

**REUSABLE SOLID ROCKET MOTOR ACTING WORKING GROUP**

<b>TITLE/AREA OF RESPONSIBILITY</b>	<b>NAME</b>	<b>MSFC ORG</b>	<b>PHONE (AS REQUIRED)</b>
ACTING CHAIRPERSON	P. McCONNAUGHEY	ED20	OFC 256-544-1599
ALTERNATE	D. MOORE A. SCHORR	MP51 MP51	OFC 256-544-2598
SUPPORT MEMBERS			
STRUCTURAL	J. HAWKINS ALT. V. RICHARD	ED22	OFC 256-544-2780
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 ALT: S. TILLERY	ED34 ED34	OFC 256-544-2660
LOADS	J. TOWNSEND	ED21	OFC 256-544-1499
THERMAL	L. CLAYTON	ED25	OFC 256-544-2322

**SPACE SHUTTLE MAIN ENGINE ACTING WORKING GROUP**

<b>TITLE/AREA OF RESPONSIBILITY</b>	<b>NAME</b>	<b>MSFC ORG</b>	<b>PHONE (AS REQUIRED)</b>
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**

<b>TITLE/AREA OF RESPONSIBILITY</b>	<b>NAME</b>	<b>MSFC ORG</b>	<b>PHONE (AS REQUIRED)</b>
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	TD63	OFC 256-544-1579
	(ALT) E. DASO	TD63	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	QS20	OFC 256-544-8432
	(ALT) A.. DANIELS	QS20	OFC 256-544-7939
PHOTO ENG ANALYSIS	T. RIECKHOFF	TD53	OFC 256-544-7677
MAIN PROPULSION SYSTEM	R. SHEPPARD	MP71	OFC 256-544-7198

Date: Mon, 03 Feb 2003 21:03:57 -0500  
From: Pete Rutledge  
Subject: Soon to be available briefing packages  
To: boconnor@hq.nasa.gov  
Cc: james.d.lloyd@hq.nasa.gov, wayne.frazier@hq.nasa.gov,  
faith.chandler@hq.nasa.gov  
X-Mailer: Microsoft Outlook Express 6.00.2800.1106

Bryan,

Hope all is going well. A couple of briefing packages should be ready for you tomorrow, Tuesday, if you want them. One is a briefing about NASA mishap investigation requirements, updated to include the formation of the Mishap Investigation Team and your Columbia Accident Investigation Board. This is an update of the briefing used for the NTSB meeting; Wayne updated it today. It could probably be e-mailed to you early tomorrow. It mostly (maybe entirely) PowerPoint text, so shouldn't take too long to download at modem speed. The second will be a briefing about the mishap investigation process; i.e., what a mishap board should do; e.g., constructing mishap timeline, interviewing witnesses, constructing fault trees, analyzing data, etc. Faith is working on this one and I suspect it would be available later in the day tomorrow. Do you want either or both of these? Or do you have any more specific needs on these or anything else? I'm e-mailing you from home, but please respond to my work e-mail address.

Thanks,

Pete

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: Tue, 04 Feb 2003 08:46:46 -0500

To: prichard@hq.nasa.gov, prutledg@hq.nasa.gov,

Bill Bihner <wbihner@mail.hq.nasa.gov>

From: James Lloyd <jlloyd@hq.nasa.gov>

Subject: CAC

Cc: code-q@lists.hq.nasa.gov,

"Dr. Michael A. Greenfield" <michael.greenfield@hq.nasa.gov>

Sender: owner-code-q@lists.hq.nasa.gov

Dr. Greenfield is instituting a process for the collection of technical questions and answers and will serve as NASA's technical clearinghouse for release to the outside community. He will be providing details on how this information is to be collected and dispositioned. He has set up an action center (referred to as the CAC) and will chair a meeting each day at 2 pm (location to be provided shortly). Bill Bihner is the Code Q representative and will be attending the meeting starting this afternoon.

I have briefed Dr. Greenfield on our process for providing a list of questions to the CAIB. We will also be involved with supporting Bill Bihner and Dr. Greenfield in developing answers to technical questions where Code Q is the obvious source for the answer. We will also be allowed to review technical answers developed by others as part of the process for Dr. Greenfield's approval for release.

Jim

X-Sender: prutledg@mail.hq.nasa.gov  
X-Mailer: QUALCOMM Windows Eudora Version 4.3.2  
Date: Tue, 04 Feb 2003 09:30:56 -0500  
To: wfrazier@hq.nasa.gov, fchandle@mail.hq.nasa.gov  
From: Pete Rutledge <prutledg@hq.nasa.gov>  
Subject: Fwd: Soon to be available briefing packages

Faith, Wayne,

We have an answer from Bryan--see below--he wants both briefings when they're ready.

