Mark Kowaleski, 07:57 AM 2/14/2003 -0500, Fwd: HCAT Action #140

X-Sender: mkowales@mail.hq.nasa.gov
X-Mailer: QUALCOMM Windows Eudora Version 4.3.2
Date: Fri, 14 Feb 2003 07:57:14 -0500
To: prichardson@hq.nasa.gov
From: Mark Kowaleski <mkowales@hq.nasa.gov>
Subject: Fwd: HCAT Action #140
Cc: prutledg@mail.hq.nasa.gov, jlloyd@mail.hq.nasa.gov,
wbihner@mail.hq.nasa.gov

Pam,

This is an action that I got from Michael Greenfield. I worked it jointly with HCAT. We might want to file it in our database.

It gives a top-level snapshot of what major mods were done to the wing, MLG door, and RCC on Columbia during OMM in Palmdale.

Mark

X-Sender: jtinsley@mail.hq.nasa.gov
X-Mailer: QUALCOMM Windows Eudora Version 4.3.2
Date: Wed, 12 Feb 2003 15:45:36 -0500
To: hCAT@hq.nasa.gov
From: John Tinsley <jtinsley@hq.nasa.gov>
Subject: HCAT Action #140
Cc: mkowales@hq.nasa.gov


Doc151.doc

Vernon W Wessel, 05:01 PM 2/5/2003 -0500, Bryan's Questions

X-Info: ODIN / NASA Glenn Research Center
X-Sender: rqwess@popserve.grc.nasa.gov
X-Mailer: QUALCOMM Windows Eudora Version 5.1.1
Date: Wed, 05 Feb 2003 17:01:14 -0500
To: prichard@hq.nasa.gov
From: Vernon W Wessel <Vernon.W.Wessel@nasa.gov>
Subject: Bryan's Questions
Cc: prutledg@hq.nasa.gov

Hello Pam,

Attached is the GRC submittal of questions. I only cleaned up the sentence structure so should be representative of what he wanted.

Thank You,
Bill

Vernon W.(Bill) Wessel
Director, Safety and Assurance Technologies Directorate

National Aeronautics and Space Administration
John H. Glenn Research Center
Mail Stop: 3-6
21000 Brookpark Road
Cleveland, Ohio 44135

Phone: (216) 433-2350
FAX: (216) 977-7005
E-Mail: Vernon.W.Wessel@grc.nasa.gov

Mission Success Starts With Safety

 Bryan's Questions.doc

Garrido-1, Humberto (Bert), 04:29 PM 2/6/2003 -0500, KSC STS-107 Questions-Feb 6

From: "Garrido-1, Humberto (Bert)" <Humberto.T.Garrido@nasa.gov>
To: "'prichard@hq.nasa.gov'" <prichard@hq.nasa.gov>
Cc: "Lebron-1, Edmundo (Eddie)" <Edmundo.J.Lebron@nasa.gov>,
Toledo-1 Oscar <Oscar.Toledo-1@nasa.gov>,
"'prutledg@hq.nasa.gov'" <prutledg@hq.nasa.gov>,
"'jlloyd@hq.nasa.gov'" <jlloyd@hq.nasa.gov>
Subject: KSC STS-107 Questions-Feb 6
Date: Thu, 6 Feb 2003 16:29:37 -0500
X-Mailer: Internet Mail Service (5.5.2656.59)

<<questions020603.doc>>

Pam-

Here are some more unedited questions from KSC. Some of these have lots of details, which perhaps can be useful to you.

We will submit more to you as we get them

See ya.

Bert


questions020603.doc

prichard@hq.nasa.gov, 03:51 PM 2/4/2003 -0500, Fwd: Support to Bryan

To: prichard@hq.nasa.gov
From: Pete Rutledge <prutledg@hq.nasa.gov>
Subject: Fwd: Support to Bryan
Cc:
Bcc:
Attached:

Another question/issue for Bryan.

Pete
X-Sender: jcastell@mail.hq.nasa.gov
X-Mailer: QUALCOMM Windows Eudora Version 4.3.2
Date: Tue, 04 Feb 2003 15:31:32 -0500
To: Pete Rutledge <prutledg@hq.nasa.gov>
From: John P Castellano <jcastell@hq.nasa.gov>
Subject: Support to Bryan
Cc: snewman@hq.nasa.gov

In status briefings Ron D. mentioned that during re-entry the Orbiter Flight Control System saw excursions that exceeded the family of previous experience but within the system margins utilizing elevon and RCS attitude control..The cause of these excursions was attributed to drag on the left wing..possibly due to missing tiles. Additionally it has been reported that the temperature rises measured at various locations (wheel well , left fuselage etc.) were in the neighborhood of 40-50 F not high enough to represent a structural problem.. Previous flights have come home with some very significant tile damage (dings) as well as some missing without causing a problem. Undoubtedly this previous experience is a factor in the analysis and belief that this mission (and potential damage) did not represent a threat to flight safety..

If we postulate that elevated temperatures (up to the point of loss of vehicle) be ruled out as the factor (thus precluding a structural failure) and that the drag on the left side was due entirely to the progressive loss of tiles (unzippering) then at some point in this unzippering the Flight control system authority to safely maintain attitude and control will be become insufficient...

Perhaps some of the Flight Control folks are already looking into running simulations to determine tile loss vs margins since it seems intuitive that at some point in tile loss that the attitude control system will be overwhelmed..and unable to compensate.

Mark Kowaleski, 08:27 AM 2/20/2003 -0500, Fwd: Re: missing Mutli-Tile Loss Thermal Analysis?

X-Sender: mkowales@mail.hq.nasa.gov
X-Mailer: QUALCOMM Windows Eudora Version 4.3.2
Date: Thu, 20 Feb 2003 08:27:01 -0500
To: prutledg@mail.hq.nasa.gov, pphillip@mail.hq.nasa.gov
From: Mark Kowaleski <mkowales@hq.nasa.gov>
Subject: Fwd: Re: missing Mutli-Tile Loss Thermal Analysis?

Looks like Bryan is not too concerned about the thermal analysis that I have been trying to get. Still no response from HCAT - I asked for this since Feb 2nd. I remain deeply concerned that JSC and HQ SMA cannot get a copy of this basic data related to this accident.

I am no longer going to pursue it.

Mark

From: BOConnor@hq.nasa.gov
Subject: Re: missing Mutli-Tile Loss Thermal Analysis?
Date: Sat, 15 Feb 2003 07:33:52 -0500
To: mkowales@hq.nasa.gov
X-MIMETrack: Serialize by Router on bes1/HQ/NASA(Release 5.0.11 |July 24, 2002) at 02/15/2003
07:33:53 AM

M,
I am strictly in blackberry (no attachment capability) mode this week. But
I will view tonight when I get home.
By the way, Linda Ham thinks you and Erminger are rying to get daa for me.
No need for me...I an get all I need through the CAIB task force route. I
you need something for some other reason, rnt through the HCAT.
Best,
O'C

Date: Fri, 14 Feb 2003 08:48:43 -0500
To: boconnor,prutledge,jlloyd
From: Mark Kowaleski <mkowales@hq.nasa.gov>
Subject: missing Mutli-Tile Loss Thermal Analysis?
Cc: pphillips,merminger

Bryan,

I'm not sure if you have seen these yet? Here is the Project's analysis of foam transport mechanisms and TPS damage assessment.

I am still trying to get my hands on the "Mult-Tile Loss Thermal Analysis," but keep getting stone-walled by JSC and HCAT. Have you, by chance, seen the thermal analysis already? It is referenced at the end of the package as being necessary to validate the conclusion of no safety-of-flight issue on the last page of Orbiter charts. A few of the charts show some serious damage potential crossing the MLG Door/Orbiter interface at multiple locations around the perimiter of the MLG Door.

Specifically, the thermal analysis missing (chart on page 10 of Orbiter TPS damage assessment) concerns larger wing damage areas and MLG Door damage.

I tried getting the analysis from Orbiter Project, Integration Office, Linda Ham directly, and HCAT, but no one seems to want to answer the mail. SMA/Erminger asked the Shuttle Project (on my behalf) a few days after the mishap for the analysis but was told that he needed to go through HCAT.

FYI, these charts showed up for the first time at HQ on Feb 1st via FAX in the HCAT. I noticed them laying on a table.

Mark Kowaleski, 08:27 AM 2/20/2003 -0500, Fwd: Re: missing Mutli-Tile Loss Thermal Analysis?

I'm probably being paranoid and it is likely that the CAIB has already seen the data??? But I am concerned about my inability to get my hands on the rest of the thermal analysis and I'm even more concerned that SMA/Erminger was told that you needed to talk to Dittemore directly to get that specific information.

Mark

Date: Mon, 10 Feb 2003 11:38:46 -0500
To: hcat@hq.nasa.gov
From: Mark Kowaleski <mkowales@hq.nasa.gov>
Subject: Re: Fwd: stress/thermal analysis request
Cc: boconnor,jlloyd,prutledge,merminger

Bill (HCAT),

OK, no problem. This is my request to the HCAT for this information.

We need a copy of the STS-107 TPS Muli-Tile Loss Thermal Analysis data package described below.

Please provide it when it becomes available.

Thanks,

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

At 10:23 AM 2/10/2003 -0500, you wrote:
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

Mark Kowaleski, 08:27 AM 2/20/2003 -0500, Fwd: Re: missing Mutli-Tile Loss Thermal Analysis?

To: boconnor
From: Mark Kowaleski <mkowales@hq.nasa.gov>
Subject: Fwd: STS-107 Ascent Debris Assessments

Bryan,

We have pursued multiple channels to obtain the ET debris and Orbiter TPS damage assessment.

As you can see, we have reached some brick walls.

Mark Erminger requested the data on my behalf but was turned down by Lambert Austin (see message below).

I called Lambert's office but he never called back.

I contacted Code M to ask for the data and I was told that the data is "restricted access."

I finally got a copy by strong-arming someone in Code M but was told "not to divulge my source."

The thermal

Mark

From: "ERMINGER, MARK D. (JSC-NC) (NASA)" <mark.d.erminger@nasa.gov>
To: "H - Kowaleski Mark (E-mail)" <mkowales@mail.hq.nasa.gov>
Subject: STS-107 Ascent Debris Assessments
Date: Wed, 5 Feb 2003 08:28:52 -0600
X-Mailer: Internet Mail Service (5.5.2653.19)

I spoke to Lambert Austin and he said that Bryan should request this information from Ron Dittemore. Systems Integration did an analysis and so did Orbiter.

X-Sender: jlloyd@mail.hq.nasa.gov
X-Mailer: QUALCOMM Windows Eudora Version 4.3.2
Date: Wed, 05 Feb 2003 19:27:18 -0500
To: michael Greenfield <michael.greenfield@hq.nasa.gov>
From: James Lloyd <jlloyd@hq.nasa.gov>
Subject: Fwd: Crew escape follow-up

Michael,

I am a little concerned that the Code Q resource, in this case was used to answer a Program question and the program is passing this along without their endorsement. It seems like the ground-rule being used is that if the question came through Code Q then Code Q gets to answer it! I think these are questions that need to be answered by Code M. I reviewed the answer and suggested some changes based on what we know about these studies. I need to be more careful how our input is being used. The worst thing that can happen now is for some program expert that hasn't been consulted to question our input. I thought these answers were being vetted! We don't have practicing aero- and fluid-dynamicists in our ranks in Code Q. Why aren't these questions being referred to the experts? I thought the HCAT was supposed to be doing dispatch.

