielded no cracks. As of December 30th, the set beginning at 275°F was
in work. Plans are to continue incrementing the initial temperature by 25°F,
running 5 cycles. Inspections are run visually and with eddy current after the
first and 5th cycles in each set.

Test #2a Update: Taking the notched 2.24" flight spares ball
through a series of flight-like thermal mechanical cycles described below yielded no
cracking. The same series of thermal shocks is being used on this ball as in
test #1 above, that is, purely thermal cycles, in an effort to crack it. On
200°F cycles, saw an eddy current indication and again during 225°F cycles deep in
the notch. It appears to be growing about an 1/8th of an inch on one edge of
the notch but is not yet visible on the surface. Once it is seen on the
surface, testing will proceed to Phase II, testing for crack arrest under
flight-like thermal mechanical/loading. Eddy current and visual inspections
are being conducted after every cycle at this time. Testing is now in the set
of 5 cycles at 250°F, but so far no surface cracks have appeared.

Test #2b Update: Taking the second 2.24" flight spares ball (without a notch) through a series of flight-like thermal mechanical cycles described below yielded no cracking. In an effort to expedite the creation of a crack, two in-line notches are being EDM'd into the ball, approximately 0.050" between them. The ball with then be subjected to a total of 1000 rapid thermal cycles from boiling water to ice water in an effort to crack it before resuming flight-like thermal/mechanical cycling.

MSFC Status: Besides developing a technique for quicker quenching, MSFC personnel have cracked both notched and pristine 2.24" balls using severe thermal cycles. In addition, they have cracked a flight spares ball (one of 1.75" diameter, without a notch, that had pre-existing subsurface flaws) with nominal thermal cycles (from ambient to LN2 temperature). Because of the similarity between LN2 temperature and LO2's temperature (flight temperature), cracking of the 1.75" ball lends credibility to the theory that the OV-103 ball might have had subsurface cracks which surfaced when subjected to cryogenic cycles. Note however that the test does not simulate the thermal mass and mechanical loading seen on the flight vehicle during loading and flight. Secondly, the fact that a flight spares ball had subsurface defects which propagated to a surface crack tends to indict the acceptance criteria.

The concern of particle liberation upstream of an SSME has been fueled by the type of cracking detected on the severely cracked 2.24" balls. Coordination with the SSME Project on the engine's tolerance to FOD is being conducted in an attempt to clear this concern.

Thermal modeling indicates that LN2 is not a good test fluid for balls in LH2 service (1.25"). If liquid hydrogen is used to simulate these conditions, safety considerations will slow testing significantly. Other mediums, such as liquid helium and liquid neon, are being considered. Note that the thermal modeling so far has considered only the ball. Model development is in work on the inserts and adjoining hardware.

NDE of all flight spares is being conducted in an effort to find more balls with subsurface indications. These would then be put in test. Finding no indications in any of the flight spares might support the theory that OV-103's ball was an outlier, i.e., that it had subsurface cracks when installed in the line.

More to come.

Hugo

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

From: HATAMLEH, OMAR (JSC-NC) (SAIC)

To: ERMINGER, MARK D. (JSC-NC) (NASA); JOHNSON, M. S. (SCOTT) (JSC-NC) (NASA); BROWNE, DAVID M. (JSC-NC) (NASA)

Cc: CULBERTSON, FRANK L., JR (JSC-NA) (SAIC); CAZES, DAVID (JSC-NA) (SAIC); EVATT, GARVIN T. (GT) (JSC-NC) (SAIC); BALU, BRIAN K. (JSC-NC) (SAIC); DYER, KEITH W. (JSC-NC) (SAIC); AUGUSTYN, JOSEPH (JSC-REMOTE); MARTINEZ, HUGO E. (JSC-NC) (GHG); TIPTON, MICHAEL R. (JSC-NX) (SAIC); PRINCE, GORMAN W. (BILLY) (JSC-NC) (GHG); ISHMAEL, MOHAMED I. (GEORGE) (JSC-NC) (SAIC); CLEMENTS, DANIEL L. (JSC-NC) (GHG); ALMASRI, WALEED (JSC-REMOTE); AL-HAYEK, FAREED A. (JSC-NC) (SAIC)

Sent: 12/27/2002 6:10 PM

Subject: RE: BSTRA ball test status

<font size=2>Cryogenic load testing in Huntington Beach is continuing on three

```
</font><br>
<font size=2>separate 2.24&quot; BSTRA balls in order to help build flight
rationale. Test<br>
</font><br>
<font size=2>1, and 2a are still in progress with no crack indications so far. 
Test<br>
</font><br>
<font size=2>2b has been completed with no crack indications.  Test 2b
indicates that<br>
</font><br>
<font size=2>a flight ball, when subjected to a single mission's worth of cryo
and<br>
</font><br>
<font size=2>mechanical combined loading, does not crack. <br>
</font><br>
<font size=2>In addition to the Huntington Beach testing, MSFC is working on a
method<br>
</font><br>
<font size=2>of cracking a ball thermally to be used in the event that a crack
cannot<br>
</font><br>
<font size=2>be initiated via the current Huntington Beach test procedure. 
MSFC was<br>
</font><br>
<font size=2>successful in cracking balls under severe conditions (300 F to -100 F
in<br>
</font><br>
<font size=2>one case and 400 F to -100 F in another case).  The crack extends
about<br>
</font><br>
<font size=2>280 degrees around on one ball, and a little less on another ball.<br>
</font><br>
<font size=2>Another interesting feature was the production of intersecting
cracks,<br>
</font><br>
<font size=2>which could ultimately lead to FOD.  <br>
</font><br>
<font size=2>MSFC sectioned a 2.25&quot; ball purchased from the Oregon vendor and
found a<br>
</font><br>
<font size=2>large porosity site (&quot;big enough to stick a pencil in&quot;) near
the center.<br>
</font><br>
<font size=2>These Oregon balls were produced much later and have process<br>
</font><br>
<font size=2>improvements which should help eliminate porosity.  This data
tends to<br>
</font><br>
<font size=2>indicate that porosity is probably to be found in most cast
balls.  In<br>
</font><br>
<font size=2>addition, metallurgy shows a finer grain structure in the middle
and<br>
</font><br>
<font size=2>coarser towards the surface.<br>
</font><br>
<font size=2>Updates to the JSC activities will be provided in a separate email
note.<br>
</font><br>
<font size=2>The next meeting is scheduled for Monday at a time to be disclosed<br>
</font><br>
<font size=2>later.  <br>
</font><br>
```

> -----Original Message-----

>From: MARTINEZ, HUGO E. (JSC-NC) (GHG)

>Sent: Monday, December 23, 2002 1:44 PM

>To: BROWNE, DAVID M. (JSC-NC) (NASA); CULBERTSON, FRANK L., JR

>(JSC-NA) (SAIC); CAZES, DAVID (JSC-NA) (SAIC); EVATT, GARVIN T. (GT)

>(JSC-NC) (SAIC); DYER, KEITH W. (JSC-NC) (SAIC); JOHNSON, M. S. (SCOTT)

>(JSC-NC) (NASA); ERMINGER, MARK D. (JSC-NC) (NASA); ALMASRI, WALEED;

>BALU, BRIAN; CLEMENTS, DANIEL; HATAMLEH, OMAR; ISHMAEL, MOHAMED;

>jaugust0; PRINCE, GORMAN; TIPTON, MICHAEL

>Subject: BSTRA ball test status

>

>Execute summary: Cryogenic load testing in Huntington Beach began

>Friday, December 20th on three separate 2.24" BSTRA balls in order to

>help build flight rationale. These three tests, which are being run in

>parallel, attempt to prove the theory that cracks will develop and then

>arrest prior to going completely through a ball. Partly into the tests

>this morning, no cracks have conclusively been observed, although one

>faint indication is being inspected further. In addition, another

>ball, a flight spares of a smaller size, was eddy current inspected and

>found to have subsurface indications not detetable with dye pen and

>visual checks. Testing will continue today and will resume on the

>evening of the 26th.

>

<font size=2>>Test #1:   2.24" ball, notch in ball,

```
instrumented.  Purpose is to help<br>
</font><br>
<font size=2>&gt;validate computer model by assessing residual stresses and
thermal<br>
</font><br>
<font size=2>&gt;response.  Have completed first 5 thermal cycles from ambient
to LN2<br>
</font><br>
<font size=2>&gt;(-320F), and there appears a faint line or shadow in the notch near
one<br>
</font><br>
<font size=2>&gt;end being inspected further to confirm or deny a crack. 
Continued with<br>
</font><br>
<font size=2>&gt;6th thermal cycles (this second set of 5 cycles is from 200 F to
LN2)<br>
</font><br>
<font size=2>&gt;until a crack is confirmed.  If no cracks develop at the
conclusion of<br>
</font><br>
<font size=2>&gt;these 10 cycles, a more severe method of creating a crack will
be<br>
</font><br>
<font size=2>&gt;developed.  If a crack develops, the same temperature cycle
will be<br>
</font><br>
<font size=2>&gt;repeated until the ball fails or the crack arrests.  The more
severe<br>
</font><br>
<font size=2>&gt;method, which is under development as a contingency, could use
boiling<br>
</font><br>
<font size=2>&gt;water and an alcohol/dry ice bath to produce a much higher
temperature<br>
</font><br>
<font size=2>&gt;gradient.<br>
</font><br>
<font size=2>&gt;<br>
</font><br>
<font size=2>&gt;Test #2a: 2.24&quot; ball in flight-like cups, notch in ball,
not<br>
</font><br>
<font size=2>&gt;instrumented*, mechanical load cycling while in LN2 bath: Purpose
of<br>
</font><br>
<font size=2>&gt;test is to show crack growth and subsequent arrest while under<br>
</font><br>
<font size=2>&gt;flight-like thermal and mechanical loads.  Briefly, the test
is<br>
</font><br>
<font size=2>&gt;scheduled to:<br>
</font><br>
<font size=2>&gt;1. Simulate nominal loads seen during propellant loading (11,000
lbs<br>
</font><br>
<font size=2>&gt;applied and removed while in LN2 bath) for 5 cycles, then
inspect.<br>
</font><br>
<font size=2>&gt;2. Simulate nominal loads seen during flight (41,000 lbs applied
and<br>
</font><br>
<font size=2>&gt;removed while in LN2 bath) for 30 cycles, then inspect.<br>
</font><br>
```

```
<font size=2>&gt;3. Apply margin loads above nominal flight loads (49,000 applied
and<br>
</font><br>
<font size=2>&gt;removed while in LN2 bath) for 5 cycles, then inspect.<br>
</font><br>
<font size=2>&gt;4. Apply margin loads above nominal flight loads (61,000 applied
and<br>
</font><br>
<font size=2>&gt;removed while in LN2 bath) for 5 cycles, then inspect.<br>
</font><br>
<font size=2>&gt;5. Apply margin loads above nominal flight loads (71,000 applied
and<br>
</font><br>
<font size=2>&gt;removed while in LN2 bath) for 5 cycles, then inspect.<br>
</font><br>
<font size=2>&gt;<br>
</font><br>
<font size=2>&gt;Currently, test #2a  is 3 cycles into the 41,000 lbs testing,
with no<br>
</font><br>
<font size=2>&gt;cracks visible after the 11,000 testing was completed.  As in
test #1,<br>
</font><br>
<font size=2>&gt;testing will continue until a crack develops / arrests. 
Inspections<br>
</font><br>
<font size=2>&gt;are visual after every cycle, and eddy current after every 5th
cycle.<br>
</font><br>
<font size=2>&gt;*Instrumentation removed.<br>
</font><br>
<font size=2>&gt;<br>
</font><br>
<font size=2>&gt;Test #2b:  Same as #2a, but without notch in ball: Purpose of
test is<br>
</font><br>
<font size=2>&gt;to show crack initiation, growth and subsequent crack arrest
while<br>
</font><br>
<font size=2>&gt;under flight-like thermal and mechanical loads, but on a pristine
ball<br>
</font><br>
<font size=2>&gt;which more closely resembles flight balls.  The test sequence
is the<br>
</font><br>
<font size=2>&gt;same as in Test #2a:<br>
</font><br>
<font size=2>&gt;<br>
</font><br>
<font size=2>&gt;The 35 nominal cycles are complete (5 cycles at 11,000 lbs plus
30<br>
</font><br>
<font size=2>&gt;cycles at 41,000 lbs), and margin testing has commenced for a total
of<br>
</font><br>
<font size=2>&gt;43 cycles so far.  There are no indications of a crack via
visual or<br>
</font><br>
<font size=2>&gt;eddy current at this time.<br>
</font><br>
<font size=2>&gt;<br>
</font><br>
<font size=2>&gt;MSFC activity:<br>
```

```
</font><br>
<font size=2>&gt;In addition to the Huntington Beach testing, MSFC is working on<br>
</font><br>
<font size=2>&gt;metallography of balls of various sizes in order to rationalize<br>
</font><br>
<font size=2>&gt;extrapolating these results to the different size balls used in
the<br>
</font><br>
<font size=2>&gt;Orbiter (2.24&quot;, 1.75&quot;, and 1.25&quot;).  In
addition, MSFC is working on a<br>
</font><br>
<font size=2>&gt;method of cracking a ball thermally to be used in the event that
a<br>
</font><br>
<font size=2>&gt;crack cannot be initiated via the current test procedure. 
Finally,<br>
</font><br>
<font size=2>&gt;MSFC reports finding an eddy current indication in a flight spares
ball<br>
</font><br>
<font size=2>&gt;(of 1.25&quot; diameter), an indication which is invisible via
visual and<br>
</font><br>
<font size=2>&gt;dye pen.  This &quot;crack&quot; must be subsurface and may be
a cluster of<br>
</font><br>
<font size=2>&gt;porosity.  Since this ball was extracted from flight spares
and may<br>
</font><br>
<font size=2>&gt;have a crack, this tends to indict the acceptance screening
process.<br>
</font><br>
<font size=2>&gt;MSFC personnel believe that there are large variations in<br>
</font><br>
<font size=2>&gt;microstructure between individual balls.  However, even
with<br>
</font><br>
<font size=2>&gt;variations, the testing being conducted at Huntington Beach will
likely<br>
</font><br>
<font size=2>&gt;show crack arrest regardless of initial crack existence.<br>
</font><br>
<font size=2>&gt;<br>
</font><br>
<font size=2>&gt;JSC Activity:  Mike Tipton has been working closely JSC
Engineering and<br>
</font><br>
<font size=2>&gt;shop support in the development of tools for inspecting 100% of
the<br>
</font><br>
<font size=2>&gt;ball surface in an installed line.  Ideally, both crack
location (via<br>
</font><br>
<font size=2>&gt;eddy current) and depth (with Ultrasonic techniques, perhaps) can
be<br>
</font><br>
<font size=2>&gt;achieved on the fleet feedlines without requiring removal of the
lines.<br>
</font><br>
<font size=2>&gt;<br>
</font><br>
<font size=2>&gt;Testing will continue throughout the day today and will resume
shortly<br>
```

```
</font><br>
<font size=2>&gt;after Christmas (on the evening of the 26th).  The next test
status<br>
</font><br>
<font size=2>&gt;will be presented Friday, December 27th at 3:00 pm.<br>
</font><br>
<font size=2>&gt;<br>
</font><br>
<font size=2>&gt;Hugo E. Martinez, PE<br>
</font><br>
<font size=2>&gt;Shuttle SR&amp;QA Propulsion &amp; Power Lead Engineer<br>
</font><br>
<font size=2>&gt;JSC NC62<br>
</font><br>
<font size=2>&gt;Phone: 281 244-1974<br>
</font><br>
<font size=2>&gt;Pager:
</font><br>
<font size=2>&gt;Fax: 281 244-1849<br>
</font><br>
<font size=2>&gt;<br>
</font><br>
<font size=2>&gt;Providing for a safer tomorrow, today.<br>
</font><br>
<font size=2>&gt;</font></blockquote></html>
<html>
<br>
<blockquote type=cite cite>From: &quot;ERMINGER, MARK D. (JSC-NC) (NASA)&quot;
&lt;mark.d.erminger@nasa.gov&gt;<br>
To: &quot;MARSHALL, YOLANDA Y. (JSC-NA) (NASA)&quot;
&lt;yolanda.y.marshall@nasa.gov&gt;,<br>
        &quot;'H - O'Connor Bryan'&quot;
&lt;boconnor@mail.hq.nasa.gov&gt;<br>
Cc: &quot;JOHNSON, GARY W. (JSC-NA) (NASA)&quot;
&lt;gary.w.johnson@nasa.gov&gt;,<br>
        &quot;JOHNSON, M. S. (SCOTT) (JSC-NC)
(NASA)&quot; &lt;m.s.johnson@nasa.gov&gt;,<br>
        &quot;'H - Kowaleski Mark'&quot;
&lt;mkowales@mail.hq.nasa.gov&gt;,<br>
        &quot;H - Bihner Bill
(wbihner@mail.hq.nasa.gov)&quot; &lt;wbihner@mail.hq.nasa.gov&gt;,<br>
        &quot;MARTINEZ, HUGO E. (JSC-NC)
(GHG)&quot; &lt;hugo.e.martinez1@jsc.nasa.gov&gt;<br>
Subject: FW: BSTRA ball test status<br>
Date: Fri, 3 Jan 2003 05:57:14 -0600 <br>
X-Mailer: Internet Mail Service (5.5.2653.19)<br>
<br>
<br>
<br>
<font face="Tahoma" size=2>-----Original Message-----<br>
<b>From:</b> MARTINEZ, HUGO E. (JSC-NC) (GHG)<br>
<b>Sent:</b> Thursday, January 02, 2003 6:16 PM<br>
<b>To:</b> HATAMLEH, OMAR (JSC-NC) (SAIC); ERMINGER, MARK D. (JSC-NC) (NASA);
JOHNSON, M. S. (SCOTT) (JSC-NC) (NASA); BROWNE, DAVID M. (JSC-NC) (NASA)<br>
<b>Cc:</b> CULBERTSON, FRANK L., JR (JSC-NA) (SAIC); CAZES, DAVID (JSC-NA) (SAIC);
EVATT, GARVIN T. (GT) (JSC-NC) (SAIC); BALU, BRIAN K. (JSC-NC) (SAIC); DYER, KEITH
W. (JSC-NC) (SAIC); AUGUSTYN, JOSEPH (JSC-REMOTE); TIPTON, MICHAEL R. (JSC-NX)
(SAIC); PRINCE, GORMAN W. (BILLY) (JSC-NC) (GHG); ISHMAEL, MOHAMED I. (GEORGE)
(JSC-NC) (SAIC); CLEMENTS, DANIEL L. (JSC-NC) (GHG); ALMASRI, WALEED (JSC-REMOTE);
AL-HAYEK, FAREED A. (JSC-NC) (SAIC)<br>
<b>Subject:</b> RE: BSTRA ball test status<br>
</font><br>
<font size=2>Cracks have finally been observed in 2 of 3 balls at Huntington Beach
```