Pete

X-Sender: boconnor@mail.hq.nasa.gov  
X-Mailer: QUALCOMM Windows Eudora Version 4.3.2  
Date: Mon, 03 Feb 2003 22:45:57 -0500  
To: prutledg@hq.nasa.gov  
From: boconnor <boconnor@hq.nasa.gov>  
Subject: Fwd: Soon to be available briefing packages

Pete,  
I'll take them both. Thanks to you and Faith and Wayne.  
We're still in the early flail mode here...these guys have a lot to learn before they can even begin to look for root cause.  
Best,

Date: Mon, 03 Feb 2003 21:03:57 -0500  
From: Pete Rutledge  
Subject: Soon to be available briefing packages  
To: boconnor@hq.nasa.gov  
Cc: james.d.lloyd@hq.nasa.gov, wayne.frazier@hq.nasa.gov,  
faith.chandler@hq.nasa.gov  
X-Mailer: Microsoft Outlook Express 6.00.2800.1106

Bryan,

Hope all is going well. A couple of briefing packages should be ready for you tomorrow, Tuesday, if you want them. One is a briefing about NASA mishap investigation requirements, updated to include the formation of the Mishap Investigation Team and your Columbia Accident Investigation Board. This is an update of the briefing used for the NTSB meeting; Wayne updated it today. It could probably be e-mailed to you early tomorrow. It mostly (maybe entirely) PowerPoint text, so shouldn't take too long to download at modem speed. The second will be a briefing about the mishap investigation process; i.e., what a mishap board should do; e.g., constructing mishap timeline, interviewing witnesses, constructing fault trees, analyzing data, etc. Faith is working on this one and I suspect it would be available later in the day tomorrow. Do you want either or both of these? Or do you have any more specific needs on these or anything else?  
I'm e-mailing you from home, but please respond to my work e-mail address.

Thanks,

Pete

O'C

Bryan O'Connor  
Associate Administrator  
Office of Safety and Mission Assurance

-----  
Peter J. Rutledge, Ph.D.  
Director, Enterprise Safety and Mission Assurance Division  
Acting Director, Review and Assessment Division  
Office of Safety and Mission Assurance  
NASA Headquarters, Code QE, Washington, DC 20546

ph: 202-358-0579  
FAX:202-358-2778  
e-mail: [pete.rutledge@hq.nasa.gov](mailto:pete.rutledge@hq.nasa.gov)

**Mission Success Starts with Safety!**

X-Authentication-Warning: spinoza.public.hq.nasa.gov: majordom set sender to owner-code-q using -f

X-Sender: prutledg@mail.hq.nasa.gov

X-Mailer: QUALCOMM Windows Eudora Version 4.3.2

Date: Tue, 04 Feb 2003 09:52:27 -0500

To: code-q@lists.hq.nasa.gov

From: Pete Rutledge <prutledg@hq.nasa.gov>

Subject: Information we prepare and provide in support of HCAT and/or the MIT/CAIB

Sender: owner-code-q@lists.hq.nasa.gov

Code Q staff members,

Please make sure Jim or I get to see and initial off on any new material we prepare for the HCAT and/or the MIT/CAIB. This is not necessary when responding to a request for copies of existing material that has already had management approval in the past. When seeking management buy-off on new material, please bring two copies; one will go to Pam Richardson, who is keeping the official collection of what we have done. When providing existing material, it would be helpful if you would at least let Pam know what you provided (no copy needed as long as you identify it), so that we will have a complete record of what goes out.

Thanks,

Pete

-----  
Peter J. Rutledge, Ph.D.  
Director, Enterprise Safety and Mission Assurance Division  
Acting Director, Review and Assessment Division  
Office of Safety and Mission Assurance  
NASA Headquarters, Code QE, Washington, DC 20546