Maybe too cautious,

X-Sender: pphillip@mail.hq.nasa.gov
X-Mailer: QUALCOMM Windows Eudora Version 4.3.2
Date: Wed, 05 Feb 2003 17:31:47 -0500
To: hcat@hq.nasa.gov
From: Pepper Phillips <pphillip@hq.nasa.gov>
Subject: Crew escape follow-up
Cc: Dr Peter Rutledge <prutledg@mail.hq.nasa.gov>,
James D Lloyd <jlloyd@mail.hq.nasa.gov>

Rebekah,

Attached is the Code Q response to Dr. Greenfield's crew escape follow-on questions.


Viability of crew escape system1.doc

Jim

Pepper Phillips, 05:31 PM 2/5/2003 -0500, Crew escape follow-up

X-Sender: pphillip@mail.hq.nasa.gov
X-Mailer: QUALCOMM Windows Eudora Version 4.3.2
Date: Wed, 05 Feb 2003 17:31:47 -0500
To: hcat@hq.nasa.gov
From: Pepper Phillips <pphillip@hq.nasa.gov>
Subject: Crew escape follow-up
Cc: Dr Peter Rutledge <prutledg@mail.hq.nasa.gov>,
James D Lloyd <jlloyd@mail.hq.nasa.gov>

Rebekah,

Attached is the Code Q response to Dr. Greenfield's crew escape follow-on questions.


Viability of crew escape system.doc

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.

To: Richardson_Pamela
From: Pete Rutledge <prutledg@hq.nasa.gov>
Subject: Fwd: Re: Question/issue for Bryan
Cc:
Bcc:
Attached:

X-Sender: fchandle@mail.hq.nasa.gov
X-Mailer: QUALCOMM Windows Eudora Version 4.3.2
Date: Tue, 04 Feb 2003 08:11:29 -0500
To: Pete Rutledge <prutledge1@comcast.net>
From: Faith Chandler <fchandle@hq.nasa.gov>
Subject: Re: Question/issue for Bryan
Cc: prutledg@hq.nasa.gov

Pam,

Per Pete's request:
Here are some quick thoughts.

The foam insulation could have produced damage for a number of reasons. One possibility is that the foam was denser than originally believed, consequently making the analysis inaccurate.

The materials could have been denser/harder than originally believed due to some of the following:
a) Problems with the quality/age of the material used (perhaps the materials used to produce the foam insulation were not
the type, chemical composition, or quality that were required).
b) Changes/errors in the manufacturing process.
c) Problems with the quality, age, or type of adhesive materials used (if any).
d) Changes/errors in applying the foam.
e) Changes/errors in preparing the ET surface (Perhaps paint or other came off the ET when the foam came off during
launch).
f) Debris (e.g., FOD or other material) intentionally or unintentionally placed under the foam.
g) Changes/errors in final preparation of the outer foam surface after application.
h) Ice build up on the foam.
i) Another possibility is that other debris was flying in the same air stream as the foam (perhaps behind it) and this (which
may not have been visible to the camera because the foam blocked the view) may have caused significant damage.

At 08:30 PM 2/3/2003 -0500, you wrote:
Faith,

Please write down and send to Pam your idea about ET foam insulation possibly being harder/denser than normal, allowing it to create more damage than expected.

Thanks,

Pete

~~~~~~~~~~~~~~~~~~~~~~~~

Faith Chandler

NASA Headquarters
Office of Safety and Mission Assurance
~~~~~~~~~~~~~~~~~~~~~~~~

- Code Q Rm 5x40
300 E Street, S.W
Washington, D.C 20546

202-358-0411
202-358-2778 (fax)

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~~~~~~~~~~~~~~~~~~~~~~~~~~

Mark Kowaleski, 10:40 AM 2/12/2003 -0500, Fwd: 02/11/03 MRT -- OVEWG TIMELINE

X-Authentication-Warning: spinoza.public.hq.nasa.gov: majordom set sender to owner-code-q using -f
X-Sender: mkowales@mail.hq.nasa.gov
X-Mailer: QUALCOMM Windows Eudora Version 4.3.2
Date: Wed, 12 Feb 2003 10:40:27 -0500
To: code-q@lists.hq.nasa.gov, bwatkins@mail.hq.nasa.gov,
whill@mail.hq.nasa.gov, dwhitehe@mail.hq.nasa.gov
From: Mark Kowaleski <mkowales@hq.nasa.gov>
Subject: Fwd: 02/11/03 MRT -- OVEWG TIMELINE
Sender: owner-code-q@lists.hq.nasa.gov

FYI...

From: "ERMINGER, MARK D. (JSC-NC) (NASA)" <mark.d.erminger@nasa.gov>
To: "H - Kowaleski Mark (E-mail)" <mkowales@mail.hq.nasa.gov>,
"H - Bihner Bill (E-mail)" <wbihner@mail.hq.nasa.gov>
Subject: 02/11/03 MRT -- OVEWG TIMELINE
Date: Tue, 11 Feb 2003 12:08:44 -0600
Importance: high
X-Message-Flag: Follow up
X-Mailer: Internet Mail Service (5.5.2653.19)

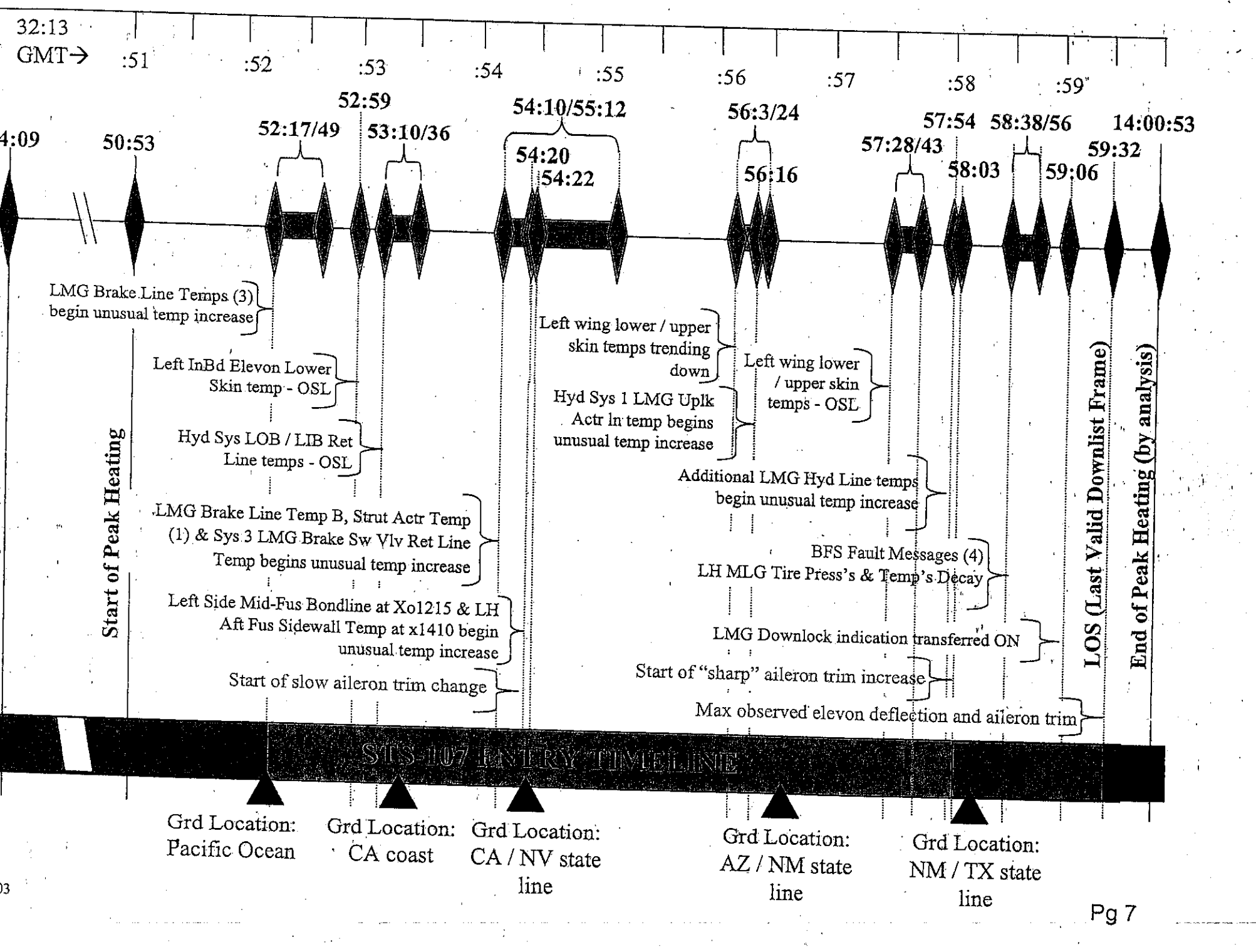
This timeline was baselined by Vehicle Engineering and presented to the MRT today.


02112003MRT_Graphic Timeline.pdf

DATA REVIEW AND TIMELINE TEAM

February 10, 2003

Don McCormack/MV


32:13
GMT→
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:58
:59
4:09
50:53
52:17/49
52:59
53:10/36
54:10/55:12
54:20
54:22
56:3/24
56:16
57:28/43
57:54
58:03
58:38/56
59:06
59:32
14:00:53
LMG Brake Line Temps (3) begin unusual temp increase
Left InBd Elevon Lower Skin temp - OSL
Hyd Sys LOB / LIB Ret Line temps - OSL
Start of Peak Heating
LMG Brake Line Temp B, Strut Actr Temp (1) & Sys 3 LMG Brake Sw Vlv Ret Line Temp begins unusual temp increase
Left Side Mid-Fus Bondline at Xo1215 & LH Aft Fus Sidewall Temp at x1410 begin unusual temp increase
Start of slow aileron trim change
Left wing lower / upper skin temps trending down
Hyd Sys 1 LMG Uplk Actr ln temp begins unusual temp increase
Left wing lower / upper skin temps - OSL
Additional LMG Hyd Line temps begin unusual temp increase
BFS Fault Messages (4)
LH MLG Tire Press's & Temp's Decay
LMG Downlock indication transferred ON
Start of "sharp" aileron trim increase
Max observed elevon deflection and aileron trim
LOS (Last Valid Downlist Frame)
End of Peak Heating (by analysis)
STS-107 ENTRY TIMELINE
Grd Location: Pacific Ocean
Grd Location: CA coast
Grd Location: CA / NV state line
Grd Location: AZ / NM state line
Grd Location: NM / TX state line

Pamela Richardson, 02:32 PM 2/11/2003 -0500, Analysis of Columbia sensor loss on left wing

X-Sender: prichard@mail.hq.nasa.gov
X-Mailer: QUALCOMM Windows Eudora Version 4.3.2
Date: Tue, 11 Feb 2003 14:32:55 -0500
To: boconnor@mail.hq.nasa.gov
From: Pamela Richardson <prichard@hq.nasa.gov>
Subject: Analysis of Columbia sensor loss on left wing
Cc: Jim.Lloyd@hq.nasa.gov, Pete.Rutledge@hq.nasa.gov

12/11/03 Thoughts to Bryan O'Connor on sensor anomalous behavior from Pam Richardson

Bryan

This is a bit unusual in the way we have been communicating these past days, but the situation is different enough that I am providing a separate e-mail. Enclosed with this e-mail is a powerpoint slide with sensor failure information on Columbia. The original set of information is now on the HQ website:

http://www.nasa.gov/columbia/COL_sensor_wire_030207.pdf

I have added some color to the chart to provide some interesting observations. On this chart, all events are listed in numerical order as time progressed. I have added blue to the sensors that went "off nominal" and red to the sensors that went "offline" from 8:52 AM EST to 9:00 AM EST. The "P" stands for a pressure sensor and the "T" stands for a temperature sensor. The 40/J105 circuit box (highlighted in orange) may have had a failure which is why all sensors connected to it went offline (highlighted also in orange 4, 5, 6, 7, 8, 15, 16). Sensors highlighted in green are associated with circuit box 50/P47 and are good sensors (23, 24, 25, 26). It is not clear from the drawing what circuit boxes are associated with the other sensors (14, 18, 19, 20, 21, 22 and 1, 2, 3, 9, 10, 11, 12, 13, 17).