using method developed at MSFC, but no conclusions can yet be drawn. FOD continues to be a serious discussion topic. At the meeting today with Ralph Roe, the Huntington Beach and MSFC test status was given, the status of the JSC remote tool development was presented, and thoughts on flight rationale were discussed.

Plans are for testing to conclude Jan 8th, although a PRCB will be held on the 6th to discuss preliminary FRR charts for STS-107. The team will not report to Ralph Roe until Monday the 6th at 9:00 am unless testing over the weekend fails (crack does not arrest or FOD is generated). In the meantime, the SSME Project will have an answer on FOD tolerance (not expected to be good). If a naturally cracked (vs. notched) ball generates FOD or does not arrest, we will have a problem necessitating the inspection of OV-102's balls. If any other ball generates FOD or does not arrest, the Test #2b ball with two in-line notches can be used to prove arrest and no FOD generation.

<u>Huntington Beach test status:
</u>
<u>Test #1</u> Update: Completed incremental thermal shock at 350 F without cracking. Abandoned this test (this is the test where they started at 200 F and quenched at -100 F, then incremented the initial temperature by 25 degrees each time and quenched again) and will crack with a wedge now.

<u>Test #2a Update:</u> During 275 F to -100 F incremental thermal shock, got multiple cracking about 320 degrees around. Will now subject it to flight-like thermal/mechanical per 4x testing. 4x testing repeats the nominal flight portion of test#2a three additional times in order to encompass 30 missions (OV-102 has seen 28 missions).

<u>Test #2b Update:</u> Had stopped testing and put in two series "thumbnail" notches and put into 212 F to 32 F rapid thermal cycles. Saw a crack between notches, detected via eddy current, not yet visible. Will then go into 4x testing.

<u>MSFC Status:
</u>
Both cracked 2.24" balls at MSFC are undergoing testing per HB's test #2 plan and no crack growth has been seen. Both of these balls were initially cracked using a severe thermal gradient. Similarly, 1.75" and 1.25" balls are undergoing testing per test #2. One 1.75" ball had cracked without a notch and without a severe thermal environment (see below) and has opened up a new crack via testing. The maximum length of a crack is 0.4 inches but shallow and stable, it appears. <u>
</u>
<u>JSC Remote Tool Development Update:
</u>
Developers claim they have "tremendous control" of ball. Some technical issues, such as needing more articulation, cleaning the device for use on the fleet, and establishing the vehicle BSTRA joint configuration are being worked. They are building an articulating joint at the end effector to address the first issue. The device will be ready this coming Sunday.

<u>Other:
</u>
SRQA got an action to perform a PRA on the potential for FOD generation. We will be working on the feasibility of this tomorrow (Jan 3rd). While we haven't coordinated with the PRA analysts yet, we feel that getting realistic numbers would not be possible with the available data.

Hugo

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

From: MARTINEZ, HUGO E. (JSC-NC) (GHG)

Sent: Wednesday, January 01, 2003 2:23 PM

To: HATAMLEH, OMAR (JSC-NC) (SAIC); ERMINGER, MARK D. (JSC-NC) (NASA);

JOHNSON, M. S. (SCOTT) (JSC-NC) (NASA); BROWNE, DAVID M. (JSC-NC) (NASA)

Cc: CULBERTSON, FRANK L., JR (JSC-NA) (SAIC); CAZES, DAVID (JSC-NA)

(SAIC); EVATT, GARVIN T. (GT) (JSC-NC) (SAIC); BALU, BRIAN K. (JSC-NC)

(SAIC); DYER, KEITH W. (JSC-NC) (SAIC); AUGUSTYN, JOSEPH (JSC-REMOTE);

TIPTON, MICHAEL R. (JSC-NX) (SAIC); PRINCE, GORMAN W. (BILLY) (JSC-NC)

(GHG); ISHMAEL, MOHAMED I. (GEORGE) (JSC-NC) (SAIC); CLEMENTS, DANIEL L.

(JSC-NC) (GHG); ALMASRI, WALEED (JSC-REMOTE); AL-HAYEK, FAREED A.

(JSC-NC) (SAIC)

Subject: RE: BSTRA ball test status

Testing at Huntington Beach and MSFC continues, as does the development of thermal and stress models in an attempt to build flight rationale for STS-107. The generation of FOD has not at all been alleviated after branched cracking was detected on an MSFC ball subjected to extreme temperature gradients.

Huntington Beach testing continues on the 3 balls in an effort to first create cracks and then to show arrest (no surface growth) under a repeated load profile. All testing described in the original email below is complete, but no cracks have been created. Huntington Beach is adding steps to their test procedure to incorporate crack initiation techniques developed at MSFC: the use of a dry ice/alcohol bath (-100°F) which allows for quicker quenching.

Test #1 Update: Since dunking the notched 2.24" cabinet ball in LN2 created no cracks (nor did boiling water to ice water thermal shocks), the ball is now being heated to an incrementally higher temperature and quenched at -100°F dry ice/alcohol. This series of thermal shocks is in effort to "sneak up" on the critical conditions required to crack a ball. The first set of 5 thermal shock cycles began at 200°F, and subsequent sets beginning at 225°F and 250°F yielded no cracks. As of December 30th, the set beginning at 275°F was in work. Plans are to continue incrementing the initial temperature by 25°F, running 5 cycles. Inspections are run visually and with eddy current after the first and 5th cycles in each set.

Test #2a Update: Taking the notched 2.24" flight spares ball through a series of flight-like thermal mechanical cycles described below yielded no cracking. The same series of thermal shocks is being used on this ball as in test #1 above, that is, purely thermal cycles, in an effort to crack it. On 200°F cycles, saw an eddy current indication and again during 225°F cycles deep in the notch. It appears to be growing about an 1/8th of an inch on one edge of the notch but is not yet visible on the surface. Once it is seen on the surface, testing will proceed to Phase II, testing for crack arrest under

flight-like thermal mechanical/loading. Eddy current and visual inspections are being conducted after every cycle at this time. Testing is now in the set of 5 cycles at 250°F, but so far no surface cracks have appeared.

Test #2b Update: Taking the second 2.24" flight spares ball (without a notch) through a series of flight-like thermal mechanical cycles described below yielded no cracking. In an effort to expedite the creation of a crack, two in-line notches are being EDM'd into the ball, approximately 0.050" between them. The ball with then be subjected to a total of 1000 rapid thermal cycles from boiling water to ice water in an effort to crack it before resuming flight-like thermal/mechanical cycling.

MSFC Status: Besides developing a technique for quicker quenching, MSFC personnel have cracked both notched and pristine 2.24" balls using severe thermal cycles. In addition, they have cracked a flight spares ball (one of 1.75" diameter, without a notch, that had pre-existing subsurface flaws) with nominal thermal cycles (from ambient to LN2 temperature). Because of the similarity between LN2 temperature and LO2's temperature (flight temperature), cracking of the 1.75" ball lends credibility to the theory that the OV-103 ball might have had subsurface cracks which surfaced when subjected to cryogenic cycles. Note however that the test does not simulate the thermal mass and mechanical loading seen on the flight vehicle during loading and flight. Secondly, the fact that a flight spares ball had subsurface defects which propagated to a surface crack tends to indict the acceptance criteria.

The concern of particle liberation upstream of an SSME has been fueled by the type of cracking detected on the severely cracked 2.24" balls. Coordination with the SSME Project on the engine's tolerance to FOD is being conducted in an attempt to clear this concern.

Thermal modeling indicates that LN2 is not a good test fluid for balls in LH2 service (1.25"). If liquid hydrogen is used to simulate these conditions, safety considerations will slow testing significantly. Other mediums, such as liquid helium and liquid neon, are being considered. Note that the thermal modeling so far has considered only the ball. Model development is in work on the inserts and adjoining hardware.

NDE of all flight spares is being conducted in an effort to find more balls with subsurface indications. These would then be put in test. Finding no indications in any of the flight spares might support the theory that OV-103's ball was an outlier, i.e., that it had subsurface cracks when installed in the line.

More to come.

Hugo

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

From: HATAMLEH, OMAR (JSC-NC) (SAIC)

To: ERMINGER, MARK D. (JSC-NC) (NASA); JOHNSON, M. S. (SCOTT) (JSC-NC) (NASA); BROWNE, DAVID M. (JSC-NC) (NASA)

Cc: CULBERTSON, FRANK L., JR (JSC-NA) (SAIC); CAZES, DAVID (JSC-NA) (SAIC); EVATT, GARVIN T. (GT) (JSC-NC) (SAIC); BALU, BRIAN K. (JSC-NC) (SAIC); DYER, KEITH W. (JSC-NC) (SAIC); AUGUSTYN, JOSEPH (JSC-REMOTE); MARTINEZ, HUGO E. (JSC-NC) (GHG); TIPTON, MICHAEL R. (JSC-NX) (SAIC); PRINCE, GORMAN W. (BILLY) (JSC-NC) (GHG); ISHMAEL, MOHAMED I. (GEORGE) (JSC-NC) (SAIC); CLEMENTS, DANIEL L. (JSC-NC) (GHG); ALMASRI, WALEED (JSC-REMOTE); AL-HAYEK, FAREED A. (JSC-NC) (SAIC)

Sent: 12/27/2002 6:10 PM

Subject: RE: BSTRA ball test status

Cryogenic load testing in Huntington Beach is continuing on three

separate 2.24" BSTRA balls in order to help build flight
rationale. Test

1, and 2a are still in progress with no crack indications so far.
Test

2b has been completed with no crack indications. Test 2b
indicates that

a flight ball, when subjected to a single mission's worth of cryo
and

mechanical combined loading, does not crack.

In addition to the Huntington Beach testing, MSFC is working on a
method

of cracking a ball thermally to be used in the event that a crack
cannot

be initiated via the current Huntington Beach test procedure.
MSFC was

successful in cracking balls under severe conditions (300 F to -100 F
in

one case and 400 F to -100 F in another case). The crack extends
about

280 degrees around on one ball, and a little less on another ball.

Another interesting feature was the production of intersecting
cracks,

which could ultimately lead to FOD.

MSFC sectioned a 2.25" ball purchased from the Oregon vendor and
found a

large porosity site ("big enough to stick a pencil in") near
the center.

These Oregon balls were produced much later and have process

improvements which should help eliminate porosity. This data
tends to

indicate that porosity is probably to be found in most cast
balls. In

addition, metallurgy shows a finer grain structure in the middle
and

coarser towards the surface.

Updates to the JSC activities will be provided in a separate email
note.