ph: 202-358-0579

FAX:202-358-2778

e-mail: pete.rutledge@hq.nasa.gov

***Mission Success Starts with Safety!***



From: "Dr. J. Steven Newman" <snewman@hq.nasa.gov>

To: <snewman@hq.nasa.gov>, <boconnor@hq.nasa.gov>, <prutledg@hq.nasa.gov>, <jlloyd@hq.nasa.gov>, <pnapala@hq.nasa.gov>, <wfrazier@hq.nasa.gov>, <fchandle@hq.nasa.gov>, <Tom.Whitmeyer@hq.nasa.gov>, <mkowales@hq.nasa.gov>, <wbihner@mail.hq.nasa.gov>, <jlemke@hq.nasa.gov>, <Laura.W.Doty@nasa.gov>, <Humberto.T.Garrido@nasa.gov>, <Amanda.H.Goodson@nasa.gov>, <Michael.D.Smiles@nasa.gov>, <yolanda.y.marshall@nasa.gov>, <mark.d.erminger@nasa.gov>, <A.H.Phillips@larc.nasa.gov>, <Wentworth.O.Denoon@nasa.gov>, <jmullin@hq.nasa.gov>, <alex.c.adams@nasa.gov>, <Clifton.T.Arnold@nasa.gov>, <matthew.bettridge@fema.gov>, <Steven.Brisbin-1@ksc.nasa.gov>, <david.m.browne1@jsc.nasa.gov>, <mcard@mail.hq.nasa.gov>, <jcastell@mail.hq.nasa.gov>, <ron.castleman@fema.gov>, <Nick.A.Cenci@nasa.gov>, <Lawrence.R.Davis@nasa.gov>, <John.Dollberg-1@ksc.nasa.gov>, <james.duffer@fema.gov>, <moises.dugan@fema.gov>, <mgaier@mail.hq.nasa.gov>, <Mark.Gordon-1@ksc.nasa.gov>, <dominic.l.gorie1@jsc.nasa.gov>, <mgreenfi@mail.hq.nasa.gov>, <Michael.Haddad-1@ksc.nasa.gov>, <wharkins@mail.hq.nasa.gov>, <william.j.harris1@jsc.nasa.gov>, <William.Higgins-1@ksc.nasa.gov>, <malcolm.j.himel1@jsc.nasa.gov>, <jerry.b.holsomback1@jsc.nasa.gov>, <Sharolee.Huet-1@ksc.nasa.gov>, <Bruce.Jansen-1@ksc.nasa.gov>, <m.s.johnson@nasa.gov>, <Wayne.Kee-1@ksc.nasa.gov>, <mlandano@mailhost4.jpl.nasa.gov>, <Roger.Langevin-1@ksc.nasa.gov>, <Edmundo.Lebtron-1@ksc.nasa.gov>, <jlyver@mail.hq.nasa.gov>, <roy.w.malone@nasa.gov>, <pmartin@mail.hq.nasa.gov>, <daniel.j.mullane@nasa.gov>, <rpatrica@mail.hq.nasa.gov>, <pphillip@mail.hq.nasa.gov>, <eraynor@mail.hq.nasa.gov>, <scott.a.seyl1@jsc.nasa.gov>, <lsirota@hq.nasa.gov>, <mstamate@mail.hq.nasa.gov>, <Michael.Stevens-1@ksc.nasa.gov>, <Burton.Summerfield-1@ksc.nasa.gov>, <david.f.thelen1@jsc.nasa.gov>, <Randall.Tilley-1@ksc.nasa.gov>, <swander@hq.nasa.gov>, <Vernon.W.Wessel@grc.nasa.gov>, <gwhite1@mail.hq.nasa.gov>, <david.w.whittle1@jsc.nasa.gov>, <gary.w.johnson@nasa.gov>, <Oscar.Toledo-1@nasa.gov>, <joan.w.broadfoot@nasa.gov>, <deborah.s.bazan1@jsc.nasa.gov>, <Brenda.P.Willis@nasa.gov>, <john.h.casper1@jsc.nasa.gov>, <david.cazes1@jsc.nasa.gov>, <Joseph.C.Cianciola@nasa.gov>, <frank.l.culbertson1@jsc.nasa.gov>, <Angela.V.Daniels@msfc.nasa.gov>, <Diana.Heberling@ssc.nasa.gov>, <marla.g.duhon1@jsc.nasa.gov>, <keith.w.dyer1@jsc.nasa.gov>, <richard.d.gardner1@jsc.nasa.gov>, <whill@mail.hq.nasa.gov>, <cheryl.a.inman1@jsc.nasa.gov>, <Leigh.Martin@msfc.nasa.gov>, <hugo.e.martinez1@jsc.nasa.gov>, <desiree.c.patterson1@jsc.nasa.gov>, <Robert.Nagy-1@ksc.nasa.gov>, <cyndi.l.skains1@jsc.nasa.gov>, <Stephen.Ernest-1@ksc.nasa.gov>, <elizabeth.torres1@jsc.nasa.gov>, <Vicki.W.Rorex@msfc.nasa.gov>, <angelia.d.walker@nasa.gov>, <rosalyn.m.patrick@nasa.gov>, <randall.h.tucker@nasa.gov>, <foster.e.anthony@nasa.gov>, <mike.kennedy@msfc.nasa.gov>.

<allan.k.layne@nasa.gov>, <rmoyer@mail.hq.nasa.gov>, <ajohnson@mail.hq.nasa.gov>, <Donald.J.Campbell@grc.nasa.gov>, <prichard@mail.hq.nasa.gov>, <Thomas.W.Hartline@nasa.gov>

X-your-intranet: <http://107team.intranets.com>

X-Intranets-helpdesk: <mailto:help@intranets.com>

Date: Tue, 04 Feb 2003 15:38:02 GMT

X-mailer: AspMail 4.0 4.03 (SMT412E7EF)

Subject: 107-Team

X-OriginalArrivalTime: 04 Feb 2003 15:38:09.0679 (UTC) FILETIME=[6B7A21F0:01C2CC63]

107-Team

Reminder: This functionality is operating on a third party server operating under an approved, NASA NPG 2810 compliant IT security plan.

As discussed in our telecons the site operates under a set of special ground rules: No ITAR Data, No Export Controlled Data, No Competition Sensitive Data. We can add to that No Investigation Sensitive Data.

Please call if you have any questions (202-358-1408).

Regards/Steve

The site will continue to support NASA SMA community in communication (members & contacts) and public domain information / document / link exchange to support NASA SMA 107-activity.

We are working with GRC and NASA IT community to implement an Enhanced Security functionality that will allow sharing of sensitive information (data covered under ITAR/Export Control). More on this capability in the near future.