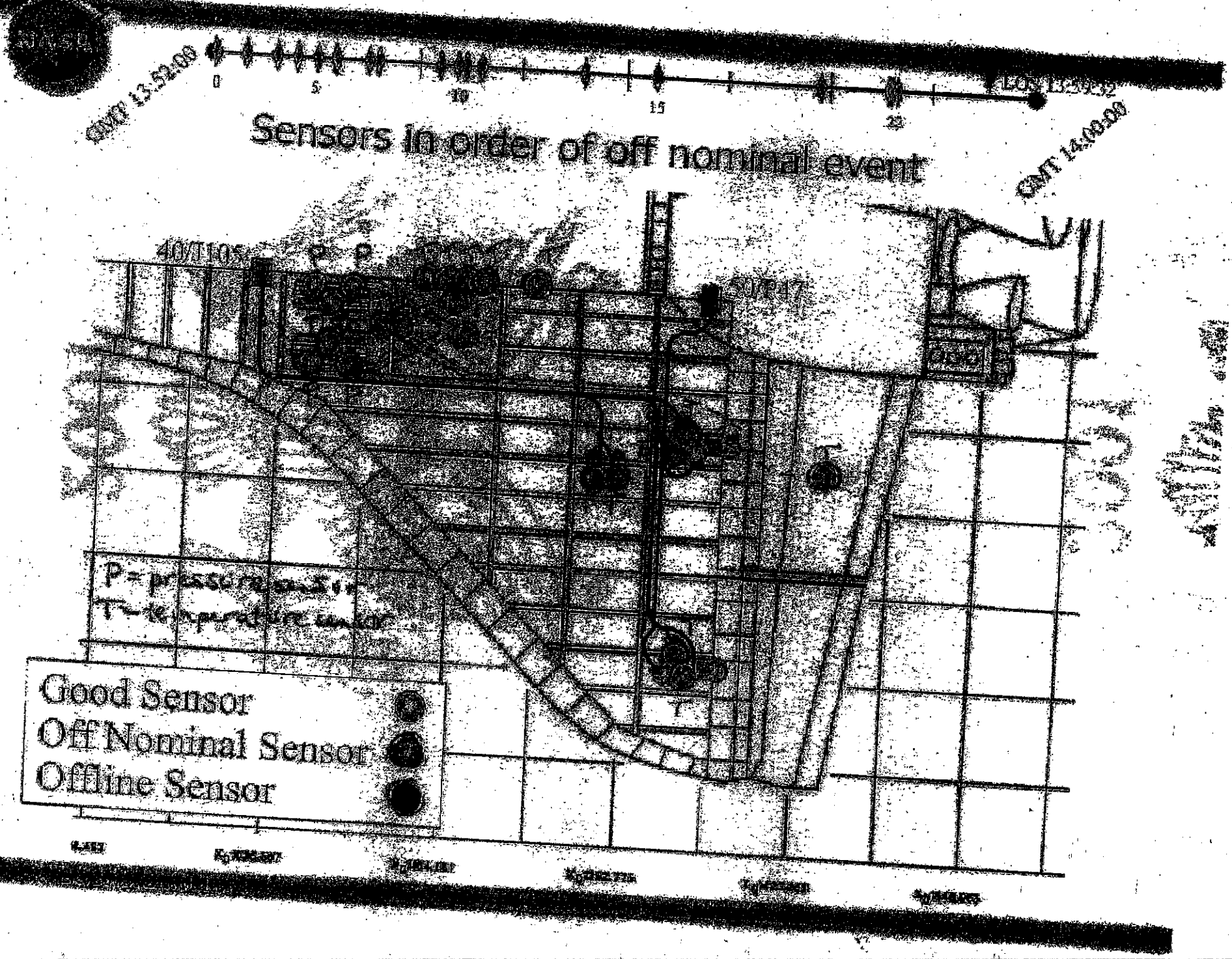
A reasonable conclusion that one might have from this color analysis is that something initiated inside the left wheel well.

Hope this is helpful, Pam

 sensor3.ppt

Pamela F. Richardson
Aerospace Technology Mission Assurance Manager
Enterprise Safety and Mission Assurance Division, Code QE
Office of Safety and Mission Assurance, NASA Headquarters
300 E. Street, S. W., Washington, DC 20546
phone: 202-358-4631, fax: 202-358-2778

"The meek can *have* the Earth. The rest of us are going to the stars." --- Robert Heinlein
"We have to learn to manage information and its flow. If we don't, it will all end up in turbulence." --- RADM Grace Hopper


Sensors in order of off nominal event
GMT 13:52:00
GMT 14:40:00
0
5
10
15
20
40/T10s
40/T17
P = pressure sensor
T = temperature sensor
Good Sensor
Off Nominal Sensor
Offline Sensor

Richard Patrican, 09:03 AM 2/10/2003 -0500, Space Shuttle PRA response

X-Sender: rpatrica@mail.hq.nasa.gov
X-Mailer: QUALCOMM Windows Eudora Version 4.3.2
Date: Mon, 10 Feb 2003 09:03:20 -0500
To: HCAT@hq.nasa.gov, whill@hq.nasa.gov
From: Richard Patrican <rpatrica@hq.nasa.gov>
Subject: Space Shuttle PRA response
Cc: mstamate@hq.nasa.gov, prutledg@hq.nasa.gov, prichard@hq.nasa.gov, jlloyd@hq.nasa.gov, mkowales@hq.nasa.gov

Per the HCAT's request, here is the response to questions concerning the Space Shuttle PRA.


Kostelnik Action 221.doc

Rich Patrican
Manager, International Space Station
Office of Safety and Mission Assurance
Headquarters Office 5X35
Phone: 202-358-0569
Fax: 202-358-2772

A Report on the Status of the Shuttle Probabilistic Risk Assessment (PRA) Model for the Contingency Action Team – February 5, 2003

(For questions, please contact Jan Railsback, 281-483-7265)

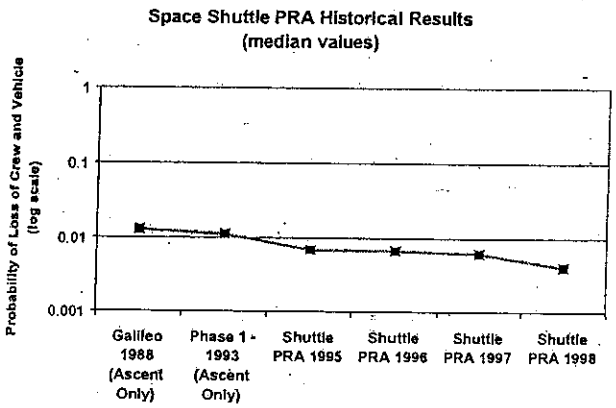
1) **An overview of the status of the Shuttle PRA model as of 1/31/2003**

Element	Status	Future Work
SSME, RSRM, SRB, ET	Preliminary Models and Data Complete	Acceptance of Models and Data by respective Project Offices by mid-March
MMOD	Preliminary Models and Data Complete	Acceptance of Models and Data by Vehicle Engineering Control Board (VECB)—Early March
Orbiter	Preliminary Models Complete; Data 75% Complete	Acceptance of Models and Data by VECB—Early March

a) Future Shuttle PRA Modeling Reviews and Reports
   i) PRA documentation to be completed, June 2003
   ii) Independent Peer Review to be completed, October 2003
   iii) Configuration Management activities to be completed, January 2004

b) Abort Modeling Activities - The Dynamic Abort Risk Evaluation (DARE) method provides Probabilistic Abort Modeling
   i) Independent Peer Review was conducted January 16-17, 2003 of DARE
   ii) Draft Results Report due end of February, 2003
   iii) Final Results Report due end of March, 2003

2) **A discussion of the overall pre-accident values, ascent and mission, preliminary values** – The Shuttle PRA model results have changed over the past several years of iterations, but the median results have consistently converged to between ~1/100 to ~1/250 for a loss of crew and vehicle for an entire mission. The differences in results are due to the amount of available data, the omission of systems from the analysis due to lack of analysis resources, and the addition of data and information from subsequent Shuttle flights. The present model (Shuttle PRA 2003) is the most comprehensive model to date, but is not yet ready for release. Previous Shuttle PRA models are not sanctioned results by the Shuttle program office. The SPRA 2003 will be the first model carrying the Shuttle program office approval.



3) **A prediction about how the model may change since the accident** – Adding in the failure mode from the Columbia accident may change the final results but how significantly it changes depends on the investigation results. The SPRA 2003 model is currently being used to help the program with possible accident scenarios. Other than making a distinction between sources of debris hits on the Orbiter, there is presently no specific change in modeling philosophy planned due to the Columbia accident. Upon completion of the current initial development effort, future Shuttle PRA activities include three major work efforts:

a) Maintenance and control of the model
b) Applications and studies using the model, and
c) Expansion of the model to include ground processing, software, and additional human errors

JOHNSON, GARY W. (JSC-NA) (NASA), 12:53 PM 2/8/2003 -0600, FW: 2-6-03 SMA noon teleconfer

From: "JOHNSON, GARY W. (JSC-NA) (NASA)" <gary.w.johnson@nasa.gov>
To: "'Pete Rutledge'" <prutledg@hq.nasa.gov>,
"'Lloyd, James(Code Q)'"
<jlloyd@hq.nasa.gov>,
"'Newman, Steve (CodeQ)'" <snewman@hq.nasa.gov>
Cc: "'Greenfield, Michael'" <mgreenfi@mail.hq.nasa.gov>,
"MARSHALL, YOLANDA Y. (JSC-NA) (NASA)" <yolanda.y.marshall@nasa.gov>,
"NAKAMURA, STACEY T. (JSC-NS) (NASA)" <stacey.t.nakamura@nasa.gov>,
"HOLSOMBACK, JERRY B. (JSC-OE) (NASA)" <jerry.b.holsomback@nasa.gov>,
"ABBEY, JOYCE B. (JSC-NA) (SAIC)" <joyce.b.abbey1@jsc.nasa.gov>,
"TAYLOR, SHARON J. (JSC-NC) (SAIC)" <sharon.j.taylor1@jsc.nasa.gov>,
"THELEN, DAVID F. (JSC-NT) (NASA)" <david.f.thelen@nasa.gov>,
"HIMEL, MALCOLM J. (JSC-NX) (NASA)" <malcolm.j.himel@nasa.gov>,
"CULBERTSON, FRANK L., JR (JSC-NA) (SAIC)"
<frank.l.culbertson1@jsc.nasa.gov>,
"ERMINGER, MARK D. (JSC-NC) (NASA)"
<mark.d.erminger@nasa.gov>,
"SEYL, SCOTT A. (JSC-NE) (NASA)"
<scott.a.seyl@nasa.gov>,
"SHAW, LARRY C. (JSC-NX) (NASA)"
<larry.c.shaw@nasa.gov>,
"'Wessel, Bill(GRC)'"
<Vernon.W.Wessel@grc.nasa.gov>,
"'Dollberg, John(KSC)'"
<John.Dollberg-1@ksc.nasa.gov>,
"'Doty, Laura(AMES)'"
<Laura.W.Doty@nasa.gov>,
"'Denoon, Wentworth(Goddard)'"
<Wentworth.O.Denoon@nasa.gov>,
"'Garrido, H.T.(Bert)KSC'"
<Humberto.T.Garrido@nasa.gov>,
"'Phillips, Alan(Langley)'"
<Alan.H.Phillips@nasa.gov>,
"'Goodson, Amanda(MSFC S&MA)'"
<Amanda.Goodson@msfc.nas.gov>,
"'Stealey, John(Stennis)'"
<John.E.Stealey@nasa.gov>
Subject: FW: 2-6-03 SMA noon teleconference
Date: Sat, 8 Feb 2003 12:53:09 -0600
X-Mailer: Internet Mail Service (5.5.2653.19)

Pete, Jim & Steve here are minutes for the 2/6/03 SMA telecon.
> -----Original Message-----
> <<2-6-03 S&MA noon teleconference.doc>>


2-6-03 S&MA noon teleconference.doc

Safety and Mission Assurance (S&MA)
TELECONFERENCE MEETING 12:00 PM CST
SHUTTLE COLUMBIA INVESTIGATION
MINUTES OF MEETING
FEBRUARY 6, 2003

1.0 INTRODUCTION

1.1 General: The NASA S&MA representatives from the various centers met via teleconference at 12:00 PM CST on February 6, 2003, to discuss the Shuttle Columbia investigation. Attachment 1 lists attendees.