<font size=2>The next meeting is scheduled for Monday at a time to be disclosed

```
</font><br>
<font size=2>later.  <br>
</font><br>
<font size=2>&gt; -----Original Message-----<br>
</font><br>
<font size=2>&gt;From:  MARTINEZ, HUGO E. (JSC-NC) (GHG)  <br>
</font><br>
<font size=2>&gt;Sent:  Monday, December 23, 2002 1:44 PM<br>
</font><br>
<font size=2>&gt;To:    BROWNE, DAVID M. (JSC-NC) (NASA); CULBERTSON,
FRANK L., JR<br>
</font><br>
<font size=2>&gt;(JSC-NA) (SAIC); CAZES, DAVID (JSC-NA) (SAIC); EVATT, GARVIN T.
(GT)<br>
</font><br>
<font size=2>&gt;(JSC-NC) (SAIC); DYER, KEITH W. (JSC-NC) (SAIC); JOHNSON, M. S.
(SCOTT)<br>
</font><br>
<font size=2>&gt;(JSC-NC) (NASA); ERMINGER, MARK D. (JSC-NC) (NASA); ALMASRI,
WALEED;<br>
</font><br>
<font size=2>&gt;BALU, BRIAN; CLEMENTS, DANIEL; HATAMLEH, OMAR; ISHMAEL,
MOHAMED;<br>
</font><br>
<font size=2>&gt;jaugust0; PRINCE, GORMAN; TIPTON, MICHAEL<br>
</font><br>
<font size=2>&gt;Subject:       BSTRA ball test
status<br>
</font><br>
<font size=2>&gt;<br>
</font><br>
<font size=2>&gt;Execute summary:  Cryogenic load testing in Huntington Beach
began<br>
</font><br>
<font size=2>&gt;Friday, December 20th on three separate 2.24&quot; BSTRA balls in
order to<br>
</font><br>
<font size=2>&gt;help build flight rationale.  These three tests, which are
being run in<br>
</font><br>
<font size=2>&gt;parallel, attempt to prove the theory that cracks will develop and
then<br>
</font><br>
<font size=2>&gt;arrest prior to going completely through a ball.  Partly into
the tests<br>
</font><br>
<font size=2>&gt;this morning, no cracks have conclusively been observed, although
one<br>
</font><br>
<font size=2>&gt;faint indication is being inspected further.  In addition,
another<br>
</font><br>
<font size=2>&gt;ball, a flight spares of a smaller size, was eddy current inspected
and<br>
</font><br>
<font size=2>&gt;found to have subsurface indications not detetable with dye pen
and<br>
</font><br>
<font size=2>&gt;visual checks.  Testing will continue today and will resume on
the<br>
</font><br>
<font size=2>&gt;evening of the 26th.<br>
</font><br>
```

```
<font size=2>&gt;<br>
</font><br>
<font size=2>&gt;Test #1:   2.24&quot; ball, notch in ball,
instrumented.  Purpose is to help<br>
</font><br>
<font size=2>&gt;validate computer model by assessing residual stresses and
thermal<br>
</font><br>
<font size=2>&gt;response.  Have completed first 5 thermal cycles from ambient
to LN2<br>
</font><br>
<font size=2>&gt;(-320F), and there appears a faint line or shadow in the notch near
one<br>
</font><br>
<font size=2>&gt;end being inspected further to confirm or deny a crack. 
Continued with<br>
</font><br>
<font size=2>&gt;6th thermal cycles (this second set of 5 cycles is from 200 F to
LN2)<br>
</font><br>
<font size=2>&gt;until a crack is confirmed.  If no cracks develop at the
conclusion of<br>
</font><br>
<font size=2>&gt;these 10 cycles, a more severe method of creating a crack will
be<br>
</font><br>
<font size=2>&gt;developed.  If a crack develops, the same temperature cycle
will be<br>
</font><br>
<font size=2>&gt;repeated until the ball fails or the crack arrests.  The more
severe<br>
</font><br>
<font size=2>&gt;method, which is under development as a contingency, could use
boiling<br>
</font><br>
<font size=2>&gt;water and an alcohol/dry ice bath to produce a much higher
temperature<br>
</font><br>
<font size=2>&gt;gradient.<br>
</font><br>
<font size=2>&gt;<br>
</font><br>
<font size=2>&gt;Test #2a: 2.24&quot; ball in flight-like cups, notch in ball,
not<br>
</font><br>
<font size=2>&gt;instrumented*, mechanical load cycling while in LN2 bath: Purpose
of<br>
</font><br>
<font size=2>&gt;test is to show crack growth and subsequent arrest while under<br>
</font><br>
<font size=2>&gt;flight-like thermal and mechanical loads.  Briefly, the test
is<br>
</font><br>
<font size=2>&gt;scheduled to:<br>
</font><br>
<font size=2>&gt;1. Simulate nominal loads seen during propellant loading (11,000
lbs<br>
</font><br>
<font size=2>&gt;applied and removed while in LN2 bath) for 5 cycles, then
inspect.<br>
</font><br>
<font size=2>&gt;2. Simulate nominal loads seen during flight (41,000 lbs applied
and<br>
```

```
</font><br>
<font size=2>&gt;removed while in LN2 bath) for 30 cycles, then inspect.<br>
</font><br>
<font size=2>&gt;3. Apply margin loads above nominal flight loads (49,000 applied
and<br>
</font><br>
<font size=2>&gt;removed while in LN2 bath) for 5 cycles, then inspect.<br>
</font><br>
<font size=2>&gt;4. Apply margin loads above nominal flight loads (61,000 applied
and<br>
</font><br>
<font size=2>&gt;removed while in LN2 bath) for 5 cycles, then inspect.<br>
</font><br>
<font size=2>&gt;5. Apply margin loads above nominal flight loads (71,000 applied
and<br>
</font><br>
<font size=2>&gt;removed while in LN2 bath) for 5 cycles, then inspect.<br>
</font><br>
<font size=2>&gt;<br>
</font><br>
<font size=2>&gt;Currently, test #2a  is 3 cycles into the 41,000 lbs testing,
with no<br>
</font><br>
<font size=2>&gt;cracks visible after the 11,000 testing was completed.  As in
test #1,<br>
</font><br>
<font size=2>&gt;testing will continue until a crack develops / arrests. 
Inspections<br>
</font><br>
<font size=2>&gt;are visual after every cycle, and eddy current after every 5th
cycle.<br>
</font><br>
<font size=2>&gt;*Instrumentation removed.<br>
</font><br>
<font size=2>&gt;<br>
</font><br>
<font size=2>&gt;Test #2b:  Same as #2a, but without notch in ball: Purpose of
test is<br>
</font><br>
<font size=2>&gt;to show crack initiation, growth and subsequent crack arrest
while<br>
</font><br>
<font size=2>&gt;under flight-like thermal and mechanical loads, but on a pristine
ball<br>
</font><br>
<font size=2>&gt;which more closely resembles flight balls.  The test sequence
is the<br>
</font><br>
<font size=2>&gt;same as in Test #2a:<br>
</font><br>
<font size=2>&gt;<br>
</font><br>
<font size=2>&gt;The 35 nominal cycles are complete (5 cycles at 11,000 lbs plus
30<br>
</font><br>
<font size=2>&gt;cycles at 41,000 lbs), and margin testing has commenced for a total
of<br>
</font><br>
<font size=2>&gt;43 cycles so far.  There are no indications of a crack via
visual or<br>
</font><br>
<font size=2>&gt;eddy current at this time.<br>
</font><br>
```

```
<font size=2>&gt;<br>
</font><br>
<font size=2>&gt;MSFC activity:<br>
</font><br>
<font size=2>&gt;In addition to the Huntington Beach testing, MSFC is working on<br>
</font><br>
<font size=2>&gt;metallography of balls of various sizes in order to rationalize<br>
</font><br>
<font size=2>&gt;extrapolating these results to the different size balls used in
the<br>
</font><br>
<font size=2>&gt;Orbiter (2.24&quot;, 1.75&quot;, and 1.25&quot;).  In
addition, MSFC is working on a<br>
</font><br>
<font size=2>&gt;method of cracking a ball thermally to be used in the event that
a<br>
</font><br>
<font size=2>&gt;crack cannot be initiated via the current test procedure. 
Finally,<br>
</font><br>
<font size=2>&gt;MSFC reports finding an eddy current indication in a flight spares
ball<br>
</font><br>
<font size=2>&gt;(of 1.25&quot; diameter), an indication which is invisible via
visual and<br>
</font><br>
<font size=2>&gt;dye pen.  This &quot;crack&quot; must be subsurface and may be
a cluster of<br>
</font><br>
<font size=2>&gt;porosity.  Since this ball was extracted from flight spares
and may<br>
</font><br>
<font size=2>&gt;have a crack, this tends to indict the acceptance screening
process.<br>
</font><br>
<font size=2>&gt;MSFC personnel believe that there are large variations in<br>
</font><br>
<font size=2>&gt;microstructure between individual balls.  However, even
with<br>
</font><br>
<font size=2>&gt;variations, the testing being conducted at Huntington Beach will
likely<br>
</font><br>
<font size=2>&gt;show crack arrest regardless of initial crack existence.<br>
</font><br>
<font size=2>&gt;<br>
</font><br>
<font size=2>&gt;JSC Activity:  Mike Tipton has been working closely JSC
Engineering and<br>
</font><br>
<font size=2>&gt;shop support in the development of tools for inspecting 100% of
the<br>
</font><br>
<font size=2>&gt;ball surface in an installed line.  Ideally, both crack
location (via<br>
</font><br>
<font size=2>&gt;eddy current) and depth (with Ultrasonic techniques, perhaps) can
be<br>
</font><br>
<font size=2>&gt;achieved on the fleet feedlines without requiring removal of the
lines.<br>
</font><br>
<font size=2>&gt;<br>
```


>Testing will continue throughout the day today and will resume shortly

>after Christmas (on the evening of the 26th). The next test status

>will be presented Friday, December 27th at 3:00 pm.

>

>Hugo E. Martinez, PE

>Shuttle SR&QA Propulsion & Power Lead Engineer

>JSC NC62

>Phone: 281 244-1974

>Pager:

>Fax: 281 244-1849

>

>Providing for a safer tomorrow, today.

></blockquote></html>
<html>

<blockquote type=cite cite><font color="#0000FF">X-Sender: boconnor@mail.hq.nasa.gov
X-Mailer: QUALCOMM Windows Eudora Version 4.3.2
Date: Fri, 03 Jan 2003 08:49:23 -0500
To: "ERMINGER, MARK D. (JSC-NC) (NASA)"
<mark.d.erminger@nasa.gov>,
        "MARSHALL, YOLANDA Y. (JSC-NA) (NASA)" <yolanda.y.marshall@nasa.gov>
From: boconnor <boconnor@hq.nasa.gov>
Subject: Re: FW: BSTRA ball test status
Cc: "JOHNSON, GARY W. (JSC-NA) (NASA)"
<gary.w.johnson@nasa.gov>,
        "JOHNSON, M. S. (SCOTT) (JSC-NC) (NASA)" <m.s.johnson@nasa.gov>,
        "'H - Kowaleski Mark'"
<mkowales@mail.hq.nasa.gov>,
        "H - Bihner Bill (wbihner@mail.hq.nasa.gov)" <wbihner@mail.hq.nasa.gov>,
        "MARTINEZ, HUGO E. (JSC-NC) (GHG)" <hugo.e.martinez1@jsc.nasa.gov>,
        Pete Rutledge
<prutledg@hq.nasa.gov>, mstamate@mail.hq.nasa.gov,
        Amanda.Goodson@msfc.nasa.gov, Shannon.Bartell-1@ksc.nasa.gov
X-MIME-Autoconverted: from quoted-printable to 8bit by bolg.public.hq.nasa.gov id IAA15938

Mark,
        With regard to Hugo's comment about performing a PRA on the potential for FOD generation, I know it is always fair to say that we don't have the data to produce a number, but we must be able to put this issue into at least some gross range of probabilities otherwise we are not doing a risk assessment, and it is unfair to ask the PM or the FRR Board to accept risk if

we don't do the best we can with a risk assessment.
        My guess is that the least you can do is get a range of probabilities for FOD generation from the metallurgists, and then applying what you think the chance of catastrophic failure would be if you did generate FOD from the SSME folks. Then you should look at what affect that resultant number (including uncertainty) has on the baseline PRA. If the baseline LOC median number is 1/245 for ascent/entry, what does it become with this new failure mode? And, looking at the uncertainties, what does the new 95th and 5th percentile number become? I think this is a legitimate question for the PM to ask if he is thinking about accepting the risk for 107. And if he doesn't I will in the delta PAR.
        What do we do with the numbers? Let's say the new median becomes 1/200. That's the same as taking out the new fuel turbopump. And if it goes to 1/150, that's like taking out the MCC, the LOX turbopump, the new heat exchanger and going back to major black zones in the contingency aborts (like we had in the 1980s), etc. And, if it goes all the way to 1/50, it is like being back in the old SRM and 17 inch disconnect days pre Challenger.   (Don't quote me with these numbers, because I am guessing with these analogies, but I use them to show what I would want to know in a risk assessment).
Best,
O'C

At 05:57 AM 1/3/2003 -0600, ERMINGER, MARK D. (JSC-NC) (NASA) wrote:

<blockquote type=cite cite>-----Original Message-----
From: MARTINEZ, HUGO E. (JSC-NC) (GHG)
Sent: Thursday, January 02, 2003 6:16 PM
To: HATAMLEH, OMAR (JSC-NC) (SAIC); ERMINGER, MARK D. (JSC-NC) (NASA); JOHNSON, M. S. (SCOTT) (JSC-NC) (NASA); BROWNE, DAVID M. (JSC-NC) (NASA)
Cc: CULBERTSON, FRANK L., JR (JSC-NA) (SAIC); CAZES, DAVID (JSC-NA) (SAIC); EVATT, GARVIN T. (GT) (JSC-NC) (SAIC); BALU, BRIAN K. (JSC-NC) (SAIC); DYER, KEITH W. (JSC-NC) (SAIC); AUGUSTYN, JOSEPH (JSC-REMOTE); TIPTON, MICHAEL R. (JSC-NX) (SAIC); PRINCE, GORMAN W. (BILLY) (JSC-NC) (GHG); ISHMAEL, MOHAMED I. (GEORGE) (JSC-NC) (SAIC); CLEMENTS, DANIEL L. (JSC-NC) (GHG); ALMASRI, WALEED (JSC-REMOTE); AL-HAYEK, FAREED A. (JSC-NC) (SAIC)
Subject: RE: BSTRA ball test status

Cracks have finally been observed in 2 of 3 balls at Huntington Beach using method developed at MSFC, but no conclusions can yet be drawn. FOD continues to be a serious discussion topic. At the meeting today with Ralph Roe, the Huntington Beach and MSFC test status was given, the status of the JSC remote tool development was presented, and thoughts on flight rationale were discussed.

Plans are for testing to conclude Jan 8th, although a PRCB will be held on the 6th to discuss preliminary FRR charts for STS-107. The team will not report to Ralph Roe until Monday the 6th at 9:00 am unless testing over the weekend fails (crack does not arrest or FOD is generated). In the meantime, the SSME Project will have an answer on FOD tolerance (not expected to be good). If a naturally cracked (vs. notched) ball generates FOD or does not arrest, we will have a problem necessitating the inspection of OV-102's balls. If any other ball generates FOD or does not arrest, the Test #2b ball with two in-line notches can be used to prove arrest and no FOD generation.

Huntington Beach test status:

Test #1 Update: Completed incremental thermal shock at 350 F without cracking. Abandoned this test (this is the test where they started at 200 F and quenched at -100 F, then incremented the initial temperature by 25 degrees each time and quenched again) and will crack with a wedge now.

Test #2a Update: During 275 F to -100 F incremental thermal shock, got multiple

>Currently, test #2a is 3 cycles into the 41,000 lbs testing, with no

>cracks visible after the 11,000 testing was completed. As in test #1,

>testing will continue until a crack develops / arrests. Inspections

>are visual after every cycle, and eddy current after every 5th cycle.

>*Instrumentation removed.

>

>Test #2b: Same as #2a, but without notch in ball: Purpose of test is

>to show crack initiation, growth and subsequent crack arrest while

>under flight-like thermal and mechanical loads, but on a pristine ball

>which more closely resembles flight balls. The test sequence is the

>same as in Test #2a:

>

>The 35 nominal cycles are complete (5 cycles at 11,000 lbs plus 30

>cycles at 41,000 lbs), and margin testing has commenced for a total of

>43 cycles so far. There are no indications of a crack via visual or

>eddy current at this time.

>

>MSFC activity:

>In addition to the Huntington Beach testing, MSFC is working on

>metallography of balls of various sizes in order to rationalize

>extrapolating these results to the different size balls used in the

>Orbiter (2.24", 1.75", and 1.25"). In addition, MSFC is working on a

>method of cracking a ball thermally to be used in the event that a

>crack cannot be initiated via the current test procedure. Finally,

>MSFC reports finding an eddy current indication in a flight spares ball

>(of 1.25" diameter), an indication which is invisible via visual and

>dye pen. This "crack" must be subsurface and may be a cluster of

>porosity. Since this ball was extracted from flight spares and may

>have a crack, this tends to indict the acceptance screening process.

>MSFC personnel believe that there are large variations in

>microstructure between individual balls. However, even with

>variations, the testing being conducted at Huntington Beach will likely

>show crack arrest regardless of initial crack existence.

>

>JSC Activity: Mike Tipton has been working closely JSC Engineering and

>shop support in the development of tools for inspecting 100% of the

>ball surface in an installed line. Ideally, both crack location (via

>eddy current) and depth (with Ultrasonic techniques, perhaps) can be

>achieved on the fleet feedlines without requiring removal of the lines.

>

>Testing will continue throughout the day today and will resume shortly

>after Christmas (on the evening of the 26th). The next test status

>will be presented Friday, December 27th at 3:00 pm.

>

>Hugo E. Martinez, PE

>Shuttle SR&QA Propulsion & Power Lead Engineer

>JSC NC62

>Phone: 281 244-1974

>

>Fax: 281 244-1849

>

>Providing for a safer tomorrow, today.