From: "Miller-1, Darcy" <Darcy.H.Miller@nasa.gov>  
To: "Faith Chandler (E-mail)" <fchandle@hq.nasa.gov>  
Subject: Crash and Crime Scene Tool  
Date: Tue, 4 Feb 2003 14:10:31 -0500  
X-Mailer: Internet Mail Service (5.5.2653.19)

Faith,

I just received this limitation, so please add it if you decide to send this to someone else. At this time, it would only be good for a small area that has a concentration of parts. See note below.

Darcy

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

From:  
Sent: Tuesday, February 04, 2003 2:09 PM  
To: Miller-1, Darcy  
Subject: RE: OPTIMUS Corporation - AutoDOCS

Darcy,

The system will not be able to reconstruct the scene over 500 mile radius in which debris is being found, however if there was an 1/4 - 1/2 mile area with a known high quantity of debris we could map that particular scene.

Thanks,

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

From: Miller-1, Darcy [<mailto:Darcy.H.Miller@nasa.gov>]  
Sent: Tuesday, February 04, 2003 11:08 AM  
To:  
Subject: RE: OPTIMUS Corporation - AutoDOCS

Is the system mature enough to be used in such a large scale application?

Thank you for offering.

Darcy

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

> From:  
> Sent: Tuesday, February 04, 2003 9:54 AM  
> To: Darcy.H.Miller@nasa.gov

> Subject: OPTIMUS Corporation - AutoDOCS

>

>

> Ms. Miller,

>

>                   , Acting Director of Public Safety gave me your name and  
> contact information. As you may recall he and                    worked on the  
> NASA EPIC project. I am contacting you in regards to another product we  
> developed that came out of the SBIR program, AutoDOCS. It is a crash and  
> crime scene reconstruction system using GPS technology. Points are  
> measured within 1 CM of accuracy and car, plane, etc. parts are input  
> electronically through scroll-down menus on a laptop computer. Upon  
> completion of the measurements and data input, information is then stored  
> in a database with a GIS to display all the points. We are trying to setup  
> a pilot with NTSB for the use in air disasters, and wanted to know if you  
> (or knew someone that would be) interested in using the product for the  
> Columbia Disaster?

>

> If you are interested in learning more about the product or would like to  
> use the system to assist in the data collection at no charge, please feel  
> free to give me a call or email me.

>

> Sincerely,

>

> OPTIMUS Corporation

>

>

**hcat@hq.nasa.gov, 09:13 AM 2/5/2003 -0500, Re: Fwd: Crash and Crime Scene Investigation Softwa**

From: hcat@hq.nasa.gov

Subject: Re: Fwd: Crash and Crime Scene Investigation Software application

Date: Wed, 5 Feb 2003 09:13:07 -0500

To: fchandle@hq.nasa.gov

Cc: prichard@hq.nasa.gov

X-MIMETrack: Serialize by Router on bes1/HQ/NASA(Release 5.0.11 |July 24, 2002) at 02/05/2003  
09:13:09 AM

Thanks

X-Sender: jlemke@mail.hq.nasa.gov  
X-Mailer: QUALCOMM Windows Eudora Version 4.3.2  
Date: Wed, 05 Feb 2003 09:14:13 -0500  
To: fchandle@mail.hq.nasa.gov  
From: jlemke <jlemke@hq.nasa.gov>  
Subject: Fwd: Supporting Bryan on the Columbia Accident Investigation Board (CAIB)

Faith:

Here's the original w/Pete's attachment.

johnl

X-Authentication-Warning: spinoza.public.hq.nasa.gov: majordom set sender to owner-code-q using -f  
X-Sender: prutledg@mail.hq.nasa.gov  
X-Mailer: QUALCOMM Windows Eudora Version 4.3.2  
Date: Sun, 02 Feb 2003 19:49:16 -0500  
To: code-q@lists.hq.nasa.gov  
From: Pete Rutledge <prutledg@hq.nasa.gov>  
Subject: Supporting Bryan on the Columbia Accident Investigation Board (CAIB)  
Sender: owner-code-q@lists.hq.nasa.gov

Code Q staff members,

As you may know Bryan is the ex-officio member of the Columbia Accident Investigation Board. He left for Barksdale AFB this afternoon around noon time. That is where he will meet up with the other CAIB members.

One of our main jobs in the immediate future will be to support him. We can support him in at least three ways: 1. We can respond to his requests. 2. We can collect, on our own initiative, data that could be of use to him (but we need to proceed most carefully on this one). 3. We can suggest questions or avenues of investigation that he might be able to inject into the work of the board.

Attached is a rough list we prepared today of investigative areas--for the most part these are areas in which the SMA community has some special expertise. For each area we have tentatively named an OSMA lead (and in some cases more than one person to work together). If you can think of other areas that we have not captured, and should, let me know. If we've associated you with the wrong area(s) or failed to associate you with the right area(s), let me know. We don't want to disrupt the investigation--we want to be prudent; we want to help Bryan. Think about whether and how you might be able to be helpful in these areas; then, before you take any action, write down your plan in a clear, concise manner, and send it to me--state what you might be able to do and how you would propose to do it. Then wait for a go-ahead from Jim or me. Keep in mind that we have asked the SMA directors at JSC, MSFC, KSC, LaRC, ARC, and SSC to work with us as needed, so this can be part of your plan, if appropriate.