2.0 SIGNIFICANT SAFETY DISCUSSION

2.1 Day 6, February 6, 2003 10:00 AM EST NASA Director's conference:
2.1 Dr. Greenfield: HQ/Q/Michael Greenfield provided an investigation status update, stating that NASA Administrator, Sean O'Keefe, maintains calm, positive, control overseeing the agency's interfaces with the White House, Congress, and the news media. He reiterated that the S&MA process is an integral part of the investigation. Dr. Greenfield also offered the following scheduling milestones:

- Wednesday, February 12, 2003, 9:30 AM EST: Mr. O'Keefe's incident/investigation testimony to Congress;
- Friday, February 7, 2003, 9:00 PM EST: S&MA preparatory question and answer data from the various centers are due to be compiled for posting on the Process-Based Mission Assurance (PBMA) website;
- Sunday, February 9, 2003: Meeting to prepare for Congressional testimony – S&MA questions and answers will be reviewed.

The S&MA Requirements Model is being used as a guideline for generating potential Congressional questions and answers that are more specific to the tragedy. Dr. Greenfield reminded the attendees to generate questions and answers with the caveat that lay people would be discussing them, and to avoid using excessive technical terminology.

Dr. Greenfield directed the attendees to focus on keeping the agency up and going, and to continue our exploration so that the Columbia's loss of crew would not be in vain. He offered that Mr. O'Keefe encouraged the agency to fix the accident cause and get back to flying safety again.

He stated that reports from the Challenger disaster were being reviewed to assess whether the agency regressed in its resultant Corrective Action Plan. Anticipated topics for discussion might include staffing, especially reductions, and the S&MA role in the external tank foam insulation impact analysis.

Dr. Greenfield wished the attendees well, and offered his assurance that we will get through this time, fly again, and do the science; adding that we owe that to America.

2.1.1 S&MA questions/answers: HQ/Q/Jim Lloyd offered that S&MA should be formulating postulated questions and answers that Congress might ask of Mr. O'Keefe next week. Former Reports, Testimony, and Articles (RTA), any written media, dating back to Challenger are being

used to generate the questions/answers; and, Mr. Lloyd requested feedback data for both the immediate and long term.

HQ/QE/Pete Rutledge stated that he would obtain the details regarding what should be included in the questions/answers from the point-of-contact, NASA General Counsel, appointed by Mr. O'Keefe. Dr. Rutledge sent an email to the attendance this morning regarding what NASA legal is looking for with regards to the questions. NASA General Counsel Paul Pastorek is preparing Mr. O'Keefe for his testimony. Testimony was originally scheduled for Thursday, February 13, 2003, however NASA requested that it be moved up to February 12th.

2.1.2 S&MA strategy: Dr. Rutledge offered that he presented and received concurrence with the following strategy by HQ/Q/Bryan O'Connor:

- Reviewed S&MA Requirements Model, which HQ/QS/John Lyver briefed, and expanded it to a global perspective. Areas that were likely sources of questions were highlighted. The model will be sent out to the S&MA directors later today so they may assist in covering any potential questions;
- Provided a methodical approach, accepted by Mr. O'Connor, who will extend it to Mr. O'Keefe;
- Strategy was further expanded today, with the addition of questions/answers data currently received from S&MA and Code Q, which HQ/Q/Will Harkins will compile. Questions for testimony preparation need to be sent to Dr. Rutledge as soon as possible;
- Determining data gaps from information currently gathered, with the first increment compilation expected today; Data will be sent to HW/GP/Jack Mannix about every two hours to update the PBMA website;
- Aerospace Safety Advisory Panel reports and the Lessons Learned Information System will also be reviewed for potential questions.
- Clarifying an organized method for processing information, through identifying what is needed, who needs it, and how it should be delivered.

2.1.3 Mishap Response Teleconference (MRT): JSC/NA/Frank Culbertson reported that today's MRT was still in progress; however, he provided the following summary from the first 2.5 hours.

JSC/MA2/Linda Ham reported that requests for hardware data should be made a top priority to expedite the process. She dispositioned some of the requests today.

JSC/DA8/Paul Hill offered that an analysis is being performed on the reported debris findings in the western US, using photos from a local California astronomy class as the analysis source. He stated that about half a dozen pieces were reportedly found, and they were attempting to use the location points to triangulate the data to determine the point above which Columbia would have flown when it reached an altitude of 80,000 feet. Jet Propulsion Laboratory interjected that Cal Tech was using photos to formulate trajectory data also.

2.1.4 Debris: Mr. Culbertson stated that the westernmost location of confirmed shuttle debris remained Fort Worth, Texas. He reported that an estimated 600-pound fuel pump, possible the engine power head, had been located and transported to Kennedy Space Center (KSC). Recovery teams accumulated debris in three main areas: Barksdale Air Force Base, Louisiana (36 pieces); Lufkin, Texas (> 1000 pieces); and Carswell Air Force Base, Texas (~ 30 pieces).

2.1.5 Program debrief: JSC/NA/Yolanda Marshall relayed that this morning JSC/MA/Ron Dittemore met with the Columbia Accident Investigation Board (CAIB) and provided a program debrief, introducing Ms. Ham as the MRT representative and JSC/MV/Ralph Roe as the Engineering Manager for orbiter investigation activities. The CAIB is the authority for release of all data – hardware and software. They are also producing a master schedule. She offered that today's meeting focused on data impoundment and control, as well as the release of hardware. She also reminded the group that we continue to support International Space Station (ISS) operations along with the investigation process. Ms. Marshall reiterated that Ms. Ham and Mr. Roe would allow turnaround maintenance activities related to Auxiliary Power Unit.

Mr. Culbertson stated that the MRT wants a master schedule for CAIB approval, with Ms. Marshall reiterated that the CAIB continues to determine our organization structure, who owns what data, and how the data is processed. Ms. Marshall will meet with the CAIB at 1:00 PM CST this afternoon to introduce and discuss what SR&QA does and where SR&QA is involved.

Mr. Lloyd offered that Mr. O'Connor supports the S&MA process and will support it to the CAIB.

In addition, Mr. Lloyd referred the attendees to the staffing process data mentioned yesterday by HQ/Q/Dale Moore, and requested that they send an electronic copy of the data to the respective budget contacts and obtain a paper copy through their Chief Financial Officers (CFOs). The paper copies will go through the CFOs to the center directors.

2.2 Comments from NASA centers:

2.4.1 Ames Research Center: Q/Laura Doty requested clarification regarding whether the CAIB would take a break tomorrow. She also reported receiving calls from around the state of California regarding reported debris on private property, and stated that they contacted JSC/Robert T. (Bob) Gaffney for guidance regarding the best procedure for dealing with the reported findings.

2.4.2 Glenn Research Center: 0500/V. C. (Bill) Wessel offered no additional comments.

2.4.3 Goddard: 300.0/Wentworth Denoon reported that most data from Owens Valley and Palinas were transmitted to JSC.

2.4.4 JSC: NA/Gary Johnson reported that JSC disseminated information regarding time charging codes for the investigation process and guided personnel to use them effective February 1, 2003.

Mr. Johnson also questioned Ms. Doty regarding whether any reported debris sightings were identified. Ms. Doty responded that Ames received two videotapes, one was copied and the original forwarded to JSC, and the other was sent directly to JSC. She offered that Ames received 4-5 phone calls of reported sightings in the California Bay Area, including one report of debris on the beach at Santa Cruz, CA, a report of a piece on a car in Burlingame, and one report from Freemont, CA. The alleged debris in Santa Cruz was reported to be a piece of aluminum, with dimensions of over one foot by about 6 inches. Ames requested that the sites be secured. Mr. Johnson asked Ms. Doty to ensure that anyone reporting debris is reminded that it may be the most important piece of evidence in the investigation.

Mr. Johnson further reported that JSC is performing fault-tree analysis through Mr. Roe's group, with the top-level analysis delivered today. This analysis support provides information identifying the areas of investigation on the orbiter.

He also stated that he sent information regarding the process for contacting the Emergency Operations Control to HQ/ QE/Steve Newman, Mr. Lloyd, and Dr. Rutledge.

Mr. Johnson reported that the Quality and Safety Control process was assembled regarding hardware shipping, that bonded storage had been acquired, and technical support personnel were in place to determine where the hardware should be located. He offered that precautions were being taken to ensure that no alterations to the hardware occur. Any hardware analysis must be performed by TPS and must receive approval. He offered that photo and video work was being handled separately, and that all evidence was being photo documented along with the paper trail documentation. Management was briefed and concurred with this plan yesterday.

Ms. Marshall offered that three decision tree teams were formed to determine the most suitable method to support ISS. Each team will perform "what if?" analysis addressing each of the following: examining a 1-month, 6-month, and 12-month delay of ISS activity, reducing the crew from three to two, and reducing the crew to zero.

Mr. Johnson stated that both JSC and the Russians were compiling lists of prioritized cargo for the ISS. Further, the European Space Agency hardware planned for launch on the Soyuz is on hold, pending the outcome of the decision tree analysis related to supporting the ISS.

Ms. Marshall stated that the Federal Emergency Management Agency reported a number of debris sites, with the most in Texas, followed by Arizona, a significant number in Louisiana, and some in California. Debris sightings were reported from as far away as the Bahamas, Canada, and Jamaica.

Ms. Marshall reported that Mr. Roe needs someone to "translate" technical terms into laymen's terminology.

2.4.5 KSC: QA/H. T. (Bert) Garrido reported that KSC is supporting JSC investigation operations and that local impoundment was gradually being completed.

HQ/QE/Ron Moyer questioned Mr. Garrido regarding whether he contacted Debbie Carstens regarding a three-volume study entitled *Study Analysis Project*, with Mr. Delgado responding that he would contact Ms. Carstens and report back to Mr. Mayer.

2.4.6 Langley: Alan Phillips reported that they contacted JSC and that wind tunnel tests would be performed today.

2.4.7 MSFC: Amanda Goodson reported that their data was impounded and that one payload was being processed for impoundment. She offered that the ET team would be at MSFC Friday to suggest improvements in the impoundment process.

Ms. Goodson offered that MSFC Center Director, Art Stephenson, and Mr. Dittemore should arrive on Friday to address about 200 employees who had not returned to work since the accident regarding concerns related to retribution toward the people who worked on the shuttle hardware.

She also asked for clarification regarding organizing the PBMA website data, and suggested sorting it by center so that it could be addressed more efficiently. Mr. Harkins reported that

about 150 questions/answers had been submitted and should be on the website soon. The data is sorted chronologically, but he will try to sort it by center.

Ms. Goodson stated that Service Life Extension Program (SLEP) activities were proceeding, with management juggling personnel who must cover both SLEP and the investigation.

JSC/NA/Mark Erminger interjected that Mr. Dittemore talked about SLEP and stated that the investigation is our number one priority. Headquarters is assessing the impact to SLEP Working Groups and will determine next week what the schedule will be.