></blockquote>
</blockquote></html>
<html>

<blockquote type=cite cite>X-Sender: wbihner@mail.hq.nasa.gov
X-Mailer: QUALCOMM Windows Eudora Version 4.3.2
Date: Mon, 06 Jan 2003 07:09:26 -0500
To: "Bryan O'Connor" <boconnor@hq.nasa.gov>
From: Bill Bihner <wbihner@hq.nasa.gov>
Subject: BSTRA Status
Cc: Pete Rutledge <prutledg@hq.nasa.gov>,
        Mark Kowaleski
<mkowales@hq.nasa.gov>,
        Richard Patrican
<rpatrica@hq.nasa.gov>

From this morning's KSC Engineering Log. The Shuttle program will have a
special PRCB tag up this afternoon at 4:00 Eastern. I plan on attending.

<x-tab>   </x-tab>Bill

Feedline BSTRA Ball Crack Troubleshooting Fleet Wide Issue: Testing on the BSTRA ball assemblies at Huntington Beach over the Holidays was successful in recreating a crack in the article under test. It was reported last week the cracks did not propagate through the ball. Additional thermal cycles were performed on the test article this past weekend with the crack propagating thru the ball causing failure of the joint. Meetings will be held this week to determine additional testing/inspections as well as potential impacts to the upcoming launch on OV-102.

</blockquote></html>
<html>
Bill, please include Michael Greenfield on the BSTRA status - he has a lot of expertise in this area and requested to be included.

Thanks,

Mark

At 06:50 PM 1/6/2003 -0500, you wrote:
<blockquote type=cite cite>Bryan,

We just finished our BSTRA status telecon. You will get a more detailed status report tomorrow at the STS-107 pre-FRR tag up at 1000.

In a nutshell, most but not all of the testing is complete. Notably, the LH2 testing is not, since LH2 does not envelope the LN2 testing. It is not scheduled to be complete before the 15th, but they think they can push that date to the left.

Ron has already decided that the BSTRA presentation at the FRR will be status only and they will take an exception on this item. (This is the only real issue that we have now for STS-107.)

The discussion at today's telecon concerned how we would get the logic that says that we can deal with a FOD issue and the logic that says how we interpret the results dealing with the cracks that were developed under severe (non-flight like) conditions.

S&MA/Erminger is continuing to work on a PRA analysis, but none was presented at today's telecon.

The SSME community is working on an analysis that will talk to what size FOD they may be able to handle. They are working to show what damage the FOD would do to moving parts in the engines and to ignition concerns (on the LOX side).

Although they continue to develop some rudimentary inspection techniques for the BSTRA joints, they only view being able to do this as desirable and not mandatory because they won't be able to do a thorough inspection of all the vehicles BSTRA joints in a timely fashion.

There will be another status telecon on Sunday and I will be at HQS for that.

Guess that's it for now - will have more info for you in the morning.

<x-tab>   </x-tab>Bill

</blockquote></html>
Bryan,

This is in response to your question about runway modifications at KSC.

For STS-107, Orbiter and KSC runway improvements negate the need to land on Edwards AFB (EDW) lakebeds for contingency situations. Flight rule changes therefore re-prioritize landing site selection. These flight rules were controls for several landing hazards, mandating a hazard report update.

HISTORY:
1992: Touch down zones were modified with traverse grooves and remaining runway ground down to reduce friction.
1996: 50' wide loadbearing asphalt shoulders were installed at KSC runway 15/33.
Date? EDW lakebed decomissioned to a level that is no longer maintained at the same levels that used to be.

EDW 4/22 (concrete) has 25' non-loadbearing shoulders.

When shoulder improvements are combined with better tires, brakes, differentional steering, and drag chute, this makes KSC the best landing choice.

Flight rules which previously listed landing preference as EDW lakebed, NOR, and KSC, now state landing preference as KSC, EDW 4/22 (concrete), and NOR. EDW lakebed will now be "de-augmented" but will continue to be carried as an Emergency Landing Site (ELS).

Mark
<x-html>
<blockquote type=cite> From: "ERMINGER, MARK D. (JSC-NC) (NASA)"
<mark.d.erminger@nasa.gov>
To: "Brown Mark (E-mail)"
<Mark.A.Brown@USAHQ.UnitedSpaceAlliance.com>,
        "Dever Lea (E-mail)"
<Winnelea.Y.Dever@USAHQ.UnitedSpaceAlliance.com>,
        DL SR&QA Standup Notes
<DL-SR&QA-Standup-Notes@ems.jsc.nasa.gov>,
        "Greenfield Michael
(E-mail)" <mgreenfield@hq.nasa.gov>,
        "H - Bihner Bill (E-mail)"
<wbihner@mail.hq.nasa.gov>,
        "H - Gregory Fred
(E-mail)" <fgregory@hq.nasa.gov>,
        "H - Hill Bill (E-mail)"
<william.hill@hq.nasa.gov>,
        "H - Kowaleski Mark
(E-mail)" <mkowales@mail.hq.nasa.gov>,
        "H - O'Connor Bryan
(E-mail)" <boconnor@mail.hq.nasa.gov>,
        "K - Abbott Robert
(E-mail)" <Robert.Abbott-1@ksc.nasa.gov>,
        "K - Barnette Jack
(E-mail)" <Jack.Barnette-1@kmail.ksc.nasa.gov>,
        "K - Bartell, Shannon
(E-mail)" <Shannon.Bartell-1@kmail.ksc.nasa.gov>,
        "K - Branard John
(E-mail)" <John.Branard-1@kmail.ksc.nasa.gov>,
        "K - Colloredo Lisa
(E-mail)" <lisa.colloredo-1@ksc.nasa.gov>,
        "K - Delgado Hector
(E-mail)" <hector.delgado-1@kmail.ksc.nasa.gov>,
        "K - Fairey, Chris
(E-mail)" <Chris.Fairey-1@ksc.nasa.gov>,
        "K - Franca Chuck
(E-mail)" <franccj@kscems.ksc.nasa.gov>,

        "K - Gawronski Anne (Logistics) (E-mail)" <Anne.Gawronski-1@ksc.nasa.gov>,
         "K - Glenn Malcolm (E-mail)" <Malcolm.Glenn-1@kmail.ksc.nasa.gov>,
         "K - Gross Sue (E-mail)" <sue.gross-1@ksc.nasa.gov>,
         "K - Higgins, Bill (E-mail)" <William.Higgins-1@kmail.ksc.nasa.gov>,
         "K - Kinnan Mike (E-mail)" <Mike.Kinnan-1@ksc.nasa.gov>,
         "K - Kleinschmidt Jane (Roy Bridges) (E-mail)"
<x-tab>   </x-tab> <Jane.Kleinschmidt-1@kmail.ksc.nasa.gov>,
         "K - McCombs John (E-mail)"
<x-tab>   </x-tab> <john.t.mccombs@usago.ksc.nasa.gov>,
         "K - Myers Penny (Shriver) (E-mail)" <penny.myers-1@ksc.nasa.gov>,
         "K - Pinch Sue (E-mail)" <Sue.Pinch-1@kmail.ksc.nasa.gov>,
         "K - Ridgway Leslie (MK) (E-mail)" <Leslie.Ridgway-1@kmail.ksc.nasa.gov>,
         "K - Scaltsas Dick (E-mail)" <richard.scaltsas-1@kmail.ksc.nasa.gov>,
         "K - Stagman, Jenny (E-mail)" <KinslVM@kscems.ksc.nasa.gov>,
         "K - Stevens Alfred (USA) (E-mail)" <alfred.m.stevens@usago.ksc.nasa.gov>,
         "K - Tilley Randy (E-mail)" <Randall.Tilley-1@kmail.ksc.nasa.gov>,
        "K - Wetmore Mike (E-mail)" <michael.wetmore-1@ksc.nasa.gov>,
        "K - Willingham, Terry (E-mail)" <Terry.Willingham-1@ksc.nasa.gov>,
        "M - Adams Alex (E-mail)" <Alex.Adams@msfc.nasa.gov>,
        "M - Balko Laura (E-mail)" <Laura.R.Balko@msfc.nasa.gov>,
        "M - Cianciola Chris (E-mail)" <chris.cianciola@msfc.nasa.gov>,
        "M - Cowart Chris (E-mail)" <chris.cowart@msfc.nasa.gov>,
        M - Grant Regina <regina.grant@msfc.nasa.gov>,
        "M - Hartline Tom (E-mail)" <Thomas.W.Hartline@msfc.nasa.gov>,
        "M - Hill Chris (E-mail)" <Christopher.Hill@msfc.nasa.gov>,
        "M - Kennedy Mike (E-mail)" <Mike.Kennedy@msfc.nasa.gov>,
        "M - King Dave (E-mail)" <David.King@msfc.nasa.gov>,
        "M - Martin Leigh (E-mail)" <Leigh.Martin@msfc.nasa.gov>,
        M - McMullins Margaret <margaret.mcmullins@msfc.nasa.gov>,
        "M - Metts Linder (E-mail)" <linder.metts@msfc.nasa.gov>,
        "M - Moorhead James (E-mail)"
<x-tab>   </x-tab>

<james.l.moorhead@USAHQ.UnitedSpaceAlliance.com>,
        "M - Mullane Dan (E-mail)"
<Daniel.J.Mullane@msfc.nasa.gov>,
        "M - Smiles, Mike
(E-mail)" <mike.smiles@ssc.nasa.gov>,
        "M - Spacek David
(E-mail)" <David.Spacek@msfc.nasa.gov>,
        "M - Teehan Paul (E-mail)"
<paul.teehan@msfc.nasa.gov>,
        "M - Walker Angelia
(E-mail)" <Angelia.Walker@msfc.nasa.gov>,
        "M - Weathers Shelby
(E-mail)" <Shelby.N.Weathers@msfc.nasa.gov>,
        "M - Yell Dena (E-mail)"
<Dena.Yell@msfc.nasa.gov>,
        "R - Hashimoto Rick
(E-mail)" <rick.hashimoto@west.boeing.com>,
        "Searcy Sam (E-mail)"
<Frances.L.Searcy@USAHQ.UnitedSpaceAlliance.com>,
        SR&QA MER Console
<SRQAMer@ems.jsc.nasa.gov>,
        "Trahan Melanie
(E-mail)"
<x-tab>   </x-tab>
<Melanie.C.Trahan@USAHQ.UnitedSpaceAlliance.com>,
        "U - Gedies Robert
(E-mail)"
<x-tab>   </x-tab>
<Robert.W.Gedies@USAHQ.UnitedSpaceAlliance.com>
Subject: Special PRCB on BSTRA Ball Cracks Results
Date: Sun, 12 Jan 2003 18:30:26 -0600
X-Mailer: Internet Mail Service (5.5.2653.19)

We will proceed toward L-2 on Tuesday 1/14. This will provide some
additional shelf life on what we have so far.

There is some additional testing in work and those results will be
reported
at L-2

The PRA shows this is a low risk but Ron would like additional review on
the
PRA prior to L-2
</blockquote></x-html>
<x-html>
<blockquote type=cite> From: "ERMINGER, MARK D. (JSC-NC) (NASA)"
<mark.d.erminger@nasa.gov>
To: "H - O'Connor Bryan (E-mail)"
<boconnor@mail.hq.nasa.gov>,
        "MARSHALL, YOLANDA Y. (JSC-NA)
(NASA)" <yolanda.y.marshall@nasa.gov>
Cc: "JOHNSON, M. S. (SCOTT) (JSC-NC) (NASA)"
<m.s.johnson@nasa.gov>,
        "H - Kowaleski Mark
(E-mail)" <mkowales@mail.hq.nasa.gov>,
        "H - Bihner Bill (E-mail)"
<wbihner@mail.hq.nasa.gov>,
        "MARTINEZ, HUGO E. (JSC-NC)
(GHG)" <hugo.e.martinez1@jsc.nasa.gov>
Subject: FW: OV-103 BSTRA Ball Crack Inspection (preliminary)
Date: Mon, 13 Jan 2003 07:17:38 -0600
X-Mailer: Internet Mail Service (5.5.2653.19)

Missing material on OV-103 BSTRA ball

> -----Original Message-----
> From:
<x-tab>   </x-tab>MARTINEZ, HUGO E.
(JSC-NC) (GHG)
> Sent:<x-tab> </x-tab>Sunday, January 12, 2003 7:43 PM
> To:<x-tab>   </x-tab>ERMINGER, MARK D. (JSC-NC) (NASA);
BROWNE, DAVID M. (JSC-NC) (NASA);
> CAZES, DAVID (JSC-NA) (SAIC); EVATT, GARVIN T. (GT) (JSC-NC) (SAIC);
> CULBERTSON, FRANK L., JR (JSC-NA) (SAIC); BOYER, ROGER L. (JSC-NC)
(SAIC);
> SCHICK, TIMOTHY D. (JSC-NC) (SAIC); REISTLE, BRUCE C. (JSC-NC)
(SAIC);
> REDING, JON D. (JSC-DF511) (USA); ALMASRI, WALEED; BALU, BRIAN;
CLEMENTS,
> DANIEL; ENGLE, ROSS; HATAMLEH, OMAR; ISHMAEL, MOHAMED; jaugust0;
MAYER,
> FRED; Patrick, Roz (MSFC); PRINCE, GORMAN; TIPTON, MICHAEL
> Subject:<x-tab>   </x-tab>OV-103 BSTRA
Ball Crack Inspection (preliminary)
>
> In addition to the status provided by Mark below, some interesting
> findings came in from KSC following the PRCB this evening. After
some
> problems encountered yesterday due to sideloads imparted on the ball
by
> the retracted umbilical, the JSC remote inspection tool was
successfully
> used to rotate the cracked ball on OV-103. It was reported that
"almost
> 100%" inspection was completed. Results so far indicate that
the crack
> runs under the insert and has a length of approximately 180 degrees
around
> but has no apparent branching. The crack does, however, have 3
islands
> that have been noted, two of which are larger. One of the larger
ones (on
> the order of 1000 microns in length or so) has approximately 30%-50%
of
> the island material missing, it appears. If the cracks, islands,
and
> "rafts" are as reported, they are not out of family with what
has been
> generated in the lab. Further characterization will be done tomorrow
by
> allowing the MSFC M&P group (as well as members of the JSC M&P
group on
> TDY at MSFC) to look at it for consistency in documenting the
features.
> In addition, an attempt will be made to view the other two BSTRA balls
in
> the LO2 17-inch line.
>
> Hugo
>
> -----Original Message-----
> From:
<x-tab>   </x-tab>ERMINGER, MARK D.
(JSC-NC) (NASA)
> Sent:<x-tab> </x-tab>Sunday, January 12, 2003 6:30 PM
> To:<x-tab>   </x-tab>Brown Mark (E-mail); Dever Lea