We have also asked all 10 SMA directors to think of questions or issues that Bryan might pursue with the CAIB. I will be collecting these inputs. Your questions and issues are solicited, as well. Put your investigator hat on, think about this, do your own personal fault trees and hazard analyses, send me your ideas. I'll collect them up, as well, to send to Bryan.

Let's do a great job for Bryan on this important matter.

Thanks,

Pete

-----  
Peter J. Rutledge, Ph.D.  
Director, Enterprise Safety and Mission Assurance Division  
Acting Director, Review and Assessment Division  
Office of Safety and Mission Assurance  
NASA Headquarters, Code QE, Washington, DC 20546

ph: 202-358-0579  
FAX:202-358-2778  
e-mail: pete.rutledge@hq.nasa.gov

***Mission Success Starts with Safety!***

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**

 OSMA Support to Bryan O1.doc

As of: February 2, 2003

SMA Support to Bryan O'Connor as Ex-Officio member of Space Shuttle Mishap Investigation Board (SSMIB)

SMA-Related Investigative Area	Remarks	OSMA Lead
Hazard reports, Fault Trees, FMEA	Relates to work of Space Shuttle System Safety Review Panel (SSRP); especially pertaining to ET foam; e.g., impact on Orbiter	Mark K., Bill B.
Risk	Accepted risks for this mission?	Mark K., Bill B.
Payload safety (as cause of mishap)	Relates to work of Payload Safety Review Panel (PSRP). Interest includes potential for hazardous payloads to have caused catastrophe..	Mike Card, John Castellano
Payload safety (safety of recovery)	Includes radiological and other hazardous payload contents	John Lyver/Gil White
Problem trends (HW/SW)	Relates to Problem Reporting and Corrective Action (PRACA); initially PRs dealing with ET foam problems may be of most interest?	Paul Boldon (SW PRs), Mark K., Bill B. (HW PRs)
Quality	Material Review Board actions, repairs, etc., initially especially in regard to foam and tile installation and repair; contractor/supplier surveillance	Tom Whitmeyer
Probabilistic Risk Assessment (PRA)	Initial interest includes 1990 Pate-Cornell PRA of Shuttle tile installation process, as well as current Shuttle PRA	Michael Stamatelatos
Pre-launch reviews	Includes Pre-launch Assessment Reviews, Mission Safety Evaluations, waivers, deviations, rules changes, limited life items, etc.	Mark K., Bill B.
Expected casualty, Ec (post-mishap)	Includes collecting/using data from this mishap to calculate Ec for Shuttle re-entry	Pat Martin (with Maria Tobin)



Software hazards	Includes software changes, software hazard analysis	Paul Boldon, Sharyl Butler (JSC), Martha Wetherholt, IV&V Ctr
SMA Policy	Emergency Preparedness, system safety, R&M, mishap investigation, etc.	Wil Harkins, Jon Mullin
Contingency Planning	A post-mishap look at correctness/effectiveness of our contingency plans; do we need updates/changes?	Gill White
NASA Safety Reporting System (NSRS), Alerts	Includes any NSRS reports or alerts pertaining to foam, tile, ingredients, etc., as well as any current Shuttle-related reports	Eric Raynor
Lessons Learned	Are there any pertinent LL in the database? Ensuring that these new lessons get into the LLLS in the long run.	Eric Raynor
SMA Reviews and Assessments	OEP, PV, FMR spot checks, staff assistance visits, other periodic center visits (including MAF)	Steve Newman, Art Lee, John Lyver
Aerospace Advisory Panel	Includes any pertinent findings	Len Sirota
Training	Of workers on the floor—certification and training for insulation application, repair, etc.	Eric Raynor
Life extension program	We were about to benchmark what USAF does for aging aircraft. Any implications for what NASA does?	Tom Whitmeyer, SLEP Panel (Obs. & Sustainment), Bill Bihner, John Castellano
Mishap Investigation protocol and methodology	Supporting with info on NPDs, NPGs, root cause methods, training for MIB members, briefing packages, etc.	Wayne Frazier, Faith Chandler
Human Factors	What opportunities were there for human factors to contribute to the mishap?	Faith Chandler

Post-mishap implications for ISS	Keeping up-to-date information on affect of this mishap on ISS supportability, etc.	Rich Patrican, Gil White
MIB Web-based work group area	PBMA work group to support information and communication needs of the MIB, including IT security of the posted/transmitted information	Steve Newman, Steve Wander
DoD data	Data that DoD might have that could be useful	Mike Card
Space Shuttle Manufacture	Background and details of the manufacturing process.	Len Sirota

X-Sender: hcat@mail.hq.nasa.gov  
X-Mailer: QUALCOMM Windows Eudora Version 4.3.2  
Date: Fri, 07 Feb 2003 10:12:01 -0500  
To: Faith Chandler <fchandle@hq.nasa.gov>  
From: HCAT <hcat@hq.nasa.gov>  
Subject: Re: Offer of investigation assistance

Thanks Faith, we will add this to the file

At 09:51 AM 2/7/2003 -0500, you wrote:  
An offer of assistance to the Columbia investigation.  
See below.