2.4.8 Stennis: Mike Smiles reported that their data was secure and had been copied as needed. The Space Shuttle Main Engine operations resumed normal mode as of 8:00 PM CST last night.

2.5 PBMA website access: Dr. Rutledge reminded JPL, Goddard, JSC, Dryden, MSFC, and Michoud to submit the required information regarding who should acquire secure access to the site to Mr. Newman.

Dr. Rutledge agreed to post the refreshed Fault-Tree Analysis for Aerospace Handbook to the website.

2.6 Independent Verification and Validation Facility: IV&V/Code 307/N. H. (Ned) Keeler reported that the magazine, *Computer World*, reported that the shuttle onboard computer was giving erroneous messages and incorrectly cited a 1999 General Accounting Office Report stating that IV&V was recommended for the shuttle program following the Rogers Report on Challenger, but was never implemented. The report was actually from 1991 and IV&V was implemented in 1993.

3.0 CONCLUSION

The next S&MA teleconference meeting is scheduled for 12:00 PM CST tomorrow, Friday, February 7, 2003, with the same attendees.

JSC/NC44/S. J. Taylor
Technical Writer

Safety and Mission Assurance (S&MA)
Daily 12:00 PM CST Teleconference
Shuttle Columbia Investigation

Date: February 6, 2003

NASA Mail Code	Name	Employer (if not NASA)	Phone Number	Email Address
Ames/Q	Laura Doty		650-604-3340	Laura.W.Doty@nasa.gov
Q	Bob Navarro		650-604-5640	Robert.J.Navarro@nasa.gov
Goddard/ 300.0	Wentworth O. Denoon		301-286-6086	Wentworth.O.Denoon@nasa.gov
GRC/0530	Ken O'Connor		216-433-8621	Kenneth.M.OConnor@nasa.gov
0520	John Reagan		216-433-2357	John.R.Reagan@nasa.gov
	Vernon C. (Bill) Wessel		216-433-2350	Vernon.W.Wessel@nasa.gov
HQ/QS	Bill Loewy		202-358-0528	bloewy@mail.hq.nasa.gov
QS	Eric Raynor		202-358-4738	eraynor@mail.hq.nasa.gov
QS	Jim Lloyd		202-358-0557	jlloyd@mail.hq.nasa.gov

NASA Mail Code	Name	Employer (if not NASA)	Phone Number	Email Address
QS	Pete Rutledge		202-358-0579	prutledg@mail.hq.nasa.gov
Q	Lynne Loewy		202-358-0549	lloewy@mail.hq.nasa.gov
QS	Wayne E. Frazier		202-358-0588	wfrazier@mail.hq.nasa.gov
QS	Sylvia Brookover		202-358-0552	sbrookov@mail.hq.nasa.gov
QS	Paul Boldon		Fax: 202 358-3104	pboldon@mail.hq.nasa.gov
Q	Dale Moore		202-358-0545	dmoore@mail.hq.nasa.gov
QE	Phil Napala		202-358-0564	pnapala@mail.hq.nasa.gov
QE	Pat Martin		202-358-0417	pmartin@mail.hq.nasa.gov
QS	Tom Whitmeyer		202-358-2228	twhitmey@mail.hq.nasa.gov
QS	Martha Wetherholt		202-358-0470	mwetherh@mail.hq.nasa.gov
QE	Steve Newman		202-358-1408	snewman@mail.hq.nasa.gov:

NASA Mail Code	Name	Employer (if not NASA)	Phone Number	Email Address
QS	Jonathan B. Mullin		202-358-0589	jmullin@mail.hq.nasa.gov
QS	John Lemke		202-358-0567	jlemke@mail.hq.nasa.gov
QE	Michael Stamatelatos		202-358-1668	mstamate@mail.hq.nasa.gov
QE	Ron Moyer		202 358-0570	rmoyer@mail.hq.nasa.gov
QE	Mark Kowaleski		202 -358-0751	mkowales@mail.hq.nasa.gov
QS	Matt Gaier		Fax: 202 358-3104	mgaier@mail.hq.nasa.gov
JSC/ NA	Gary Johnson		281-483-4136	Gary.w.Johnson@jsc.nasa.gov
NA	Frank Culbertson	SAIC	281-244-1602	Frank.l.culbertson1@jsc.nasa.gov
NA	Joyce Abbey	SAIC	281-483-6885	Joyce.b.abbey1@jsc.nasa.gov
NA	Dave Thelon		281-483-0675	David.f.thelon@jsc.nasa.gov
NC	Sharon Taylor	SAIC	281-483-9551	Sharon.j.taylor1@jsc.nasa.gov
NS	Stacey Nakamura		281 483-4345	Stacey.t.nakamura@jsc.nasa.gov

NASA Mail Code	Name	Employer (if not NASA)	Phone Number	Email Address
NX	Malcolm J. (Mac) Himel		281 483-4086	Malcolm.j.himel@jsc.nasa.gov
KSC/QA	H.T. (Bert) Garrido		321-867-2118	Humberto.T.Garrido@nasa.gov
USK-072	Ronnie Gooden	USA	321-861-0087	Ronald.Gooden-1@ksc.nasa.gov
Langley/ S&MA	Alan H. Phillips		757-864-3358	Alan.H.Phillips@nasa.gov
S&MA	Don Porter		757-864-3344	Donald.J.Porter@nasa.gov
MSFC/ QS01	Amanda Goodson		256-544-0043	Amanda.H.Goodson@nasa.gov
QS20	Alex Adams		256-544-4658	Alex.C.Adams@nasa.gov
	Laura Malone			
Stennis/ VA 14	John Stealey		228-688-2236	John.E.Stealey@nasa.gov
QA00	Mike Smiles		228-688-2351	Michael.Smiles@ssc.nasa.gov
IV&V	N. H. (Ned) Keeler		304-367-8201	Nelson.H.Keeler@nasa.gov

ERMINGER, MARK D. (JSC-NC) (NASA), 05:22 PM 2/8/2003 -0600, STS-107 Foam Loss S&MA Invo

From: "ERMINGER, MARK D. (JSC-NC) (NASA)" <mark.d.erminger@nasa.gov>
To: "H - Lloyd Jim (E-mail)" <james.d.lloyd@hq.nasa.gov>,
"h - Rutledge Pete (E-mail)" <prutledg@hq.nasa.gov>,
"H - Kowaleski Mark (E-mail)" <mkowales@mail.hq.nasa.gov>
Cc: "MARSHALL, YOLANDA Y. (JSC-NA) (NASA)" <yolanda.y.marshall@nasa.gov>,
"HOLSOMBACK, JERRY B. (JSC-OE) (NASA)" <jerry.b.holsomback@nasa.gov>,
"JOHNSON, GARY W. (JSC-NA) (NASA)" <gary.w.johnson@nasa.gov>,
"JOHNSON, M. S. (SCOTT) (JSC-NC) (NASA)" <m.s.johnson@nasa.gov>,
"M - Adams Alex (E-mail)" <Alex.Adams@msfc.nasa.gov>,
"M - Mullane Dan (E-mail)" <Daniel.J.Mullane@msfc.nasa.gov>
Subject: STS-107 Foam Loss S&MA Involvement
Date: Sat, 8 Feb 2003 17:22:30 -0600
X-Mailer: Internet Mail Service (5.5.2653.19)

Per your request

MSFC S&MA will prepare a similar report to give you a timeline of their involvement in this problem.

<<Summary Timeline of STS-107 Foam Loss S&MA Involvement.doc>>


Summary Timeline of STS-107 Foam Loss S&MA Involvement.doc

jlloyd@mail.hq.nasa.gov, 08:33 AM 2/9/2003 -0500, Assembly of SMA Interaction with Shuttle Dec

Reply-To: jlloyd@mail.hq.nasa.gov
X-Originating-IP: 68.100.166.170
X-URL: http://mail2web.com/
From: "jlloyd@mail.hq.nasa.gov" <jlloyd@mail.hq.nasa.gov>
To: mgreenfi@hq.nasa.gov
Cc: prutledg@hq.nasa.gov, jlemke@hq.nasa.gov, bocconor@hq.nasa.gov
Subject: Assembly of SMA Interaction with Shuttle Decision Processes
Date: Sun, 9 Feb 2003 08:33:44 -0500
X-OriginalArrivalTime: 09 Feb 2003 13:33:45.0343 (UTC) FILETIME=[DE7398F0:01C2D03F]

Michael,

I sent you a first draft on the effort to assemble the factual story of SMA involvement in the decisions made for four Shuttle flows starting with STS 112 and concluding with the PAR preparation for STS 114 (the next scheduled flight). I am sending Mark Erminger's summary of events around STS 107; he is now doing the same for other flights. MSFC is also doing a similar timeline assembly. It is taking some time to assemble the pieces from the bottom up and we are integrating thew whole at Code Q.

If you have a few minutes you might want to provide any information you have about your personal involvement in the early part of this time line when you were still a manager in Code Q. Please forward to my attention and we will fold it in.

We are not going to do any speculation in this report as to whether the leading theories are proper or not. That is the purview of the CAIB as you know. I have highlighted several passages herin knowing pretty much what you are seeking. It seems to me that the foam strike was being considered as something that we have seen in our experience with previous flights and that although analysis was being performed as per normal assessment of anomalies there was no critical level of concern raised. I see no evidence here of any special independent assessments being initiated as there is no intrinsic capability for this within SMA community tracking the flight operations. Let me know if this satisfies you needs today as we are trying to have a pretty complete package by COB Monday

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Summary Timeline of STS-107 Foam Loss S&MA Involvement Erminger[1].doc

STS-107 Foam Loss S&MA Involvement
Shuttle Program S&MA Activity compiled by Mark Erminger
2/8/03

1/16/03 excerpt from MER Safety Console e-mail after launch

STS-107 was successfully launched on January 16, 2003 at GMT 16:15:39 (09:30 CST)

1/16/03 excerpts from Jon Disler JSC STS-107 Launch Video Screening Report

ANOMALY CANDIDATES

No potentially anomalous events were noted during the screening of the STS-107 launch videos that were received. The long range tracking videos (second engineering replays) have not been sent via satellite to JSC. When the second replays are received they will be screened and a report will be sent to distribution.

OBSERVATIONS

The following observations are not considered anomalous but are worth noting:

OTV009, OTV054 - Right inboard and outboard elevon motion was apparent during liftoff. Elevon motion during liftoff is a normal event. However, the elevon motion seen on STS-107 may have been greater than that typically seen.

Mark Erminger comments: Nothing unusual in this report

1/17/03 excerpt from Jon Disler JSC STS-107 Launch Screening - Long Range Tracking Videos

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_video/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

Mark Erminger comments: This is definitely a concern because it is a repeat anomaly and it clearly struck the Orbiter

1/18/03 excerpts from Jon Disler JSC STS-107 Launch Film Review Status

The screening of the STS-107 long range tracking camera films is complete except for the viewing of camera film E204 which will be screened Sunday morning (1/19). Camera E212 provided an additional look at the Orbiter left wing at the time of the debris strike (described in the previous report on the video screening). No significant new information was learned from today's film screening.

Crew acquired down linked video imaging the External Tank (ET), probably the source of the debris that struck the Orbiter left wing, was reviewed this afternoon. 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.

Mark Erminger comments: No information in this report as to the extent of the damage to the Orbiter as a results of foam impact.