(E-mail); DL SR&QA Standup Notes;
> Greenfield Michael (E-mail); H - Bihner Bill (E-mail); H - Gregory Fred
> (E-mail); H - Hill Bill (E-mail); H - Kowaleski Mark (E-mail); H -
> O'Connor Bryan (E-mail); K - Abbott Robert (E-mail); K - Barnette Jack
> (E-mail); K - Bartell, Shannon (E-mail); K - Branard John (E-mail); K -
> Colloredo Lisa (E-mail); K - Delgado Hector (E-mail); K - Fairey, Chris
> (E-mail); K - Franca Chuck (E-mail); K - Gawronski Anne (Logistics)
> (E-mail); K - Glenn Malcolm (E-mail); K - Gross Sue (E-mail); K - Higgins,
> Bill (E-mail); K - Kinnan Mike (E-mail); K - Kleinschmidt Jane (Roy
> Bridges) (E-mail); K - McCombs John (E-mail); K - Myers Penny (Shriver)
> (E-mail); K - Pinch Sue (E-mail); K - Ridgway Leslie (MK) (E-mail); K -
> Scaltsas Dick (E-mail); K - Stagman, Jenny (E-mail); K - Stevens Alfred
> (USA) (E-mail); K - Tilley Randy (E-mail); K - Wetmore Mike (E-mail); K -
> Willingham, Terry (E-mail); M - Adams Alex (E-mail); M - Balko Laura
> (E-mail); M - Cianciola Chris (E-mail); M - Cowart Chris (E-mail); M -
> Grant Regina; M - Hartline Tom (E-mail); M - Hill Chris (E-mail); M -
> Kennedy Mike (E-mail); M - King Dave (E-mail); M - Martin Leigh (E-mail);
> M - McMullins Margaret; M - Metts Linder (E-mail); M - Moorhead James
> (E-mail); M - Mullane Dan (E-mail); M - Smiles, Mike (E-mail); M - Spacek
> David (E-mail); M - Teehan Paul (E-mail); M - Walker Angelia (E-mail); M -
> Weathers Shelby (E-mail); M - Yell Dena (E-mail); R - Hashimoto Rick
> (E-mail); Searcy Sam (E-mail); SR&QA MER Console; Trahan Melanie (E-mail);
> U - Gedies Robert (E-mail)
> Subject:<x-tab>   </x-tab>Special PRCB on BSTRA Ball Cracks Results
>
> We will proceed toward L-2 on Tuesday 1/14. This will provide some
> additional shelf life on what we have so far.
>
> There is some additional testing in work and those results will be
> reported at L-2
>
> The PRA shows this is a low risk but Ron would like additional review on
> the PRA prior to L-2
</blockquote></x-html>
<x-html>
<blockquote type=cite> From: "ERMINGER, MARK D. (JSC-NC) (NASA)" <mark.d.erminger@nasa.gov>
To: "JOHNSON, M. S. (SCOTT) (JSC-NC) (NASA)" <m.s.johnson@nasa.gov>
Cc: "MAYER, FRED F. (JSC-NC) (SAIC)" <fred.f.mayer1@jsc.nasa.gov>,
        "H - Kowaleski Mark (E-mail)" <mkowales@mail.hq.nasa.gov>,
        "H - Bihner Bill (E-mail)"

<wbihner@mail.hq.nasa.gov>
Subject: FW: STS-107 Long Range Tracking Video Screening
Date: Fri, 17 Jan 2003 12:57:45 -0600
X-Mailer: Internet Mail Service (5.5.2653.19)

> -----Original Message-----
> From:
<x-tab>   </x-tab>DISLER, JONATHAN M. (JON) (JSC-SX) (LM)
> Sent:<x-tab> </x-tab>Friday, January 17, 2003 12:56 PM
> To:<x-tab> </x-tab>Armando Oliu (E-mail); BAHR, PATRICIA A. (PAT) (JSC-SJ) (NASA);
> BARBARA A. CONTE (JSC-DM) (E-mail); Bill Lamkin; BOBBIE G. SWAN (JSC-CA)
> (E-mail); Brenda Eliason; BRIAN K. BALU (JSC-NC) (E-mail); Carlos
> Ortiz-Longo; Chris "The Man" Cloudt; Chris Hadfield (E-mail); Chris
> Lessmann; Christine Boykin; Curt Larsen / MS2; Dan Clements / NC-GH2;
> David Brown / CB (STS-107); David Moyer / MER Manager (E-mail); DAVID R.
> BRETZ (JSC-SN) (E-mail); David Rigby / MPS SSM (E-mail); DENA S. HAYNES
> (JSC-EV) (E-mail); Don Prevett; DONALD L. (DON) MCCORMACK (JSC-MV)
> (E-mail); Doug White; Douglas Powell (MAF); FRED F. MAYER (JSC-NC)
> (E-mail); Gail Hargrove Boeing-Houston Imagery Scrn.; Greg Katnik; Gregory
> Galbreath; GREGORY J. BYRNE (JSC-SN3) (E-mail); JAMES B. (BRITT) WALTERS
> (JSC-SF2) (E-mail); 'James Feeley' (E-mail); James Walters; JAVIER J.
> JIMENEZ (JSC-EA) (E-mail); Jeff Goodmark (E-mail); Jene Richart / MS2;
> Jill Lin; Jim Harder; 'John McKee' (E-mail); John Ventimiglia; JONATHAN M.
> (JON) DISLER (JSC-SN) (E-mail); Jorge Rivera; Julie Kramer; Karen Alfaro
> (E-mail); KENNETH L. BROWN (JSC-MV) (E-mail); KEVIN L. CROSBY (JSC-SN)
> (E-mail); 'L Lohrli' (E-mail); Malcolm Glenn; MARK D. ERMINGER (JSC-NC)
> (E-mail); Mark Erminger; MARK L. HOLDERMAN (JSC-MS) (E-mail); MARSHA S.
> IVINS (JSC-CB) (E-mail); MARTINEZ, HUGO E. (JSC-NC) (GHG); Michael
> Anderson / CB (STS-107); MICHAEL W. SNYDER (JSC-SN) (E-mail); Mike Cagle /
> Boeing Film Screen; Mike O'farrell; P J. (JEFF) BERTSCH (JSC-DD) (E-mail);
> Pam Madera (E-mail); PAUL F. DYE (JSC-DA8) (E-mail); PAYNE, ROBERT W.
> (JSC-SA13) (LM); 'Philip Kopfinger' (E-mail); Philip Peterson / Boeing
> Film Screen (E-mail); Philip Reid / Boeing Film Screen; PREMKUMAR SAGANTI
> PhD (JSC-SN) (E-mail); RANDALL W. ADAMS (JSC-MS2) (E-mail); RAYMOND T.
> (RAY) SILVESTRI (JSC-DM4) (E-mail); Rick Husband / CB (STS-107); Robbie
> Robbinson; Robert Page; ROBERT SCHARF (JSC-SN) (E-mail); Robert Speece;
> ROBERT W. FRICKE JR (JSC-MV) (E-mail); Rodney Rocha / ES2 (E-mail);

```
Rodney</div>
<div>&gt; Wallace; Rohit Dhawan; Ronald Clayton / MS2; Roy Glanville; Rudy Ramon;
SA</div>
<div>&gt; REP; Sara Brandenburg; Scott Otto; Stephen Frick / CB; Steve Derry;
Tom</div>
<div>&gt; Rieckhoff; Tom Wilson; 'Treith' (E-mail)</div>
<div>&gt; Subject:<x-tab>      </x-tab>STS-107 Long
Range Tracking Video Screening</div>
<div>&gt; </div>
<div>&gt;  JSC STS-107 Launch Screening - Long Range Tracking Videos</div>
<div>&gt; </div>
<div>&gt; January 17, 2003</div>
<div>&gt; </div>
<div>&gt; JSC Image Science and Analysis Group Human Exploration Science Office /
SX</div>
<div>&gt; </div>
<div>&gt; ANOMALY</div>
<div>&gt; </div>
<div>&gt; ET204, ET208, ET212 - During ascent at approximately 81 seconds MET,
a</div>
<div>&gt; large light-colored piece of debris was seen to originate from an
area</div>
<div>&gt; near the ET/Orbiter forward attach bipod.  The debris appeared to
move</div>
<div>&gt; outboard in a -Y direction, then fell aft along the left Orbiter
fuselage,</div>
<div>&gt; and struck the leading edge of the left wing.  The strike appears to
have</div>
<div>&gt; occurred on or relatively close to the wing glove near the Orbiter</div>
<div>&gt; fuselage.  After striking the left wing the debris broke into a spray
of</div>
<div>&gt; white-colored particles that fell aft along the underside (-Z side) of
the</div>
<div>&gt; Orbiter left wing.  The spray of particles was last seen near the
LSRB</div>
<div>&gt; exhaust plume.</div>
<div>&gt; </div>
<div>&gt; Still views and a movie loop of this event are being placed on our
web</div>
<div>&gt; site for viewing at the following address:</div>
<div>&gt; </div>
<div>&gt; &lt;a
href="http://sn-isag.jsc.nasa.gov/shuttleweb/mission_support/sts-107/launch_vid"
EUDORA=AUTOURL>http://sn-isag.jsc.nasa.gov/shuttleweb/mission_support/sts-107/launch
_vid</a>&gt; eo/107launchvideo.shtml&gt;</div></div>
<div>&gt; </div>
<div>&gt; The times of this event are as follows:</div>
<div>&gt; </div>
<div>&gt; Debris first seen near ET/Orbiter forward attach:  016:15:40:21.699
UTC</div>
<div>&gt; Debris contacted left wing:</div>
<div>&gt; 016:15:40:21.882 UTC</div>
<div>&gt; </div>
<div>&gt; Screening of the high speed and high resolution long range tracking
films</div>
<div>&gt; that may show more detail of this event will begin on Saturday
morning,</div>
<div>&gt; January 18th. </div>
<div>&gt; </div>
<div>&gt; Normal Observations Noted Included:  </div>
<div>&gt; </div>
<div>&gt; Vapor off the SRB stiffener rings, recirculation, SRB plume
brightening,</div>
```

```
<div>&gt; and slag debris after SRB separation.</div>
<div>&gt; </div>
<div>&gt; NOTES:</div>
<div>&gt; </div>
<div>&gt; The long range video tracking views had very soft focus possibly due
to</div>
<div>&gt; clouds and haze.  </div>
<div>&gt; </div>
<div>&gt; SRB separation occurred at approximately 016:15:41:06.558 UTC as seen
on</div>
<div>&gt; camera ET208.</div>
<div>&gt; </div>
<div>&gt; Five long range tracking videos were received and screened.  Timing
data</div>
<div>&gt; was received on all of the videos received except ET207.  </div>
<div>&gt; </div>
<div>&gt; The launch film screening will be conducted on Saturday and Sunday and
a</div>
<div>&gt; report will be sent to distribution on Monday, January 20, 2003. 
</div>
<div>&gt; </div>
<div>&gt; Jon Disler / SX3-LM</div>
<div>&gt; Joe Caruana / SX3-LM</div>
<div>&gt; Eric Nielsen / SX3-HEI</div>
<div>&gt; </div>
<div>&gt; </div>
<div>&gt; </div>
</blockquote></x-html>
<html>
<br>
<blockquote type=cite cite>From: &quot;Davis, Terry&quot;
&lt;Terry.Davis@ATK.com&gt;<br>
To: &quot;Burnette, Sheila&quot; &lt;Sheila.Burnette@ATK.com&gt;,<br>
       &quot;Cianciola, Chris (MSFC)&quot;
&lt;Chris.Cianciola@msfc.nasa.gov&gt;,<br>
       &quot;'Foster Anthony'&quot;
&lt;Foster.Anthony@msfc.nasa.gov&gt;,<br>
       &quot;Frandsen, Blaine&quot;<br>
<x-tab>      </x-tab>&lt;Blaine.Frandsen@A
TK.com&gt;,<br>
       &quot;'Fred Meyer'&quot;
&lt;fred.f.mayer1@jsc.nasa.gov&gt;,<br>
       &quot;Freeze, Korie&quot;
&lt;Korie.Freeze@ATK.com&gt;,<br>
       &quot;Hill, Christopher (MSFC)&quot;<br>
<x-tab>      </x-tab>&lt;Christopher.Hill@
msfc.nasa.gov&gt;,<br>
       &quot;Leonard, Jerry&quot;<br>
<x-tab>      </x-tab>&lt;Jerry.Leonard@ATK
.com&gt;,<br>
       &quot;'Leslie Ringo'&quot;
&lt;leslie.a.ringo@jsc.nasa.gov&gt;,<br>
       &quot;Lewis, Timothy (KSCNASA)&quot;
&lt;TIMOTHY.LEWIS-1@ksc.nasa.gov&gt;,<br>
       &quot;'Mark Kowaleski'&quot;
&lt;mkowales@hq.nasa.gov&gt;,<br>
       &quot;Nemecek, Larry (NASA)&quot;<br>
<x-tab>      </x-tab>&lt;Larry.Nemecek@thi
okol.com&gt;,<br>
       &quot;Pickart, Mark (DCMA)&quot;<br>
<x-tab>      </x-tab>&lt;MPICKART@DCMDW.DC
MA.MIL&gt;,<br>
       &quot;Ricks, Glen&quot;
```

```
&lt;Glen.Ricks@ATK.com&gt;,<br>
        &quot;Robinson, William (NASA)&quot;
&lt;William.Robinson@ATK.com&gt;,<br>
        &quot;Roth, Richard&quot;<br>
<x-tab>        </x-tab>&lt;Richard.Roth@ATK.
com&gt;,<br>
        &quot;Sanofsky, Kerry&quot;
&lt;Kerry.Sanofsky@ATK.com&gt;,<br>
        &quot;'William Hill'&quot;
&lt;william.hill@hq.nasa.gov&gt;,<br>
        &quot;McCann, Bradley&quot;<br>
<x-tab>        </x-tab>&lt;Bradley.McCann@AT
K.com&gt;<br>
Subject: STS-107 (RSRM-88) PFA<br>
Date: Tue, 10 Dec 2002 14:52:33 -0600<br>
X-Mailer: Internet Mail Service (5.5.2653.19)<br>
<br>
<font face="arial" size=2 color="#0000FF">Attached is a pdf file of the STS-107
(RSRM-88) S&amp;amp;MA</font><br>
<font face="arial" size=2 color="#0000FF">Preflight Assessment review currently
scheduled for </font><br>
<font face="arial" size=2 color="#0000FF">tomorrow morning (Wednesday, 11
December).</font><br>
<font face="arial" size=2 color="#0000FF">Please reply to this email to confirm
receipt of this</font><br>
<font face="arial" size=2 color="#0000FF">presentation package.</font><br>
<font face="arial" size=2 color="#0000FF">Thank!</font><br>
 <br>
<font face="Lucida Sans Unicode" color="#800080"><i>Terry Davis</i></font><br>
<font face="Lucida Sans Unicode" color="#800080"><i>Flight Readiness</i></font><br>
<font face="Lucida Sans Unicode" color="#800080"><i>ATK Thiokol
Propulsion</i></font><br>
<font face="Lucida Sans Unicode" color="#800080"><i>Phone: (435)
863-4179</i></font><br>
<font face="Lucida Sans Unicode" color="#800080"><i><a
href="mailto:                                          </a></i></font><br>
 <br>
 <br>
</blockquote></html>
<x-html><br>
<blockquote type=cite><div>From: &quot;ERMINGER, MARK D. (JSC-NC) (NASA)&quot;
&lt;mark.d.erminger@nasa.gov&gt;</div>
<div>To: &quot;H - Kowaleski Mark (E-mail)&quot;
&lt;mkowales@mail.hq.nasa.gov&gt;</div>
<div>Subject: FW: JSC STS-107 Launch Film Screening Report</div>
<div>Date: Wed, 22 Jan 2003 14:03:31 -0600</div>
<div>X-Mailer: Internet Mail Service (5.5.2653.19)</div>
<br>
<div>Mike Card called and was wondering if Bryan O'Connor knew about the
debris</div>
<div>hitting the wing.  This didn't pass my personal filter for making a</div>
<div>specialeffort to tell Bryan about this.</div>
<br>
<div>&gt;  -----Original Message-----</div>
<div>&gt; From:
<x-tab>        </x-tab>DISLER, JONATHAN M.
(JON) (JSC-SX) (LM)  </div>
<div>&gt; Sent:<x-tab> </x-tab>Sunday, January 19, 2003 8:30 PM</div>
<div>&gt; To:<x-tab>   </x-tab>Armando Oliu (E-mail); BAHR, PATRICIA
A. (PAT) (JSC-SJ) (NASA);</div>
<div>&gt; BARBARA A. CONTE (JSC-DM) (E-mail); Bill Lamkin; BOBBIE G. SWAN
(JSC-CA)</div>
<div>&gt; (E-mail); Brenda Eliason; BRIAN K. BALU (JSC-NC) (E-mail); Carlos</div>
```