X-Sender:  
X-Mailer: QUALCOMM Windows Eudora Version 5.1  
Date: Fri, 07 Feb 2003 07:46:53 -0700  
To: fchandle@mail.hq.nasa.gov  
From:  
Subject: Columbia Investigation

**FAITH:**

Please add \_\_\_\_\_ to the list for consideration as a potential investigation team member. Credentials and background are listed below:

\_\_\_\_\_ is a registered Professional Electrical Engineer. He has a Degree in Electrical Engineering from the University of Utah. He is also a Certified Crime Scene Investigator. He has conducted hundreds of accident investigations for over the past forty years, and has taught thousands of people the principles of accident investigation and mishap analysis.

\_\_\_\_\_ is currently the director of the System Safety Development Center (SSDC); a continuation of the SSDC established by the Atomic Energy Commission (AEC). The SSDC has developed and taught the principles of accident investigation to The AEC, IAEA, DOE, DOE Contractors, NASA, OSHA, MSHA, NTSB, other governmental agencies, and industry in the United States and other countries. The SSDC developed the investigation techniques of MORT Charting, Fault Tree Analysis, Barrier Analysis, Change Analysis, Events and Causal Factors Charting, and Root Cause Analysis. The SSDC has been the leader in causal factor determination and corrective action implementation for over three decades.

System Safety Development Center  
2540 Woodhill Way  
Pocatello, ID 83201-2635

-----  
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)

-----

X-Sender: mkowales@mail.hq.nasa.gov  
X-Mailer: QUALCOMM Windows Eudora Version 4.3.2  
Date: Sat, 08 Feb 2003 08:26:19 -0500  
To: fchandle@mail.hq.nasa.gov  
From: Mark Kowaleski <mkowales@hq.nasa.gov>  
Subject: Fwd: Columbia Tragedy Talking Points

Faith,

I think this is it and I already sent to Jim & Pete. One more message will follow.

Thanks for covering the CAC!

Mark

X-Sender: astockin@mail.hq.nasa.gov  
X-Mailer: QUALCOMM Windows Eudora Version 4.3.2  
Date: Fri, 07 Feb 2003 09:54:53 -0500  
To: rdavis@hq.nasa.gov, hrothman@hq.nasa.gov, rcooper@hq.nasa.gov,  
dmcswen@hq.nasa.gov, dcomstoc@hq.nasa.gov, rstephen@hq.nasa.gov,  
mark.kowaleski@hq.nasa.gov, gmartin@hq.nasa.gov, jbingham@hq.nasa.gov,  
astockin@hq.nasa.gov, wbierbow@hq.nasa.gov, adiaz@hq.nasa.gov  
From: Ashley Stockinger <astockin@hq.nasa.gov>  
Subject: Fwd: Columbia Tragedy Talking Points

CAC group,

These are the budget talking points that were discussed in the 2:00 yesterday.

Ashley

X-Sender: dcomstoc@mail.hq.nasa.gov  
X-Mailer: QUALCOMM Windows Eudora Version 4.3.2  
Date: Wed, 05 Feb 2003 22:26:57 -0500  
To: Ashley Stockinger <astockin@hq.nasa.gov>, cac@hq.nasa.gov  
From: dcomstoc <dcomstoc@hq.nasa.gov>  
Subject: Fwd: Columbia Tragedy Talking Points  
Cc: tcoleman@hq.nasa.gov, pcarrawa@hq.nasa.gov, ggaukler@hq.nasa.gov,  
ahenders@mail.hq.nasa.gov, amumford@hq.nasa.gov

Ashley:

Please register this in CAC. Code B will take the lead on this and work it with Code M.

- Doug

From: Brant\_Sponberg@omb.eop.gov

X-Sender: jlloyd@mail.hq.nasa.gov  
X-Mailer: QUALCOMM Windows Eudora Version 4.3.2  
Date: Thu, 20 Feb 2003 12:11:04 -0500  
To: fchandle@hq.nasa.gov  
From: James Lloyd <jlloyd@hq.nasa.gov>  
Subject: Fwd: HF & the CAIB

You'll get this at home also.

X-Sender: boconnor@mail.hq.nasa.gov  
X-Mailer: QUALCOMM Windows Eudora Version 4.3.2  
Date: Thu, 20 Feb 2003 11:49:57 -0500  
To: jmosquer@ems.jsc.nasa.gov  
From: boconnor <boconnor@hq.nasa.gov>  
Subject: Fwd: HF & the CAIB  
Cc: \_\_\_\_\_, James Lloyd <jlloyd@hq.nasa.gov>

Jim,  
Please add this person to our list of potential experts.  
Tx,

X-Sender: jlloyd@mail.hq.nasa.gov  
X-Mailer: QUALCOMM Windows Eudora Version 4.3.2  
Date: Thu, 20 Feb 2003 10:34:19 -0500  
To: boconnor@mail.hq.nasa.gov  
From: James Lloyd <jlloyd@hq.nasa.gov>  
Subject: Fwd: HF & the CAIB

Bryan,

A recommendation from Faith for a disinterested Human Factors expert if the Board would like to obtain one.