1/19/03 excerpts from the MER Safety STS-107 Flight Day 3 Report

One item came to our attention yesterday after we sent out the daily report. High-speed film analysis from ascent showed a large, light-colored piece of debris break off the Orbiter/ET forward attach bipod at MET 81 seconds. The piece struck the wing leading edge of the left wing on or neat the wing glove and broke into a spray of white colored particles that streamed under the left wing and was last seen near the left SRB exhaust plume. Analysis of high speed and high resolution tracking films are being conducted to get more detail of this event. See the following URL:
http://sn-isag.jsc.nasa.gov/shuttleweb/mission_support/sts-107/index107.shtm

1/19/03 excerpts from Jon Disler JSC STS-107 Launch Film Screening Report

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_video/107launchvideo.shtml>

The times of this event are as follows:

Debris first seen near ET/Orbiter forward attach: 016:15:40:21.699 UTC
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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:

<http://sn-isag.jsc.nasa.gov/shuttleweb/mission_support/sts-107/launch_film/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.

Mark Erminger comments: This report made me feel better about the foam impact on the wing because the foam broke into a spray of white-colored particles and that there did not appear to be larger scale damage to the wing. Also, they compare the elevon motion to previous flights of OV-102 and concluded it was normal.

1/20/03 was a Federal Holiday

1/20/03 excerpt from the MER Safety Console STS-107 Flight Day 04 Report

With respect to the debris hit on the left wing leading edge discussed in the Second Daily Report, JSC image analysis personnel have completed their review of the high-speed and high-resolution long-range tracking films. Comparison views of what can be seen 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 larger scale damage were noted as indicated by the lack of changes in the brightness of the port lower wing surface.

1/22/03 excerpt from Jon Disler STS-107 Debris Strike and Previous Mission Information – Preliminary

Preliminary - Information, including views on the STS-107 debris strike to the left wing can be found at the following web site:

http://sn-isag/shuttleweb/mission_support/sts-107/debris_report/107_debris_report.shtml

STS-112 and STS-50 both had debris damage caused by missing TPS from the ET forward bipod ramp.

Measurement of the debris size on STS-107 and the debris size seen on STS-112 are shown.

Information from previous missions STS-112 and STS-50 are included.

1/23/03 excerpt from Shuttle Standup

ET

- *Aware of debris issue*
- *Know generally where the debris came from*
- *Will have to wait until the Orbiter gets back*

USA Orbiter

- *Working Debris Analysis*

USA Integration

- *Debris analysis completed a couple of runs looking at 20x10x6 and 20x16x6*
- *Provided input area, velocity, and impact angles to Orbiter*

Mark Erminger Comment: The size of the debris got my attention and I added this as a topic for the STS-114 PAR

1/24/03 excerpt from PAR-5 Minutes

STS-114/ULF1 (OV-104) FLIGHT MILESTONE DATES

Special Topics:

1. *SHUTTLE*
   A. *JSC*

2. STS-107 ET Foam Loss (to be presented @ FRR Tagup) *****
(George Ishmael-)

B. MSFC
2. ET: STS-107 ET Foam Loss (to be presented @ FRR Tagup) *****
(Keith Layne)

Mark Erminger comment: We scheduled this for the FRR Tag-Up because the PAR was on 1/31/03 the day before landing. We needed to get the post landing data in order to complete their assessment. This data included Orbiter Inspection and reviewing ET film that was on the Orbiter.

1/27/03 excerpt from Jon Disler Note CAD Showing Debris Strike to STS-107 Wing

A CAD drawing of the Orbiter showing the position of the landing gear door that is overlayed to the STS-107 ET208 image of the debris strike to the Orbiter left wing can be seen at the following address:

http://sn-isag.jsc.nasa.gov/shuttleweb/mission_support/sts-107/index107.shtml

[redacted]

1/27/03 excerpts from Shuttle Standup

ET

- Still need to look at the pictures from the disconnect area to find out where the debris came from on the last flight.

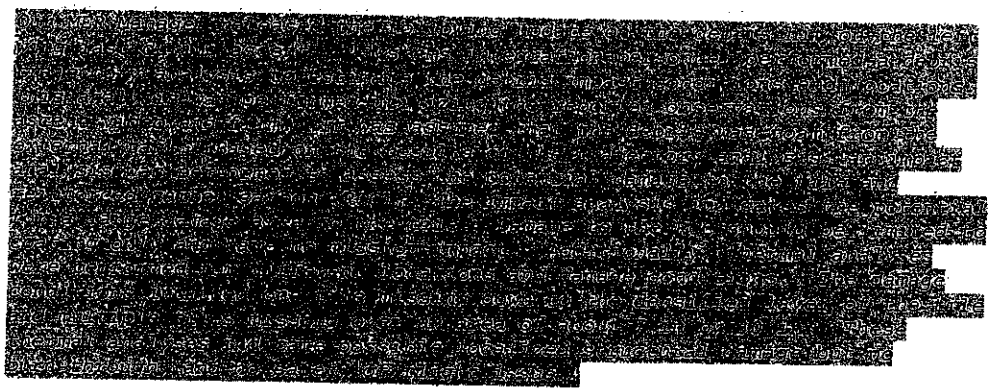
USA Orbiter

- Analysis of ET debris hit indicates that Orbiter tile damage is within family and not a safety of flight issue.
- Analysis showed we're OK with the loss of a couple of tiles around wheel well.

Integration

- Working to assure photo ops expedite hand held photograph processing.

1/28/03 excerpt from MER Safety STS-107 Flight Day 12 Report



Mark Erminger Comments: Based on this report, this issue appears to be resolved for STS-107. I talked to Scott Johnson and he said this item was reviewed in the MER Engineering Meeting and was not thought to be a problem so they did not bring it to the Mission Management Team.

1/28/03 excerpt from STS-114 Orbiter Rollout-Out Review

Attended by Mark Erminger

The ET ProjectManager/Jerry Smelser made a verbal walk-on presentation about the STS-107 ET Foam Loss problem. Jerry said this was an Accepted Risk Hazard and will require ET camera film and review after landing.

Mark Erminger Comments: I made a comment after the ET Project presentation that this would become an STS-114 flight issue if we saw something post flight that we did not expect or pointed to something different on the tank. Linda Ham and the Jerry Smelser agreed. I recall Linda Ham saying that she wanted to expedite getting the film off the Orbiter and get it processed for ET to evaluate.

1/29/03 excerpt from Bob Page STS-107 Launch+4 Day Consolidated Film/Video Report

During ascent at approximately 81 seconds MET, debris was seen to originate from an area near the ET/Orbiter forward attach bipod. Due to lighting conditions in the area, it is not known whether debris originated as a single item which broke up or if it originated as several separate items. Four objects are seen or surmised from the data..

Object#1, the largest of the items, was a light colored piece of debris which 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 along the underside (-Z side) of the Orbiter left wing. The spray of particles was last seen near the LSRB exhaust plume.

Object #1, darker and smaller in appearance than the first, is visible in the frame immediately following the appearance of Object #1. Its travel path seems to be slightly more outboard and more in the -Z direction than the first. This object actually strikes the wing before Object #1. (A spray of particles is een traversing aft prior to the strike from Object #1).

Object #3 is not seen directly in any views. However, evidence of its existence comes from a second spray of particles at the same time as and parallel to the spray from Object #2.

Mark Erminger comment: This information is consistent with previous reports and this appears to not be a problem.

1/30/03 excerpt from Shuttle Standup

ET

•Nothing new on TPS issue

Linda Ham

•Working hard to get the cameras out on the runway to process for foam loss review

jlloyd@mail.hq.nasa.gov, 08:07 PM 2/10/2003 -0500, RE: Timeline of Events for STS 107 Foam Los

Reply-To: jlloyd@mail.hq.nasa.gov
X-Originating-IP: 68.100.166.170
X-URL: http://mail2web.com/
From: "jlloyd@mail.hq.nasa.gov" <jlloyd@mail.hq.nasa.gov>
To: alex.c.adams@nasa.gov
Cc: mark.kowaleski@hq.nasa.gov, prutledg@mail.hq.nasa.gov, jlloyd@mail.hq.nasa.gov, mark.d.erminger1@jsc.nasa.gov, angela.v.daniels@nasa.gov
Subject: RE: Timeline of Events for STS 107 Foam Loss
Date: Mon, 10 Feb 2003 20:07:17 -0500
X-OriginalArrivalTime: 11 Feb 2003 01:07:17.0777 (UTC) FILETIME=[EBCEE010:01C2D169]
X-MIME-Autoconverted: from quoted-printable to 8bit by bolg.public.hq.nasa.gov id UAA21981

Thanks for your efforts, Alex. I think this effort will show that SMA was an partner in the decison process and was not absent from the count. This is as prescribed by the Rogers' Commission.

Original Message:

From: Adams, Alex Alex.C.Adams@nasa.gov
Date: Mon, 10 Feb 2003 17:47:44 -0600
To: mark.kowaleski@hq.nasa.gov, prutledg@mail.hq.nasa.gov, jlloyd@mail.hq.nasa.gov, mark.d.erminger1@jsc.nasa.gov, Angela.V.Daniels@nasa.gov
Subject: Timeline of Events for STS 107 Foam Loss

Mark, Pete and Jim,

Please see the following attachment for a listing of MSFC S&MA timeline of events for STS-107 foam loss. Thanks for the patience! -Alex Adams

<<Timeline of Events for STS 107 Foam Loss .pdf>>

James Lloyd, 08:54 AM 2/11/2003 -0500, Re: Timeline of Events for STS 107 Foam Loss

X-Sender: jlloyd@mail.hq.nasa.gov
X-Mailer: QUALCOMM Windows Eudora Version 4.3.2
Date: Tue, 11 Feb 2003 08:54:32 -0500
To: "Mark M. Kowaleski (E-mail)" <mark.kowaleski@hq.nasa.gov>,
"'prutledg@mail.hq.nasa.gov'" <prutledg@mail.hq.nasa.gov>
From: James Lloyd <jlloyd@hq.nasa.gov>
Subject: Re: Timeline of Events for STS 107 Foam Loss
Cc: "Mark D. Erminger (E-mail)" <mark.d.erminger1@jsc.nasa.gov>,
"Daniels, Angela" <Angela.V.Daniels@nasa.gov>,
"Adams, Alex" <Alex.C.Adams@nasa.gov>, jlemke <jlemke@hq.nasa.gov>

Pete, Let's get this incorporated into the paper that Mark K. has assembled, edit as necessary and return to all for a final look at the integrated product. One thing we need to capture is the basis for decision for the decision points of current interest. If that is captured in this paper I didn't see it clearly. I suggest that we unambiguously indicate that, as a minimum, the decision may have been based on accepted risk if the impact of the foam was seen by all as something within the experience base and having been accepted previously

At 05:47 PM 2/10/2003 -0600, Adams, Alex wrote:

Mark, Pete and Jim,

Please see the following attachment for a listing of MSFC S&MA timeline of events for STS-107 foam loss. Thanks for the patience! -Alex Adams

<<Timeline of Events for STS 107 Foam Loss .pdf>>

Jim

Adams, Alex, 05:47 PM 2/10/2003 -0600, Timeline of Events for STS 107 Foam Loss

From: "Adams, Alex" <Alex.C.Adams@nasa.gov>
To: "Mark M. Kowaleski (E-mail)" <mark.kowaleski@hq.nasa.gov>,
"'prutledg@mail.hq.nasa.gov'" <prutledg@mail.hq.nasa.gov>,
"'jlloyd@mail.hq.nasa.gov'" <jlloyd@mail.hq.nasa.gov>
Cc: "Mark D. Erminger (E-mail)" <mark.d.erminger1@jsc.nasa.gov>,
"Daniels, Angela" <Angela.V.Daniels@nasa.gov>
Subject: Timeline of Events for STS 107 Foam Loss
Date: Mon, 10 Feb 2003 17:47:44 -0600
X-Mailer: Internet Mail Service (5.5.2653.19)

Mark, Pete and Jim,

Please see the following attachment for a listing of MSFC S&MA timeline of events for STS-107 foam loss. Thanks for the patience! -Alex Adams

<<Timeline of Events for STS 107 Foam Loss .pdf>>

Timeline of Events for STS 107 Foam Loss .pdf

Timeline of Events for STS-107/ET-93 Bipod Foam Loss:

- January 16, 2003:
  - The STS-107/ET-93 was Launched at KSC.
- January 17, 2003:
  - ET Assurance Team reviewed the post-flight photos from launch in which foam loss was identified in the area of the forward bipod.
- January 21, 2003:
  - ET Project gave Lockheed Martin (LM) an action to investigate increased occurrence of foam loss.
  - ET Assurance Team and Shuttle Assurance Department received still photos and video of STS-107 foam loss.
- January 23, 2003:
  - The ET Assurance Team participated in ET Project review/telecon of STS-107 foam loss.
- January 24, 2003:
  - The ET Assurance Team provided an update to Shuttle Assurance Department on STS-107 foam loss.
    - The ET Assurance Team identified the Foam Loss as a PAR STS-114 Presentation Topic.
- January 28, 2003:
  - The Shuttle Assurance Department participated in the STS-114 Orbiter Rollout Review.
    - The ET Project recommended no constraint to rollout, pending review of photos and inspection of Orbiter tile damage upon landing of STS-107.
- January 30, 2003:
  - LM Michoud Assembly Facility (MAF) presented a preliminary foam loss fault tree to the ET Project and ET Assurance.
    - The fault tree was developed to determine the root cause of increased occurrence of foam loss in the bipod area per PRCB action S062151, MSFC-ET/1-1.