> Ortiz-Longo; Chris "The Man" Cloudt; Chris Hadfield (E-mail); Chris
> Lessmann; Christine Boykin; Curt Larsen / MS2; Dan Clements / NC-GH2;
> David Brown / CB (STS-107); David Moyer / MER Manager (E-mail); DAVID R.
> BRETZ (JSC-SN) (E-mail); David Rigby / MPS SSM (E-mail); DENA S. HAYNES
> (JSC-EV) (E-mail); Don Prevett; DONALD L. (DON) MCCORMACK (JSC-MV)
> (E-mail); Doug White; Douglas Powell (MAF); FRED F. MAYER (JSC-NC)
> (E-mail); Gail Hargrove Boeing-Houston Imagery Scrn.; Greg Katnik; Gregory
> Galbreath; GREGORY J. BYRNE (JSC-SN3) (E-mail); JAMES B. (BRITT) WALTERS
> (JSC-SF2) (E-mail); 'James Feeley' (E-mail); James Walters; JAVIER J.
> JIMENEZ (JSC-EA) (E-mail); Jeff Goodmark (E-mail); Jene Richart / MS2;
> Jill Lin; Jim Harder; 'John McKee' (E-mail); John Ventimiglia; JONATHAN M.
> (JON) DISLER (JSC-SN) (E-mail); Jorge Rivera; Julie Kramer; Karen Alfaro
> (E-mail); KENNETH L. BROWN (JSC-MV) (E-mail); KEVIN L. CROSBY (JSC-SN)
> (E-mail); 'L Lohrli' (E-mail); Malcolm Glenn; MARK D. ERMINGER (JSC-NC)
> (E-mail); Mark Erminger; MARK L. HOLDERMAN (JSC-MS) (E-mail); MARSHA S.
> IVINS (JSC-CB) (E-mail); MARTINEZ, HUGO E. (JSC-NC) (GHG); Michael
> Anderson / CB (STS-107); MICHAEL W. SNYDER (JSC-SN) (E-mail); Mike Cagle /
> Boeing Film Screen; Mike O'farrell; P J. (JEFF) BERTSCH (JSC-DD) (E-mail);
> Pam Madera (E-mail); PAUL F. DYE (JSC-DA8) (E-mail); PAYNE, ROBERT W.
> (JSC-SA13) (LM); 'Philip Kopfinger' (E-mail); Philip Peterson / Boeing
> Film Screen (E-mail); Philip Reid / Boeing Film Screen; PREMKUMAR SAGANTI
> PhD (JSC-SN) (E-mail); RANDALL W. ADAMS (JSC-MS2) (E-mail); RAYMOND T.
> (RAY) SILVESTRI (JSC-DM4) (E-mail); Rick Husband / CB (STS-107); Robbie
> Robbinson; Robert Page; ROBERT SCHARF (JSC-SN) (E-mail); Robert Speece;
> ROBERT W. FRICKE JR (JSC-MV) (E-mail); Rodney Rocha / ES2 (E-mail); Rodney
> Wallace; Rohit Dhawan; Ronald Clayton / MS2; Roy Glanville; Rudy Ramon; SA
> REP; Sara Brandenburg; Scott Otto; Stephen Frick / CB; Steve Derry; Tom
> Rieckhoff; Tom Wilson; 'Treith' (E-mail)
> Subject:<x-tab>   </x-tab>JSC STS-107 Launch Film Screening Report
>
> STS-107
> Launch Film Screening Report
> January 20, 2003
> JSC Image Science and Analysis Group
> Human Exploration Science Office / SX
>
>
> ANOMALY

>
> E204, E208, E212- During ascent at approximately 81 seconds MET, a large
> light-colored piece of debris was seen to originate from an area near the
> ET/Orbiter forward attach bipod. The debris appeared to move outboard in
> a -Y direction, then fell aft along the left Orbiter fuselage, and struck
> the underside (-Z) of the leading edge of the left wing. The strike
> appears to have occurred on or relatively close to the wing glove near the
> Orbiter fuselage. After striking the left wing, the debris broke into a
> spray of white-colored particles that fell aft along the underside (-Z
> side) of the Orbiter left wing. The spray of particles was last seen near
> the LSRB exhaust plume.
>
> Comparison views of the strike area immediately before and after the event
> were examined for indications of damage to the wing. The resolution on
> the films and videos is insufficient to see individual tiles. However, no
> indications of damage at a larger scale as indicated by changes in
> brightness of the wing surface area(s) that may indicate damage was noted.
>
>
> Still views and enhanced movie loops of this event are available for at
> the following web address:
>
> http://sn-isag.jsc.nasa.gov/shuttleweb/mission_support/sts-107/launch_vid> eo/107launchvideo.shtml>
>
> The times of this event are as follows:
>
> Debris first seen near ET/Orbiter forward attach: 016:15:40:21.699 UTC
> Debris contacted left wing:
> 016:15:40:21.882 UTC
>
> Crew acquired down linked video imaging the External Tank (ET), probably
> the source of the debris that struck the Orbiter left wing, was reviewed.
> Unfortunately the view is of the far side of the ET and provided no
> information as to the source of the debris object.
>
> A down linked view of the Orbiter left wing upper surface from a payload
> bay camera did not image the suspected impact area.
>
> OBSERVATIONS:
>
> Selected launch views are available for viewing at:
>

> <a
href="http://sn-isag.jsc.nasa.gov/shuttleweb/mission_support/sts-107/launch_fil"
EUDORA=AUTOURL>http://sn-isag.jsc.nasa.gov/shuttleweb/mission_support/sts-107/launch
_fil> m/107launchfilm.shtml>
>
> Other launch film screening event observations similar to those seen
on
> previous missions are:
> On the launch video screening report dated 1/16/03 we reported that
the
> right elevon motion may have been greater on STS-107 than has been
> typically seen. A comparison of the elevon motion was done with
views
> from STS-113 and the previous Columbia flight (STS-109). It was
concluded
> that the motion on STS-107 was normal in that it was similar to the
elevon
> motion seen on STS-113 and STS-109.
>
> E5, E17, E18, E19, E20 - Orange vapor (possibly free burning hydrogen)
was
> seen forward of the SSME rims and near the base heat shield during
SSME
> ignition. The orange vapor on the STS-107 films appeared to be
similar to
> those typically seen on previous mission films and videos.
>
> E19, E20, E76 - During SSME start-up, the SSME Mach diamonds formed in
the
> expected sequence (3, 2, 1). The times for the Mach diamond
formation
> given below are from the engineering film E76:
>
>
<x-tab>   </x-tab><x-tab>   &n
bsp;   </x-tab>SSME #3 - 15:38:56.736 UTC
>
<x-tab>   </x-tab><x-tab>   &n
bsp;   </x-tab>SSME #2 - 15:38:56.816 UTC
>
<x-tab>   </x-tab><x-tab>   &n
bsp;   </x-tab>SSME #1 - 15:38:57.227 UTC
>
> The start times for SSME ignition based on the E76 film were:
>
>
<x-tab>   </x-tab><x-tab>   &n
bsp;   </x-tab>SSME #3 - 15:38:55.215 UTC
>
<x-tab>   </x-tab><x-tab>   &n
bsp;   </x-tab>SSME #2 - 15:38:55.355 UTC
>
<x-tab>   </x-tab><x-tab>   &n
bsp;   </x-tab>SSME #1 - 15:38:55.455 UTC
>
> E5, E76 - Movement of the SSME #3 Dome Mounted Heat Shield (DMHS)
blanket
> was seen during SSME ignition on camera E5. On camera E76, SSME #2
and
> SSME #3 DMHS blanket movement was seen during SSME ignition
(15:38:56.466
> UTC). This event has been seen on previous mission films.
>

> E1, E2, E4, E5, E20, E31 - Typical of previous missions, multiple pieces
> of ice debris were seen falling from the ET/Orbiter umbilicals and along
> the body flap during SSME ignition through liftoff. Ice debris was seen
> falling near the LH2 umbilical four inch recirculation line. None of the
> debris were seen to contact the launch vehicle.
>
> E5, E18, E20, E31 - A line of frost was visible at the juncture of the
> base of SSME #2 and the Dome Mounted Heat Shield (DMHS) during liftoff.
>
> E18, E20 - Typical of previous missions, small areas of tile surface
> material erosion were seen forming on the base heat shield and on the RCS
> stingers at the following times:
>
>
<x-tab>   </x-tab><x-tab>   </x-tab>15:38:56.000 UTC - Erosion mark inboard of the left RCS
> stinger
>
<x-tab>   </x-tab><x-tab>   </x-tab>15:38:56.562 UTC - Erosion mark outboard of SSME #2 near the
> body flap
>
<x-tab>   </x-tab><x-tab>   </x-tab>15:38:57.329 UTC - Erosion mark on the tip of the left RCS
> stinger
>
<x-tab>   </x-tab><x-tab>   </x-tab>15:38:58.639 UTC - Erosion mark on the left OMS pod between
> the OMS nozzle and vertical stabilizer
>
> E2, E19- Faint, light-orange-colored flashes were seen in the SSME exhaust
> plumes, possibly debris induced, during SSME ignition and through liftoff
> at the times shown below:
>
>   SSME #1 - 15:38:57.728 UTC
>   SSME #1 - 15:38:58.385 UTC
>   SSME #1 - 15:38:58.779 UTC
>   SSME #1 - 15:38:59.019 UTC
>   SSME #3 - 15:38:57.395 UTC
>   SSME #3 - 15:38:59.532 UTC
> <x-tab>   </x-tab>
> Flashes in the SSME exhaust plume prior to liftoff have been seen on
> previous mission films.
>

> E17 - Several small, dark-colored pieces of debris (possibly paint chips)
> were seen falling from a seam line on the -Z side of the LO2 TSM just
> before liftoff (15:38:59.566 UTC).
>
> E1, E5, E17, E52 - As typically seen on previous missions, multiple pieces
> of SRB throat plug and/or SRB flame duct debris were seen near the right
> and left SRBs during liftoff. On camera E1, two pieces of SRB flame duct
> debris were seen arcing between the two SRB's and falling aft along the -Z
> side of the body flap during liftoff (15:39:00.4 UTC). On camera E17, a
> large appearing, light-colored piece of probable SRB throat plug material
> was seen aft of the vehicle during liftoff (15:39:01.873 UTC). At
> liftoff, light-colored debris was seen falling aft near the +Y side of the
> RSRB aft skirt (15:39:02.456 UTC). On camera E52, debris from the base of
> the SRB's was seen traveling north of the MLP at liftoff (15:39:02.203
> UTC).
>
> E5- A light-colored piece of debris was seen falling aft from near the
> ET/RSRB aft attach during liftoff (15:39:01.235 UTC).
>
> E8 - SRB ignition was at 15:39:00.000 UTC based on the observation of the
> PIC firing at RSRB holddown post M-2.
>
> E18 - A dark-colored, flexible, strap or tag-like object was seen on the
> LH2 TSM T-0 umbilcal disconnect prior to liftoff.
>
> E19 - A long, dark-colored, flexible, strap-like object was seen coming
> from the top of the LH2 TSM T-0 door before detaching and falling aft in
> front of the TSM T-0 door after liftoff (15:39:03.582 UTC)
>
> E8, E13 - The left and right SRB GN2 purge lines appeared wrapped,
> upright, and intact until they were obscured by exhaust plumes at
> 15:39:00.000 UTC (right purge line) and 15:39:00.003 UTC (left purge
> line).
>
> E7, E10, E11, E14 - The left and right SRB north holddown post blast
> shields closed prior to when the SRB nozzle exit plane rose past the level
> of the SRB holddown post shoes, as they are designed to do. However, the
> holddown post M4 blast shield may have closed quicker than typical.

>
> E33, E34, E36, E39, E52- The GH2 vent arm retraction appeared normal. Ice
> and vapors were seen falling aft along the ET during the vent arm
> retraction. The GH2 vent arm contact with the deceleration cable on

the
> E39 camera close-up view from inside the FSS of the vent arm capture was
> visible. As designed, the arm appeared to make contact very close to the
> center position of the deceleration cable. The vent arm appeared to latch
> normally with no rebound. A measurement of the position of the vent arm
> with respect to the center of the deceleration cable at the time of
> initial contact will be made and reported separately.
>
> E207, E212 - An assessment of the body flap motion during ascent compared
> to that seen on previous missions could not be made because of the soft
> focus on the STS-107 long range tracking camera views.
>
> E52, E212, E213, E222, E223- Multiple pieces of debris, too numerous to
> count (mostly umbilical ice and RCS paper debris), were seen falling aft
> of the launch vehicle during ascent. Umbilical ice and RCS paper debris
> during ascent has been seen on previous mission films and videos.
> Examples are:
>
> 15:39:17.021 UTC: Forward RCS paper debris noted falling aft along the
> right wing (E52)
> 15:39:20.093 UTC: RCS paper debris noted. (E223)
> 15:39:20.169 UTC: Spray of RCS paper debris noted aft of the SSMEs.
> (E222)
> 15:39:23.9 UTC: Debris from ET/Orbiter umbilicals noted falling aft along
> body flap. (E213)
> Frame 960: RCS paper debris noted falling aft of SSME exhaust plume.
> (E212)
>
> E5, E20, E31, E52, E212, E222 - Pieces of orange-colored umbilical purge
> barrier material were seen falling aft along the -Z side of the body flap
> during SSME ignition (15:38:57.703 UTC). On camera E20, three pieces of
> light-orange colored umbilical purge barrier material were noted falling
> aft near SSME #2 prior to liftoff (15:38:58.394 UTC). Umbilical purge
> barrier material was seen falling along the body flap during tower clear
> on camera E52. On camera E222, a piece of umbilical purge barrier
> material was seen near the Orbiter right wing during liftoff (15:39:03.014
> UTC). During early ascent, multiple pieces of umbilical purge barrier
> material were seen falling aft of the left wing on the camera E52 view.
> On camera E212, a piece of umbilical purge barrier material was seen
> falling along the body flap. On camera E222, a piece of umbilical

purge
> barrier material was seen falling aft of the body flap at approximately
32
> seconds MET (15:39:31.840 UTC). Purge barrier material falling from
the
> ET umbilicals has been typically seen on previous mission tracking
camera
> views.
>
> Cameras E52, E213, E220, E222, E223 - Light-colored flares (possibly
> debris induced) were seen in the SSME exhaust plumes during ascent on
the
> intermediate and long range tracking camera films. Examples of the
flares
> observed are:
>
> 15:39:14.576 UTC: Flare noted in SSME exhaust plume (E52)
> 15:39:33.178 UTC: Flare seen in SSME exhaust plume (E213)
> 15:39:33.424 UTC: Flare seen in SSME exhaust plume (E213)
> 15:39:33.471 UTC: Flare seen in SSME exhaust plume (E222)
> 15:39:33.475 UTC: Flare seen in SSME exhaust plume (E213)
> 15:39:35.469 UTC: Flare seen in SSME exhaust plume (E213)
> 15:39:35.633 UTC: Flare seen in SSME exhaust plume (E213)
> 15:39:37.175 UTC: Flare seen in SSME exhaust plume (E222)
> 15:39:37.177 UTC: Flare seen in SSME exhaust plume (E213)

> 15:39:40.367 UTC: Flare seen in SSME exhaust plume (E213)
> 15:39:33.168 UTC: Flare seen in SSME exhaust plume (E213)
> 15:39:41.992 UTC: Flare seen in SSME exhaust plume (E213)
> 15:39:51.001 UTC: Flare seen in SSME exhaust plume (E220)
> 15:39:57.060 UTC: Flare seen in SSME exhaust plume (E223)
>
> Flares in the SSME exhaust plumes have been seen on previous
missions
> films and videos.
>
> E204, E207, E220, E222, E223 - As on previous missions, debris was
seen
> exiting the SRB exhaust plumes. The debris exiting the SRB exhaust
plumes
> during the majority of ascent is probably instafoam from the aft end
of
> the SRBs. The more dense appearing debris near the time of tail-off,
just
> prior to SRB separation, is probably SRB slag debris. Examples of
this
> debris are:
>
> 15:39:27.186 UTC: Debris seen falling along SRB exhaust plume
(E223)
> 15:39:48.926 UTC: Debris seen falling along SRB exhaust plume
(E220)
> 15:39:49.350 UTC: Debris seen falling along SRB exhaust plume (E223)