X-Sender: fchandle@mail.hq.nasa.gov  
X-Mailer: QUALCOMM Windows Eudora Version 4.3.2  
Date: Thu, 20 Feb 2003 10:05:26 -0500  
To: jlloyd@hq.nasa.gov  
From: Faith Chandler <fchandle@hq.nasa.gov>  
Subject: HF & the CAIB

Jim,

I have noticed that the CAIB does not have human factors expertise.  
Given that 60-90% of accidents in complex systems involve multiple human errors, it is likely

that the board will find that this accident has some link to human error (probably as a contributing factor or an intermediate cause.)

If possible, please note this when you see Bryan this weekend.  
If the CAIB (or its support team) needs an independent HF person, Dr. Scott Shappell, FAA (Oklahoma City), is very well known and has evaluated error in many aviation related investigations. Scott can be reached at

~~~~~

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)

~~~~~

Jim

O'C

Bryan O'Connor  
Associate Administrator  
Office of Safety and Mission Assurance

Jim

**shilding , Frazier\_Wayne, Lloyd\_James, Rutledge\_Peter, 05:03 PM 2/2/2003 -0500, Witness Interview**

To: shilding <shilding@mail.hq.nasa.gov>, Frazier\_Wayne, Lloyd\_James, Rutledge\_Peter

From: Faith Chandler <fchandle@hq.nasa.gov>

Subject: Witness Interviewing

Cc:

Bcc:

Attached: C:\Documents and Settings\fchandle\My Documents\Columbia\Witness Interviews.doc;

Suzanne,

Per your request, here is information on Witness Interviewing.



## Steps to Witness Interviewing

1. Identify the witness.
  - An initial list of witnesses may be provided to you by your lead. If you are not provided with a list, see NPG Appendix E-2, paragraph 1.4 (below) for guidance.
  - One witness may lead you to (identify) another witness.
  - Don't forget management/supervision can be a witness.
  - Don't forget to interview first responders and site security, who can also be witnesses.
2. Get familiar with the scene and the witnesses prior to the interview.
  - Review photographs of the scene.
  - Draw or get map of scene.
  - Review prior written statement from the witness (if one was taken).
3. Interview as soon as possible. (Preferred within 72 hours of accident).
  - Information may be forgotten if interviews are delayed.
  - As witnesses hear from other witnesses via the media, information that is remembered may include more conjecture or opinion and may be less accurate, so interview as soon as possible.
4. Prepare for the Interview.
  - Carefully select the location of the interview.
    - a. A comfortable place that is not too formal.
    - b. A location that provides privacy. (Interview witnesses individually).
  - Make sure all recording equipment is working before the interview.
  - Make sure you have all consumables (e.g., audio or video tapes, papers, pens) so that you do not have to leave an interview to obtain additional supplies.
  - Generate a set of questions for the interview to ensure basic & critical information is gathered. (During the interview, create, and document additional questions as needed.)
  - Have a map or sketch of the scene so that the witness can identify their location.
4. Record the interview.
  - **Obtain witness permission for note taking and/or recording.** (You may want to indicate that recording the interview will assist in ensuring accuracy of their statement).
  - Take detailed notes (e.g., transcribe) or record.
  - Transcribe quickly.
  - Note content of statement, gestures, and voice inflection.
5. Establish rapport with the interviewee.
  - Put witness at ease first and then stay at their level.
  - Insure their understanding of interview/mishap board goals (Read attached statement from NASA NPG Appendix E-1. Verify witness understanding).
  - Do not interrogate the witness.

- Always be non-confrontational.
  - Don't intimidate the witness.
  - Listen carefully to the details.
6. Get the facts.
- Identify the witness' name, title, employer, and place of business. (However, witness may be given the option of not having their name published with the statement.)
  - Identify information concerning the witness' location and the time of the events.
  - Obtain facts concerning what, when, who, where, why, and how.
  - Ask open-ended questions that allow the witness to describe the event.
  - Ask questions that lead to a narrative rather than a yes or no answer.
  - Avoid leading questions.
  - Don't refer to other witnesses or share information learned in other interviews.
  - Be patient.
  - Keep witness talking about and focused on the subject.
  - Make sure that you understand their answers to your questions (Ask follow-up questions, ask the same question in a different way, etc).
  - Be persistent, but open-minded. If they can't or won't answer, note and continue.
  - Always be courteous and considerate to the interviewee.
  - Document any reported injuries and/or complaints. (After interview, verify that these have been recorded).
7. Adjust to the types of witnesses.
- Injured witness – be diplomatic.
  - Timid witness – stress your need for their help.
  - Illiterate witness – avoid embarrassing them.
  - Opinionated witness – be sensitive to their attitudes, carefully sift what they say. Avoid arguing with the witness.
  - Talkative witness – request that they stick to the facts.
  - Know-nothing witness – may have some information. Don't dismiss too quickly.
8. Get witness agreement.
- Rephrase questions and repeat answers to insure that you understand correctly.
  - Read notes to witness to verify accuracy.
  - Ask witness to sign to verify that the notes are accurate (optional).
9. Conclude.
- Give witness a copy of his/her statements.
  - Sincerely thank the witness.
  - Advise them that they may be called back.
  - Provide them with a phone number and address if they recall additional information that they wish to communicate.