ERMINGER, MARK D. (JSC-NC) (NASA), 02:30 PM 2/8/2003 -0600, STS-112 Foam Loss Program S&

From: "ERMINGER, MARK D. (JSC-NC) (NASA)" <mark.d.erminger@nasa.gov>
To: "h - Rutledge Pete (E-mail)" <prutledg@hq.nasa.gov>,
"H - Kowaleski Mark (E-mail)" <mkowales@mail.hq.nasa.gov>,
"H - Lloyd Jim (E-mail)" <james.d.lloyd@hq.nasa.gov>
Cc: "MARSHALL, YOLANDA Y. (JSC-NA) (NASA)" <yolanda.y.marshall@nasa.gov>,
"HOLSOMBACK, JERRY B. (JSC-OE) (NASA)" <jerry.b.holsomback@nasa.gov>,
"JOHNSON, GARY W. (JSC-NA) (NASA)" <gary.w.johnson@nasa.gov>,
"JOHNSON, M. S. (SCOTT) (JSC-NC) (NASA)" <m.s.johnson@nasa.gov>,
"M - Adams Alex (E-mail)" <Alex.Adams@msfc.nasa.gov>,
"M - Mullane Dan (E-mail)" <Daniel.J.Mullane@msfc.nasa.gov>
Subject: STS-112 Foam Loss Program S&MA Involvement
Date: Sat, 8 Feb 2003 14:30:10 -0600
X-Mailer: Internet Mail Service (5.5.2653.19)

Jim and Pete: per your request.

Alex Adams wil be sending you a MSFC S&MA timeline of their involvement in this issue.

<<Summary Timeline of STS-112 Foam Loss S&MA Involvement.doc>>


Summary Timeline of STS-112 Foam Loss S&MA Involvement.doc

STS-112 Foam Loss S&MA Involvement
Shuttle Program S&MA Activity compiled by Mark Erminger
2/8/03

Explanation of MER Safety Console: Shuttle S&MA personnel monitor the Shuttle mission in real time in the Mission Evaluation Room. They work issues, review requests from the Flight Control Team through the CHIT process, and identify problems for the S&MA Mission Management Team representative to take to the Mission Management Team meetings during the mission.

10/7/02 Excerpts From the MER Safety Console e-mail note after launch

STS-112 was successfully launched on October 7, 2002 at GMT time 280/19:45:51 (2:45 pm CDT). The launch countdown was smooth with minor vehicle anomalies, all of which were cleared for launch. Weather was a minor concern for launch, with showers pushing the 30 mile limit but it cleared up in time for T-9 and preferred launch time.

Performance during powered flight was nominal, although L4D failed off at SRB separation. MECO occurred on time and at the proper orbital targets.

There is one (1) anomaly identified for the launch at the time of this report.

MER Anomalies:
MER 01 Primary Thruster L4D Failed Off

Explanation of JSC Launch Video Screening Report: This report is prepared by the Life Sciences Directorate SX/Jon Disler. He is a member of the JSC Image Science and Analysis Group. They distribute these reports by e-mail several times during and after the mission.

10/8/02 excerpts from the JSC STS-112 Launch Video Screening Report

ANOMALY CANDIDATES

No potentially anomalous events were noted during the screening of the STS-112 launch videos

OBSERVATIONS

External Tank Camera -

A single, light-colored piece of debris (frost/ice) was seen near the ET LO2 feedline falling aft toward the Orbiter nose and the forward ET/Orbiter bipod attach and continuing aft along the fuselage tiles approximately three seconds after liftoff (19:45:54.082 UTC).

A second piece of debris was seen falling aft along the ET past the forward bipod at tower clear (19:45:55.417 to 19:45:55.484 UTC). The debris appeared dark at first and then fell into sunlight and appeared light in color. The debris was not seen to contact the vehicle. A third piece of debris, following the same trajectory, was seen falling aft along the ET and past the forward ET/Orbiter bipod at tower clear (19:45:55.500 UTC).

At approximately seventy-two seconds after liftoff, a single light-colored piece of debris was seen above the right wing (19:47:03.218 UTC). This debris appeared to contact the leading edge of the right wing, before deflecting and falling aft (19:47:03.250 UTC). No damage to the wing was noted.

Mark Erminger comments: At this point, nothing seemed out of the ordinary

10/12/02 excerpts from the JSC STS-112 Launch Video Screening Report

ANOMALY CANDIDATE:

Cameras E212, E220, E222 - A single piece of light-colored debris was seen to impact the ETA ring near the IEA box on the LSRB at approximately 33 seconds MET (19:46:24.690 UTC). After impact the debris broke into multiple pieces and fell aft along the LSRB exhaust plume. On Camera E207, a large spray of debris was seen falling aft along the LSRB aft

skirt that was probably from this event (19:46:24.727 UTC). The debris was first visible aft of the ET intertank near the ET hydrogen tank TPS (19:46:24.590 UTC), one tenth of a second prior to the debris impact with the ETA ring.

ON-ORBIT DOWNLINKED ORBITER VIEWS:

STS-112 on-orbit downlink ESC video imaging the top (+Z) aspect of the Orbiter from the nose to the tail has been received. No significant damage to the Orbiter was confirmed from these high-resolution images. Minor tile damage was seen between the Orbiter overhead windows 7 and 8. Small tile damage marks appear to be present on one or two tiles forward of windows 3 and 4. A small, faint, mark (possibly damage) is visible on the leading edge of the right wing.

Mark Erminger comments: The Anomaly candidate item above caught my attention but did not appear to be very significant. There was no indication in this report about any foam loss from the External Tank striking the Orbiter

10/14/02 Federal Holiday

Explanation of STS-112 Launch+4 Day Consolidated Film/Video Report: This report is prepared by KSC/Bob Paige and is the Consolidated Film/Video Report from KSC, JSC, MSFC, and Program Integration

10/15/02 excerpt from the STS-112 Launch+4 Day Consolidated Film/Video Report

A single piece of light-colored piece of debris was seen to impact the ETA Ring near the IEA box on the LSRB at approximately 33 seconds MET (19:46:24.690 UTC). After impact the debris broke into multiple small pieces and fell aft along the LSRB exhaust plume. On Camera E207, a large spray of debris was seen falling aft along the LSRB Aft Skirt that was probably from this event (19:46:24.727 UTC). The debris was first visible aft of the ET Intertank one tenth of a second prior to the debris impact with the ETA ring (19:46:24.590 UTC). Expedited processing of the Umbilical Well Cameras has been requested.

Mark Erminger comments: The item in this report is the same item from the 10/12 report. There was still no indication in this report about any foam loss from the External Tank striking the Orbiter.

10/18/02 excerpt from the MER Safety Console Report

Shuttle Atlantis landed at KSC on runway 33 at 291:15:43 GMT (10:43 A.M.) after closing the payload bay doors at 291:12:05 GMT (8:05 A.M.) and performing the deorbit burn at 291:14:36 GMT (9:36 A.M.). The deorbit burn lasted 2 minutes and 11 seconds and imparted a retrograde differential velocity of 250.8 ft/sec. There were no new anomalies during the deorbit burn and landing timeframe.

10/21/02 E-mail note from John Disler titled "STS-112 Photo of Missing TPS on ET Bipod Ramp"

http://sn-isag.jsc.nasa.gov/shuttleweb/mission_support/sts-112/l12et/bipod_tps.jpg

Checkout the picture on the above web site..

A large portion of the -Y ramp adjacent to the -Y foot of the forward ET / Orbiter attach bipod can be seen to be missing on the view above. Substrate material is visible.

This event is considered to be a possible source for the debris that was seen striking the LSRB ETA ring on the STS-112 launch camera films.

The External Tank film screening will continue and a detailed report will be sent to distribution at the completion of the film screening.

Jon Disler

Mark Erminger comments: This is the first indication of foam missing from the bipod area but there was no indication of anything striking the Orbiter

Explanation of Shuttle Standup: The Shuttle Program has a meeting with all of the Elements and

Projects on Mondays and Thursdays starting at 7:30 AM central time. KSC goes over vehicle preparation status for upcoming flights and each Element/Project goes over significant problems that they are working

10/21/02 Excerpts from Shuttle Standup

ET

- *Umbilical camera film showed we lost some insulation in the bipod area*
- *We understand that we had hits on the underside of the Orbiter that were a little on the high side but within family*

Mark Erminger comment: [redacted]

10/22/02 excerpt from Jon Disler JSC STS-112 Landing Video Screening Report

ANOMALY CANDIDATES

None.

FUNNIES / UNUSUAL OBSERVATIONS

None.

Mark Erminger comments: No indication of anything striking the Orbiter

10/22/02 excerpt from Jon Disler STS-112 External Tank Imagery Screening Report

ANOMALY CANDIDATES

None.

FUNNIES / UNUSUAL OBSERVATIONS

The following is considered to be a possible source for the debris that was seen striking the LSRB ETA ring on the launch camera films:

A large portion of the ramp adjacent to the -Y foot of the ET / Orbiter forward bipod attach is missing. The damaged area measured approximately 6 x 12 inches. Substrate material is visible.

OBSERVATIONS

With the exception of the damaged forward bipod -Y ramp noted above, the External Tank appeared to be in satisfactory condition on the ET imagery.

Mark Erminger comments: No indication of anything striking the Orbiter in this report

10/24/02 excerpt from Shuttle Standup

ET

- *FRR topics. Lox feedline inspection repair, thin stringer, loss of TPS in bi-pod close-out area.*

Explanation of PAR: PAR is the acronym for Pre-Launch Assessment Review. This is what we call the S&MA flight preparation process for Shuttle and Station. We use this process to make sure that the S&MA community is in agreement before proceeding to the Shuttle Flight Readiness Review or the Space Station Stage Operations Readiness Review.

Explanation of PAR-5: The PAR-5 is a weekly meeting that I hold with S&MA Shuttle and Station representatives from JSC, KSC, MSFC, and NASA HQ. Each week we review PAR agendas for the next 3 Shuttle flights and the Station flights that fall within that window.

10/24/02 Excerpt from Shuttle Program STS-112 In-Flight Anomaly review at Program Requirements Control Board

Bob Page presented the anomaly for the debris impacting the ETA Ring during this review and recommended this be a program IFA. PRCBD S062151 does not include this item as a baselined Program IFA. The problem would still be treated as a valid problem and would be worked regardless of whether it had been accepted as an Official Program IFA.