>
> SRB separation was timed at 15:41:06.536 UTC on camera E207.
>
> Other normal events observed included: RCS paper debris, ice and
vapor
> from the LO2 and LH2 TSM T-0 umbilicals prior to and after disconnect,
ET
> twang, multiple pieces of debris in the exhaust cloud after liftoff
> including rope-like debris (probable water baffle material),

acoustic
> waves in the exhaust cloud after liftoff, charring of the ET aft dome, ET
> aft dome outgassing, vapor off the SRB stiffener rings, expansion waves,
> linear optical effects, recirculation, SRB plume brightening, and SRB slag
> debris after SRB separation.
>
> Normal Pad events observed included: Hydrogen igniter operation, MLP
> deluge water activation, FSS deluge water operation, LH2 and LO2 TSM door
> closure, and sound suppression system water operation.
>
> NOTES:
>
> Twelve 16 mm films, thirteen 35 mm films, and 24 launch videos were
> screened. The focus on several of the long range tracking camera film
> views was very soft which hindered imagery analysis and the analysis of
> the debris strike to the Orbiter wing.
>
> This concludes the routine JSC STS-107 launch film and video screening.
> Image enhancements of the debris strike event, web site updates, or other
> special support requests, will be performed prior to landing.
>
> Jon Disler / SX3-LM
> Chris Cloudt / SX3-HEI
> Joe Caruana / SX3-LM
>
>
>
</blockquote></x-html>
<x-html>
<blockquote type=cite> From: "ERMINGER, MARK D. (JSC-NC) (NASA)" <mark.d.erminger@nasa.gov>
To: "MAYER, FRED F. (JSC-NC) (SAIC)" <fred.f.mayer1@jsc.nasa.gov>,
        "JOHNSON, M. S. (SCOTT) (JSC-NC) (NASA)" <m.s.johnson@nasa.gov>,
        "'H - Kowaleski Mark'" <mkowales@mail.hq.nasa.gov>,
        "H - Bihner Bill (wbihner@mail.hq.nasa.gov)" <wbihner@mail.hq.nasa.gov>
Subject: FW: STS-107 Launch+4 Day Consolidated Film/Video Report
Date: Wed, 29 Jan 2003 13:13:32 -0600
X-Mailer: Internet Mail Service (5.5.2653.19)

-----Original Message-----
From: Page-1, Robert [mailto:Robert.W.Page@nasa.gov]
Sent: Wednesday, January 29, 2003 12:56 PM
To: Abner, Charlie; ALFARO, KAREN (JSC-SP5) (LM); Atkinson, Bill C.;
Ayotte-1, William; BAHR, PATRICIA A. (PAT) (JSC-SJ) (NASA); BALU, BRIAN K.
(JSC-NC) (SAIC); Bauder, Stephen P; Blue, John B; Brewer, John M; BROWN,
KENNETH L. (JSC-MV6) (NASA); Bursian, Henry; Burt, Rick; Butler, Mike;

BYRNE, GREGORY J., PHD (JSC-SX) (NASA); Cash, Steve; Chapman, John;
Chitko,
Pete J.; BOYKIN, CHRISTINE M. (JSC-MS2) (NASA); Clever, William W.;
Davis,
Benny; DERRY, STEPHEN M. (STEVE) (JSC-EG3) (NASA); DISLER, JONATHAN M.
(JON)
(JSC-SX) (LM); DYE, PAUL F. (JSC-DA8) (NASA); Engler, Tom; ERMINGER, MARK
D.
(JSC-NC) (NASA); Fagan, Michael; Ferris, Frances; Fisher, Gary; Fricke,
Robert W.; Fuller, Mike; GALBREATH, GREGORY F. (GREG) (JSC-ES2) (NASA);
Gardze, Eric P.; GLANVILLE, ROY W. (JSC-NC) (NASA); Glenn-1, Malcolm;
Goldman, Gene; GOMEZ, REYNALDO J. (RAY) (JSC-EG3) (NASA); Gordon, Steve
L;
Greenwood, Terry F.; BYRNE, GREGORY J., PHD (JSC-SX) (NASA); Guidi-1,
John;
HALSELL, JAMES D (JSC-REMOTE); HAM, LINDA J. (JSC-MA2) (NASA); Harris,
Yolanda; Hawkins, Tyrell; HAYNES, DENA S. (JSC-EV) (NASA); Herst, Terri;
Holderman, Mark L.; Holmes, Steven G.; Hopson, George; Huff, Joy N.;
IVINS,
MARSHA S. (JSC-CB) (NASA); Jim Ross; Jones-1, Frank; Kaminsky, James;
Kelley-1, David; Kienitz, Fred; Kynard, Mike; Lafleur, Tom C; Laufenberg,
Katherine M; Leggett, Kenneth D; Leinbach-1, Mike; LIN, JILL D. (JSC-MV5)
(NASA); Lorelei Lohrli-Kirk; Maddux, Lewis; Mango, Ed; Martin, David M.;
MARTINEZ, HUGO E. (JSC-NC) (GHG); MAYER, FRED F. (JSC-NC) (SAIC);
MCCORMACK,
DONALD L. (DON) (JSC-MV6) (NASA); Moore, Dennis; Moyer, David; Muddle,
William H.; Muhar, Mark; Murphy, Alan; Nagle, Scott M; Nash, Richard;
Newton, John; Oliu-1, Armando; Ortiz-Longo, Carlos V.; Otte, Neil; Otto,
Scott; Owens, Karen K.; Page-1, Robert; PATTERSON, JOE K. (KEN) (JSC-DM)
(USA); Preston, Ken; PREVETT, DONALD E. (DON) (JSC-EP) (NASA); Purtle,
Lawrence; Ramon, Rudolph; Revay, Kenneth P; Rieckhoff, Tom; Rivera,
Jorge;
Rudolphi, Michael; Segert-1 Randall; Smelser, Jerry; Snoddy, Jim; SNYDER,
MICHAEL W. (JSC-SX) (LM); Sofge, Al (NASA HQ); Speece-1, Bob;
Stevenson-1,
Charlie; Sutton, Marcy; Swan, Bobbie G.; Teehan, Paul; Tepool, Ronald;
Tinsley, John; WALLACE, RODNEY O. (ROD) (JSC-MS2) (NASA); WALTERS, JAMES
B.
(BRITT) (JSC-SM) (NASA); White, Doug; Williams, Tom; Wilson, David;
Wilson,
Thomas F.; Woolhouse, Dwight; Worlund, Len
Subject: STS-107 Launch+4 Day Consolidated Film/Video Report

Attached is a copy of the STS-113 Launch+4 Day Consolidated Film/Video
Report.

 <<107CFVR_L+4.pdf>>

During my computer replacement, I lost the distribution list and have
been
working ro restore it. Please review over the list of names that this
is
being sent to and verify that the proper individuals are getting it.
Also,
the following were getting it before and I cannot find e-mail addresses
for
them. If you have one, please provide it to me; Bakes, Russell;
Conte,
Barbara A; Counts, Parker; Feeley, James; Jones, Ferdinand; Kan, Kenneth;
Kopfinger, Philip; Lamkin, Bill; Nichols, Stanley;Robertson, James;
Sanofsky, Kerry; Schomburg, Calvin.

Bob Page
KSC/MK-SIO
(321)867-8516

</blockquote></x-html>
<x-html>
<blockquote type=cite> From: "ERMINGER, MARK D. (JSC-NC) (NASA)"
<mark.d.erminger@nasa.gov>
To: "H - Kowaleski Mark (E-mail)"
<mkowales@mail.hq.nasa.gov>
Subject: FW: STS-107 Launch+4 Day Consolidated Film/Video Report
Date: Sat, 1 Feb 2003 11:15:30 -0600
X-Mailer: Internet Mail Service (5.5.2653.19)