His presentation did include this statement

- *Expedited processing of the Umbilical Well Cameras and a Debris Transport Analysis were requested to help identify the origin.*

Bob included pictures of the missing TPS on the –Y Bipod in his presentation

SR&QA is a member of the PRCB and was present during this review.

Presentation is stored on Shuttle Program Web Page at

http://sspweb.jsc.nasa.gov/webdata/mss/SSPPRCB/archive/2002/10242002PRCB_S062151(STS-112-IN-FLIGHT-ANOMALIES-REVIEW).pdf

10/25/02 Excerpt from PAR-5 Minutes

STS-113/11A (OV-105)/INCREMENT6 FLIGHT MILESTONE DATES

Special Topics:

1. *Shuttle*
   B. MSFC
      2. STS-112 ET Bipod Ramp Foam Loss
      (Keith Layne)

Mark Erminger comments: [redacted] Added the STS-112 ET Bipod Foam Loss to the agenda for the STS-113 FRR to be held on 10/29/02 during the PAR-5 meeting on 10/25/02.

10/29/02 STS-113 S&MA FRR Tag-Up

MSFC/Keith Layne made a presentation to the S&MA Community including JSC, KSC, MSFC, and NASA HQ AA OSMA on the STS-112/ET- 115 Bi-Pod ramp foam loss. Keith presented flight rationale and recommended no constraint to STS-113/ET-116 and subsequent flights. There was some discussion on this topic but everyone agreed with his recommendation.

Here is the text from the last page of his presentation:

•Root Cause:
–Most likely cause related to suspect subsurface voids during bipod ramp closeout coupled with launch environments
•Corrective Action:
–PRCB action issued to ET Project to investigate bipod foam area process and report improvements
•Flight Rationale:
–Prelaunch inspections will reveal any concerns for ice/frost formation
–SLA protects the bipod housing from overheating during flight
–The foam application process is fully validated and performed by certified practitioners
–No anomalies were identified during STS-112/ET-115 or STS-113/ET-116 build paper reviews
–Previous failures were accepted as no safety of flight impact
–Statistical analysis assures demonstrated reliability at 95% confidence is 0.984 for bipod foam loss
–No "Safety of Flight" damage from loss of foam in history of Program
•S&MA Recommendation:

-No constraint to STS-113/ET-116 and subsequent flights

The presentation is stored on the PAR Home Page at

http://wwwsrqa.jsc.nasa.gov/PAR/DOCS/PARWEB/STS-113,%2011A%20JFRR/Overview/M-TDC-STS112BipodFoamLoss.ppt

Explanation of NASA HQ document "Safety and Mission Assurance Report": This report is produced by NASA HQ Code Q prior to every Shuttle Mission summarizing significant issues that the S&MA community has reviewed before the flight.

10/29/03 excerpt from NASA HQ document "Safety and Mission Assurance Report for the STS-113 Mission"

14	STS-112 Bipod Ramp Foam Loss	Resolved	1) Post separation photos of STS-112 showed foam loss in bipod area. STS-32 & STS-50 had similar foam loss. 2) Most probable cause is subsurface voids in the two-tone foam acreage.	1) Build paper review revealed no out-of-family processing was identified. 2) Flight history indicates greater than 99% chance of no foam loss in these specific areas. 3) The two-gun spray process used is considered the most tightly controlled spray process.	No chang level. rational good fli and low of occur

10/31/02 excerpt from External Tank Project presentation at the STS-113 Flight Readiness Review

Mark Erminger comment: This issue would have been presented at the ET/SRB Mate Review if the anomaly had occurred before that meeting was held. In this case, the Anomaly occurred after the ET/SRB Mate Review

Here is the text from page 4 of their presentation:

Rationale for Flight

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

The presentation is stored on the Shuttle Program web page at

http://usago1.ksc.nasa.gov/usago/orgs/kscspi001/launch/previous/sts-113/frr/8_et.pdf

10/31/02 excerpt from Mark Erminger STS-113 Flight Readiness Review presentation

Significant Assessments

ET

· STS-112 Bipod Ramp Foam Loss

With the satisfactory completion of identified open work, Safety and Mission Assurance has no constraints to STS-113/11A. S&MA has no issues that constrain any of the mission success criteria.

Mark Erminger comment: I do not present the details of the S&MA review at the FRR when the responsible Project has already presented the subject. My presentation is the last presentation of the day. I do make a statement that the issue has already been presented and that the S&MA community agreed with the rationale that they presented.

This issue was considered closed for STS-113 after the Flight Readiness Review and was not discussed any further in relation to STS-113.

10/31/02 excerpt from Bob Paige STS-112 Landing+3 Day Consolidated Film/Video Report

Camera: UMB16-1

Missing Foam material was seen on the -Y Thrust Panel in the +Z direction from the EB Fitting. Possible cause of the hits seen on the left side of the Orbiter. Similar pattern seen on STS-99

11/23/02 Excerpts From the MER Safety Console e-mail note after launch (after numerous attempts to launch)

STS-113 was successfully launched on November 23, 2002 at GMT time 328:00:49:48 (6:49:48 pm CDT)

James Lloyd, 07:34 AM 2/12/2003 -0500, Re: Fw: FRR Charts

X-Sender: jlloyd@mail.hq.nasa.gov
X-Mailer: QUALCOMM Windows Eudora Version 4.3.2
Date: Wed, 12 Feb 2003 07:34:59 -0500
To: MGreenfi@hq.nasa.gov
From: James Lloyd <jlloyd@hq.nasa.gov>
Subject: Re: Fw: FRR Charts

It certainly has more depth at this point than does the AA, OSF's recollection which is probably accurate as far as it goes. Our report is nearing readiness.

At some point I would like to see the Program's own rendition of what they did in response to foam shedding -- still only one of the leading theories. Remember the rule of engagement here is that the program is to prove it is safe and that Safety is to assure. It is not that safety has to prove it unsafe. I know you know this; at the same time, I appreciate that we have to have our story together. Bill Readdy has made a statement on the very top slice. Who is his adviser on these decisions he is making at the COFR process time frame? Is it Bill Hill?

At 05:58 AM 2/12/2003 -0500, MGreenfi@hq.nasa.gov wrote:

> Is your cofr brief ready yet

----- Original Message -----
From: William Readdy [wreaddy@hq.nasa.gov]
Sent: 02/11/2003 10:05 PM
To: SOKeefe@hq.nasa..gov; Fred Gregory <fgregory@hq.nasa.gov>; gmahone@hq.nasa.gov; ppastore@hq.nasa.gov; Michael Greenfield <michael.greenfield@hq.nasa.gov>
Subject: FRR Charts

Gents,
I revisited my STS-113 FRR briefing charts and, although the STS-112 bipod foam was mentioned, it was briefed as *no safety of flight* issue. S&MA concurred in that assessment. It was not briefed *at all* in the STS-107 FRR.
V/r,
Reads

Jim

GAFFNEY, ROBERT T. (JSC-JA171) (NASA), 11:49 AM 2/7/2003 -0600, STS-107 Caller Information

From: "GAFFNEY, ROBERT T. (JSC-JA171) (NASA)" <robert.t.gaffney@nasa.gov>
To: "'Jon Mullin'" <Jmullin@hq.nasa.gov>
Subject: STS-107 Caller Information
Date: Fri, 7 Feb 2003 11:49:03 -0600
X-Mailer: Internet Mail Service (5.5.2448.0)

Jon, the attached forms contain the information sheet (JA14 INFORMATION SHEET FOR STS-107 REPORTS OF DEBRIS,) the JSC EOC is using to collect information provided by any source via telephone or fax. When the other centers receive calls or walk-ins, it would be great if the report form could be used and then faxed directly to our operation in Houston at 281-483-5680. Before faxing the report, please call the JSC EOC at 281-483-9780 to get a log number. PLEASE NOTE: THE LOG NUMBER SHOULD ALSO BE ADDED TO ANY DEBRIS BAGS/ENVELOPES/PACKAGES AS WELL AS REFERENCED IN ANY
IMAGERY E-MAILS. So if a citizen or agency says they have some stuff and want to mail it or e-mail it to us, please give our teams a chance find it all again by keeping log numbers associated with reports. The General Information sheet (small text) contains the awareness training provided to call takers. The remaining sheet (also labeled General Information but in large text) contains the short version of what call takers are told, especially about how to treat information they are exposed to.

If citizens or local agencies want to turn in debris they have in their possession or have seen, please develop a process to accept it consistent with mishap investigation evidence procedures and then mail it to the address on the bottom of the JA14 sheet. Imagery should be e-mailed to columbiaimages@nasa.gov. If the file is larger than 10MB, go to the website at http://www.jsc.nasa.gov/instructions.html.

Since this is a mishap investigation, please ask anyone who takes information to impound all REPEAT ALL paper associated with reports they take in accordance with NASA HQ or their center instructions.

Use the 281-483-9780 telephone number to contact the JSC EO Office if we can answer any questions.

Thanks very much for your continued support,

Bob Gaffney
JSC Emergency Preparedness Manager
(281) 483-4249

Bob Gaffney
JSC Emergency Preparedness Manager
(281) 483-4249

GAFFNEY, ROBERT T. (JSC-JA171) (NASA), 11:49 AM 2/7/2003 -0600, STS-107 Caller Information

<<caller information.doc>>

caller information1.doc

Name of person taking this call _____

JA14 INFORMATION SHEET FOR STS-107 REPORTS OF DEBRIS

You should answer the phone: **Johnson Space Center Emergency Operations Center**

Date of Call: _____ Time of Call: _____ [CST]
Circle one: a.m. p.m.

Name of Caller: _____ Representing: _____

Where can you (caller) be reached? Phone # _____

Report of: Circle one: Debris Services Info only Legal claim

Time and day of sighting: _____ Did you witness this sighting? _____yes _____no
Time Zone: Circle one: PST MST CST EST
Circle one: a.m. p.m.

If no, name of witness _____
witness phone # _____

Description of debris:

Number of pieces _____

Aircraft part? _____yes _____no Fluid on debris? _____yes _____no

Size(s): _____ Material Type: _____
(metal, wiring, fiberglass, cloth, tile, etc.)

Color: _____ Shape: _____

Markings? Describe: _____

Location of debris **(Yard, Street, Front, Back of Structure…)**

Street Address: _____

City: _____ State: _____ Zip Code: _____

GPS Location (if known): _____

Or Cross Street/Intersections: _____

Other (highway markers, mileage…): _____

Additional Remarks: _____
(Condition found (e.g. untouched handled?). If handled, what was done?)

_____

_____

Did you take pictures? ___yes ___no If yes: __video __photo ***Reminder: Acquire log number***
If digital, transmit to: Columbiaimages@nasa.gov If larger than 10MB: http://www.jsc.nasa.gov/instructions.html
If prints or video, mail to: NASA Johnson Space Center, Columbia MIT,
Mail Code JA17, Houston, TX 77058-3963

Is this an E-bay report? If so, item # _____ screen name: _____

General Information

- Upon arrival at EOC sign the roster.
- Check message board for policy change notices and form changes.
- Take breaks.
- Record on "Call Volume Log". "Threat Form".
- Fill out the information sheet in its entirety.
- Use only blue or black pen.
- Write legibly.
- Do not write on the back of any form. Staple any additional sheets.
- Ask caller to spell name, city, etc. if you don't know.
- It is okay to accept collect calls. If the caller is concerned about the cost of call, offer to call them back.
- Do not remove anything from this room. All paper trash should be deposited only in the trashcans designated for paper close to the main door in this room. If you are asked to make any copies of anything, don't leave copies or originals in copy room or on copier.
- Do not share or discuss anything you learned in this room with the public or media.
- If the caller is concerned about giving their name or phone number, assure them the information is given only to investigation officials and will never be released to the public.