Print this out in color

-----Original Message-----
From: Page-1, Robert [<a href="mailto:Robert.W.Page@nasa.gov"
EUDORA=AUTOURL>mailto:Robert.W.Page@nasa.gov]
Sent: Wednesday, January 29, 2003 12:56 PM
To: Abner, Charlie; ALFARO, KAREN (JSC-SP5) (LM); Atkinson, Bill C.;
Ayotte-1, William; BAHR, PATRICIA A. (PAT) (JSC-SJ) (NASA); BALU, BRIAN
K. (JSC-NC) (SAIC); Bauder, Stephen P; Blue, John B; Brewer, John M;
BROWN, KENNETH L. (JSC-MV6) (NASA); Bursian, Henry; Burt, Rick; Butler,
Mike; BYRNE, GREGORY J., PHD (JSC-SX) (NASA); Cash, Steve; Chapman,
John; Chitko, Pete J.; BOYKIN, CHRISTINE M. (JSC-MS2) (NASA); Clever,
William W.; Davis, Benny; DERRY, STEPHEN M. (STEVE) (JSC-EG3) (NASA);
DISLER, JONATHAN M. (JON) (JSC-SX) (LM); DYE, PAUL F. (JSC-DA8) (NASA);
Engler, Tom; ERMINGER, MARK D. (JSC-NC) (NASA); Fagan, Michael; Ferris,
Frances; Fisher, Gary; Fricke, Robert W.; Fuller, Mike; GALBREATH,
GREGORY F. (GREG) (JSC-ES2) (NASA); Gardze, Eric P.; GLANVILLE, ROY W.
(JSC-NC) (NASA); Glenn-1, Malcolm; Goldman, Gene; GOMEZ, REYNALDO J.
(RAY) (JSC-EG3) (NASA); Gordon, Steve L; Greenwood, Terry F.; BYRNE,
GREGORY J., PHD (JSC-SX) (NASA); Guidi-1, John; HALSELL, JAMES D
(JSC-REMOTE); HAM, LINDA J. (JSC-MA2) (NASA); Harris, Yolanda; Hawkins,
Tyrell; HAYNES, DENA S. (JSC-EV) (NASA); Herst, Terri; Holderman, Mark
L.; Holmes, Steven G.; Hopson, George; Huff, Joy N.; IVINS, MARSHA S.
(JSC-CB) (NASA); Jim Ross; Jones-1, Frank; Kaminsky, James; Kelley-1,
David; Kienitz, Fred; Kynard, Mike; Lafleur, Tom C; Laufenberg,
Katherine M; Leggett, Kenneth D; Leinbach-1, Mike; LIN, JILL D.
(JSC-MV5) (NASA); Lorelei Lohrli-Kirk; Maddux, Lewis; Mango, Ed; Martin,
David M.; MARTINEZ, HUGO E. (JSC-NC) (GHG); MAYER, FRED F. (JSC-NC)
(SAIC); MCCORMACK, DONALD L. (DON) (JSC-MV6) (NASA); Moore, Dennis;
Moyer, David; Muddle, William H.; Muhar, Mark; Murphy, Alan; Nagle,
Scott M; Nash, Richard; Newton, John; Oliu-1, Armando; Ortiz-Longo,
Carlos V.; Otte, Neil; Otto, Scott; Owens, Karen K.; Page-1, Robert;
PATTERSON, JOE K. (KEN) (JSC-DM) (USA); Preston, Ken; PREVETT, DONALD E.
(DON) (JSC-EP) (NASA); Purtle, Lawrence; Ramon, Rudolph; Revay, Kenneth
P; Rieckhoff, Tom; Rivera, Jorge; Rudolphi, Michael; Segert-1 Randall;
Smelser, Jerry; Snoddy, Jim; SNYDER, MICHAEL W. (JSC-SX) (LM); Sofge, Al
(NASA HQ); Speece-1, Bob; Stevenson-1, Charlie; Sutton, Marcy; Swan,
Bobbie G.; Teehan, Paul; Tepool, Ronald; Tinsley, John; WALLACE, RODNEY
O. (ROD) (JSC-MS2) (NASA); WALTERS, JAMES B. (BRITT) (JSC-SM) (NASA);
White, Doug; Williams, Tom; Wilson, David; Wilson, Thomas F.; Woolhouse,
Dwight; Worlund, Len
Subject: STS-107 Launch+4 Day Consolidated Film/Video Report


```
<br>
<br>
<div>Attached is a copy of the STS-113 Launch+4 Day Consolidated Film/Video</div>
<div>Report.</div>
<br>
<div> &lt;&lt;107CFVR_L+4.pdf&gt;&gt; </div>
<br>
<div>During my computer replacement, I lost the distribution list and have
been</div>
<div>working ro restore it.  Please review over the list of names that this
is</div>
<div>being sent to and verify that the proper individuals are getting it. 
Also,</div>
<div>the following were getting it before and I cannot find e-mail addresses
for</div>
<div>them.  If you have one, please provide it to me; Bakes, Russell;
Conte,</div>
<div>Barbara A; Counts, Parker; Feeley, James; Jones, Ferdinand; Kan, Kenneth;</div>
<div>Kopfinger, Philip; Lamkin, Bill; Nichols, Stanley;Robertson, James;</div>
<div>Sanofsky, Kerry; Schomburg, Calvin.</div>
<br>
<div>Bob Page</div>
<div>KSC/MK-SIO</div>
<div>(321)867-8516</div>
<br>
<br>
<br>
<br>
<br>
<br>
<br>
</blockquote></x-html>
Per meeting today.

Mark
<html>
Pam, FYI, a suggestion (you might already be doing it) might be to make outlines of
all the data you are collecting (this is what I did for the 107 data we touched here
in Code Q - see outline below).  This way the user could just scan to see what
is in the database.<br>
<br>
And thanks for your kind words of encouragement.<br>
<br>
Mark<br>
<br>
<br>
<blockquote type=cite cite>Date: Mon, 03 Feb 2003 09:55:31 -0500<br>
To: jlloyd<br>
From: Mark Kowaleski &lt;mkowales@hq.nasa.gov&gt;<br>
Subject: STS-107 OSMA data<br>
Cc: prutledge,bbihner,fchandle@mail.hq.nasa.gov<br>
<br>
Jim &amp;amp; Pete,<br>
<br>
I gathered together all the STS-107 OSMA-related data that OSMA touched, saw, or
responded to.<br>
<br>
Jim:  As requested, I will hand it over to you when I see you in person.<br>
<br>
I asked Bill to provide copies of any email and launch day notes that he may
have.<br>
I'll add those to the binder when I get them.<br>
<br>
```

```
Here is the outline of the two-voluem data set:<br>
<br>
Mark<br>
<br>
<div align="center">
STS-107 OSMA mission related data products<br>
<br>
</div>
<font face="Times New Roman, Times"
size=4>1)<x-tab>      </x-tab></font>Volume I, STS-107
OSMA Data
<dl><font face="Times New Roman, Times" size=4>
<dd>a)<x-tab>      </x-tab></font>Safety &amp; Mission
Assurance Report
<dl><font face="Times New Roman, Times" size=4>
<dd>i)<x-tab>      </x-tab></font>FRR version
</dl>
</dl><br>
<font face="Times New Roman, Times"
size=4>ii)<x-tab>     </x-tab></font>PMMT version
<dl><font face="Times New Roman, Times" size=4>
<dd>b)<x-tab>      </x-tab></font>Pre-flight
Assessment Reviews (PFA)
<dl><font face="Times New Roman, Times" size=4>
<dd>i)<x-tab>      </x-tab></font>RSRM-88 PFA
</dl>
</dl><br>
<font face="Times New Roman, Times"
size=4>ii)<x-tab>     </x-tab></font>SRB - BI116 PFA
(SR&amp;QA Review)<br>
<font face="Times New Roman, Times"
size=4>iii)<x-tab>    </x-tab></font>SSME PFA<br>
<font face="Times New Roman, Times"
size=4>iv)<x-tab>     </x-tab></font>ET-93 PFA
<dl><font face="Times New Roman, Times" size=4>
<dd>c)<x-tab>      </x-tab></font>Preflight Assessment
Review
<dl><font face="Times New Roman, Times" size=4>
<dd>i)<x-tab>      </x-tab></font>PAR-5 Minutes 
Topics (PAR Planning Notes from JSC)<font face="Times New Roman, Times" size=4>
<dd>(1)<x-tab>     </x-tab></font>Jan 10, 2003
</dl>
</dl><br>
<font face="Times New Roman, Times"
size=4>(2)<x-tab>     </x-tab></font>Jan 17, 2003<br>
<font face="Times New Roman, Times"
size=4>(3)<x-tab>     </x-tab></font>Jan 24, 2003
<dl>
<dl><font face="Times New Roman, Times" size=4>
<dd>ii)<x-tab>     </x-tab></font>Pre-Flight Assessment
Review
</dl>
</dl><br>
<font face="Times New Roman, Times"
size=4>iii)<x-tab>    </x-tab></font>PFA - FRR Tag-up<br>
<font face="Times New Roman, Times"
size=4>iv)<x-tab>     </x-tab></font>PFA -  PMMT
Tag-up<br>
<font face="Times New Roman, Times"
size=4>v)<x-tab>      </x-tab></font>Range Safety Data
Package<br>
<br>
<font face="Times New Roman, Times"
```

```
size=4>2)<x-tab>      </x-tab></font>Volume II,
STS-107 Email Exchange
<dl><font face="Times New Roman, Times" size=4>
<dd>a)<x-tab>      </x-tab></font>Email Exchange
<dl><font face="Times New Roman, Times" size=4>
<dd>i)<x-tab>      </x-tab></font>Email MER daily
status reports
</dl>
</dl><br>
<font face="Times New Roman, Times"
size=4>ii)<x-tab>    </x-tab></font>Email OSF status
messages to Code Q<br>
<font face="Times New Roman, Times"
size=4>iii)<x-tab>   </x-tab></font>Email SR&amp;QA Reports<br>
<font face="Times New Roman, Times"
size=4>iv)<x-tab>     </x-tab></font>Email Inter-office
(OSMA)
<dl><font face="Times New Roman, Times" size=4>
<dd>b)<x-tab>      </x-tab></font>Launch Operations
Data (on-console)
<dl><font face="Times New Roman, Times" size=4>
<dd>i)<x-tab>      </x-tab></font>Interim Problem
Reports (Pre-tanking report)
</dl>
</dl><br>
<font face="Times New Roman, Times"
size=4>ii)<x-tab>     </x-tab></font>ET Tanking Meeting SRB
Special Topic<br>
<font face="Times New Roman, Times"
size=4>iii)<x-tab>    </x-tab></font>PMMT (L-1) and Launch Day
Notes (Kowaleski)<br>
PMMT (L-1) and Launch Day Notes (Bihner)</blockquote></html>
<html>
Alex, this bounced, here it is again.<br>
<br>
Mark<br>
<br>
<br>
<blockquote type=cite cite>Date: Tue, 04 Feb 2003 11:33:00 -0500<br>
To: SMA_Team_107<br>
From: Mark Kowaleski &lt;mkowales@hq.nasa.gov&gt;<br>
Subject: ET Foam loss assessment<br>
Cc: snewman,prichard@hq.nasa.gov<br>
<br>
Hi Folks,<br>
<br>
Here is the first round of questions:<br>
<br>
1) Would someone please forward me the analysis that we did for the ET foam loss hit
risk to Columbia's TPS?  <br>
<br>
I caught a glimpse of the package (about 20 pages) in Code M (Code M says they never
saw it prior to this past weekend), but we never got it here in Code Q.  This
was to be presented at the STS-107 PAR, but we never got to it because of ITAR.<br>
<br>
2) During STS-113, we discussed risk of bipod foam loss during STS-112.  At
that time we also mentioned bipod foam loss on STS-32 and ST-50.<br>
<br>
Would you please send me any analysis you may have that was done for STS-112
(priority) and for STS-32 and 50.<br>
<br>
3) I understand that the ET O2 feedline for STS-107 uses a unique foam (BX-265
???).<br>
```

```
<br>
4) I need an education on the different type of foams (if any) that are used for
bipod and other close-out items when preparing the tank.<br>
How have these foams types and their application process changed over time?<br>
<br>
Many thanks for your support.  More questions will follow.<br>
<br>
I don't mind multiple submissions, we'll sort it out on this end.<br>
<br>
Mark </blockquote></html>
<html>
<br>
<blockquote type=cite cite>Date: Mon, 03 Feb 2003 09:55:31 -0500<br>
To: jlloyd<br>
From: Mark Kowaleski &lt;mkowales@hq.nasa.gov&gt;<br>
Subject: STS-107 OSMA data<br>
Cc: prutledge,bbihner,fchandle@mail.hq.nasa.gov<br>
<br>
Jim &amp; Pete,<br>
<br>
I gathered together all the STS-107 OSMA-related data that OSMA touched, saw, or
responded to.<br>
<br>
Jim:  As requested, I will hand it over to you when I see you in person.<br>
<br>
I asked Bill to provide copies of any email and launch day notes that he may
have.<br>
I'll add those to the binder when I get them.<br>
<br>
Here is the outline of the two-voluem data set:<br>
<br>
Mark<br>
<br>
<div align="center">
STS-107 OSMA mission related data products<br>
<br>
</div>
<font face="Times New Roman, Times"
size=4>1)<x-tab>      </x-tab></font>Volume I, STS-107
OSMA Data
<dl><font face="Times New Roman, Times" size=4>
<dd>a)<x-tab>      </x-tab></font>Safety &amp; Mission
Assurance Report
<dl><font face="Times New Roman, Times" size=4>
<dd>i)<x-tab>      </x-tab></font>FRR version
</dl>
</dl><br>
<font face="Times New Roman, Times"
size=4>ii)<x-tab>     </x-tab></font>PMMT version
<dl><font face="Times New Roman, Times" size=4>
<dd>b)<x-tab>      </x-tab></font>Pre-flight
Assessment Reviews (PFA)
<dl><font face="Times New Roman, Times" size=4>
<dd>i)<x-tab>      </x-tab></font>RSRM-88 PFA
</dl>
</dl><br>
<font face="Times New Roman, Times"
size=4>ii)<x-tab>     </x-tab></font>SRB - BI116 PFA
(SR&amp;QA Review)<br>
<font face="Times New Roman, Times"
size=4>iii)<x-tab>    </x-tab></font>SSME PFA<br>
<font face="Times New Roman, Times"
size=4>iv)<x-tab>     </x-tab></font>ET-93 PFA
```

```
<dl><font face="Times New Roman, Times" size=4>
<dd>c)<x-tab>      </x-tab></font>Preflight Assessment
Review
<dl><font face="Times New Roman, Times" size=4>
<dd>i)<x-tab>      </x-tab></font>PAR-5 Minutes 
Topics (PAR Planning Notes from JSC)<font face="Times New Roman, Times" size=4>
<dd>(1)<x-tab>     </x-tab></font>Jan 10, 2003
</dl>
</dl><br>
<font face="Times New Roman, Times"
size=4>(2)<x-tab>     </x-tab></font>Jan 17, 2003<br>
<font face="Times New Roman, Times"
size=4>(3)<x-tab>     </x-tab></font>Jan 24, 2003
<dl>
<dl><font face="Times New Roman, Times" size=4>
<dd>ii)<x-tab>     </x-tab></font>Pre-Flight Assessment
Review
</dl>
</dl><br>
<font face="Times New Roman, Times"
size=4>iii)<x-tab>    </x-tab></font>PFA - FRR Tag-up<br>
<font face="Times New Roman, Times"
size=4>iv)<x-tab>     </x-tab></font>PFA -  PMMT
Tag-up<br>
<font face="Times New Roman, Times"
size=4>v)<x-tab>      </x-tab></font>Range Safety Data
Package<br>
<br>
<font face="Times New Roman, Times"
size=4>2)<x-tab>      </x-tab></font>Volume II,
STS-107 Email Exchange
<dl><font face="Times New Roman, Times" size=4>
<dd>a)<x-tab>      </x-tab></font>Email Exchange
<dl><font face="Times New Roman, Times" size=4>
<dd>i)<x-tab>      </x-tab></font>Email MER daily
status reports
</dl>
</dl><br>
<font face="Times New Roman, Times"
size=4>ii)<x-tab>     </x-tab></font>Email OSF status
messages to Code Q<br>
<font face="Times New Roman, Times"
size=4>iii)<x-tab>    </x-tab></font>Email SR&amp;amp;QA Reports<br>
<font face="Times New Roman, Times"
size=4>iv)<x-tab>     </x-tab></font>Email Inter-office
(OSMA)
<dl><font face="Times New Roman, Times" size=4>
<dd>b)<x-tab>      </x-tab></font>Launch Operations
Data (on-console)
<dl><font face="Times New Roman, Times" size=4>
<dd>i)<x-tab>      </x-tab></font>Interim Problem
Reports (Pre-tanking report)
</dl>
</dl><br>
<font face="Times New Roman, Times"
size=4>ii)<x-tab>     </x-tab></font>ET Tanking Meeting SRB
Special Topic<br>
<font face="Times New Roman, Times"
size=4>iii)<x-tab>    </x-tab></font>PMMT (L-1) and Launch Day
Notes (Kowaleski)<br>
PMMT (L-1) and Launch Day Notes (Bihner)</blockquote></html>
<html>
<br>
```

<blockquote type=cite cite>Date: Tue, 04 Feb 2003 11:33:00 -0500
To: SMA_Team_107
From: Mark Kowaleski <mkowales@hq.nasa.gov>
Subject: ET Foam loss assessment
Cc: snewman,prichard@hq.nasa.gov

Hi Folks,

Here is the first round of questions:

1) Would someone please forward me the analysis that we did for the ET foam loss hit risk to Columbia's TPS?

I caught a glimpse of the package (about 20 pages) in Code M (Code M says they never saw it prior to this past weekend), but we never got it here in Code Q. This was to be presented at the STS-107 PAR, but we never got to it because of ITAR.

2) During STS-113, we discussed risk of bipod foam loss during STS-112. At that time we also mentioned bipod foam loss on STS-32 and ST-50.

Would you please send me any analysis you may have that was done for STS-112 (priority) and for STS-32 and 50.

3) I understand that the ET O2 feedline for STS-107 uses a unique foam (BX-265 ???).

4) I need an education on the different type of foams (if any) that are used for bipod and other close-out items when preparing the tank.
How have these foams types and their application process changed over time?

Many thanks for your support. More questions will follow.

I don't mind multiple submissions, we'll sort it out on this end.

Mark </blockquote></html>
<html>
Tom, sorry, I forgot to add you to this. Maybe you have some thoughts/data on these questions?

<blockquote type=cite cite>Date: Tue, 04 Feb 2003 11:33:00 -0500
To: SMA_Team_107
From: Mark Kowaleski <mkowales@hq.nasa.gov>
Subject: ET Foam loss assessment
Cc: snewman,prichard@hq.nasa.gov

Hi Folks,

Here is the first round of questions:

1) Would someone please forward me the analysis that we did for the ET foam loss hit risk to Columbia's TPS?

I caught a glimpse of the package (about 20 pages) in Code M (Code M says they never saw it prior to this past weekend), but we never got it here in Code Q. This was to be presented at the STS-107 PAR, but we never got to it because of ITAR.

2) During STS-113, we discussed risk of bipod foam loss during STS-112. At that time we also mentioned bipod foam loss on STS-32 and ST-50.

Would you please send me any analysis you may have that was done for STS-112 (priority) and for STS-32 and 50.

3) I understand that the ET O2 feedline for STS-107 uses a unique foam (BX-265

???).

4) I need an education on the different type of foams (if any) that are used for bipod and other close-out items when preparing the tank.
How have these foams types and their application process changed over time?

Many thanks for your support. More questions will follow.

I don't mind multiple submissions, we'll sort it out on this end.

Mark </blockquote></html>
<html>
So, I just learned that QS can't access QE files on the U-drive. Kind of puts a crimp in the One NASA concept...

Anyway, I moved the file to Q_All under SLEP.

Mark

<blockquote type=cite cite>Date: Tue, 04 Feb 2003 11:31:55 -0500
To: Code_Q_All
From: Mark Kowaleski <mkowales@hq.nasa.gov>
Subject: OSMA SLEP presentation

Hi Folks,

At the SMA telecon yesterday, we talked about crew escape, etc.

If you would like to see the SLEP presentation I gave (for Bryan) at the SLEP Kick-off Meeting, it is on the U-Drive.

Go to Qall / QE / Shuttle Backup / SLEP. It is called: Code Q_SLEP_OC mods.ppt

Mark </blockquote></html>
<x-html>
<blockquote type=cite> From: "ERMINGER, MARK D. (JSC-NC) (NASA)" <mark.d.erminger@nasa.gov>
To: "'Mark Kowaleski'" <mkowales@hq.nasa.gov>
Subject: RE: ET Foam loss assessment
Date: Tue, 4 Feb 2003 10:57:46 -0600
X-Mailer: Internet Mail Service (5.5.2653.19)

This was to be presented at the STS-107 PAR, but we never got to
it because of ITAR.

Not true.

We did not present because they were not ready. They needed to get
post-landing data

-----Original Message-----
From: Mark Kowaleski [mailto:mkowales@hq.nasa.gov]
Sent: Tuesday, February 04, 2003 10:33 AM
To: HARRIS, WILLIAM J. (JSC-MA) (NASA); William.Higgins-1@ksc.nasa.gov;
ERMINGER, MARK D. (JSC-NC) (NASA); Daniel.J.Mullane@msfc.nasa.gov;
adams@hq.nasa.gov; BROWNE, DAVID M. (JSC-NC) (NASA);
Allan.K.Layne@msfc.nasa.gov; Rosalyn.M.Patrick@msfc.nasa.gov;
Joseph.C.Cianciola@nasa.gov; Randall.H.Tucker@msfc.nasa.gov; JOHNSON, M. S.
(SCOTT) (JSC-NC) (NASA)

Cc: snewman@hq.nasa.gov; prichard@hq.nasa.gov
Subject: ET Foam loss assessment

Hi Folks,

Here is the first round of questions:

1) Would someone please forward me the analysis that we did for the ET foam

loss hit risk to Columbia's TPS?

I caught a glimpse of the package (about 20 pages) in Code M (Code M says

they never saw it prior to this past weekend), but we never got it here in

Code Q. This was to be presented at the STS-107 PAR, but we never got to

it because of ITAR.

2) During STS-113, we discussed risk of bipod foam loss during STS-112.
At
that time we also mentioned bipod foam loss on STS-32 and ST-50.

Would you please send me any analysis you may have that was done for
STS-112 (priority) and for STS-32 and 50.

3) I understand that the ET O2 feedline for STS-107 uses a unique foam
(BX-265 ???).

4) I need an education on the different type of foams (if any) that are
used for bipod and other close-out items when preparing the tank.
How have these foams types and their application process changed over
time?

Many thanks for your support. More questions will follow.

I don't mind multiple submissions, we'll sort it out on this end.

Mark
</blockquote></x-html>
<html>
Keith, that is fine. Thanks.

Mark

At 11:13 AM 2/4/2003 -0600, you wrote:

<blockquote type=cite cite>Mr. Kowaleski I have been advised that all
requests for data be submitted through Alex Adams or Angela Walker. Sorry for
any inconvenience this may cause.

Keith Layne

-----Original Message-----
From: Mark Kowaleski [<a
href="mailto:mkowales@hq.nasa.gov">mailto:mkowales@hq.nasa.gov]
Sent: Tuesday, February 04, 2003 10:33 AM
To: william.j.harris1@jsc.nasa.gov;
William.Higgins-1@ksc.nasa.gov;
mark.d.erminger1@jsc.nasa.gov; Daniel.J.Mullane@msfc.nasa.gov;

adams@hq.nasa.gov; david.m.browne1@jsc.nasa.gov;
Allan.K.Layne@msfc.nasa.gov; Rosalyn.M.Patrick@msfc.nasa.gov;