**Text from  
NPG 8621.1: NASA Procedures and Guidelines for Mishap Reporting,  
Investigating and Recordkeeping**

**Appendix E-1. Statement to Witnesses**

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The purpose of this safety investigation is to determine the root cause(s) of the mishap that occurred on \_\_\_\_\_, and to develop recommendations toward the prevention of similar mishaps in the future. It is not our purpose to place blame or to determine legal liability. Your testimony is entirely voluntary, but we hope that you will assist the board to the maximum extent of your knowledge in this matter.

Your testimony will be documented and retained as part of the mishap investigation report background files but will not be released as part of the investigation board report.

NASA will make every effort to keep your testimony confidential and privileged to the greatest extent permitted by law. However, the ultimate decision as to whether your testimony may be released may reside with a court or administrative body outside NASA.

For the record, please state your full name, title, address, employer, and place of employment.

**Appendix E-2. Locating and Interviewing Witnesses**

---

**1.1 Introduction**

**The category of eyewitnesses in this section will be interpreted as persons in the vicinity of the mishap site at the time of the mishap.** Such persons as designers, manufacturers, physicians, maintenance personnel, mechanics, metallurgists, crewmembers, and other experts in specialized fields shall not, for purposes of this section, be considered as eyewitnesses unless they observed the mishap firsthand.

NOTE: Witness statements include all factual statements obtained during the course of the investigation from any party providing evidence or testimony.

**1.2 Philosophy**

1.2.1 The NASA philosophy of questioning witnesses to mishaps is to **interview rather than interrogate**. "Interview" connotes a cooperative meeting where the interviewer approaches the interviewee as an equal. The cooperation of the interviewee is sought; encouragement is given to tell the story freely without interruption or intimidation. An interview is usually conducted informally with a voluntary or cooperative answering of questions although safety investigation teams also occasionally conduct formal interviews. Even in those cases, witnesses are not sworn in.

1.2.2 "Interrogation" is considered questioning done on a formal or authoritative level such as a lawyer/witness situation, or a police officer/suspect session.

1.2.3 It is the interview rather than the interrogation philosophy which is desirable in the questioning of witnesses by mishap investigators. **Witnesses shall be informed that their testimonies are to be documented and will be retained as part of the investigation report background files but will not be released as part of the investigation report.** Witness shall also be informed that NASA will make every

effort to keep their testimonies confidential and privileged to the greatest extent permitted by law. (See Appendix E-1) However, the ultimate decision as to whether their testimonies may be released may reside with a court or administrative body outside NASA.

### **1.3 Purpose**

1.3.1 The investigator interviews mishap witnesses with two basic objectives in mind: (1) To find out what the witness observed or did, (2) To find out the witness's opinion of potential causes of the mishap.

1.3.2 The thoroughness with which these two objectives are carried out is contingent upon the thoroughness of the investigator. The experienced investigator realizes that bits of seemingly insignificant information may assume great importance when combined with investigation findings in other areas.

**NOTE: The following are excerpts with modifications, from Federal Railroad Administration (FRA) literature.**

### **1.4 Locating Eye Witnesses**

1.4.1 Locating mishap witnesses often requires an extensive search of the mishap site area. The following potential sources are intended as a guide in supplementing the investigator's ingenuity in locating witnesses.

1.4.2 Residents in the vicinity of the site may have information regarding time of the mishap, engine sound, duration of sound, fluctuation of dynamic level, unusual noises, local weather, relative speed, heading, initial condition of wreckage, rescue operations, etc.

1.4.3 Local authorities often will have names of witnesses.

1.4.4 Service personnel; e.g., ticket agents, dispatchers, operators, station attendants, waiters, store clerks, etc., may have valuable witness information.

1.4.5 Witnesses who believe they possess significant information often contact newspaper offices.

1.4.6 A plea, via local news media, may encourage the reticent or transient witness to contact the mishap investigation headquarters. The address and telephone number of the mishap investigation headquarters must be included.

1.4.7 Temporary area personnel such as letter carriers, delivery personnel, public utility employees, repair personnel etc., who may have been in the area at the time of the mishap may have pertinent information.

1.4.8 Expeditious arrival at the site facilitates the questioning of sightseers and the curious regarding what attracted them to the site. Those spectators may also know of other witnesses who have departed the site.

1.4.9 Rescue personnel can often provide significant occupant location or status information prior to or at the beginning of rescue operations.

1.4.10 One witness may lead to another. Ascertain whether or not the witness was alone at the time of the observation.

### **1.5 Witness Location Significance**

1.5.1 The exact spot from which a witness makes an observation may explain differences from that of other witnesses in the mishap vicinity. A witness location chart, to be used in conjunction with the written statement, should be prepared for clarification purposes.

1.5.2 A witness downwind of a mishap may often hear sounds not audible to the upwind observer.

1.5.3 Sound is deflected and distorted by walls or buildings and may cause the witness to erroneously report direction, sound origin, or dynamic level.

1.5.4 Noise level at the point of observation may account for a witness missing significant sounds noted by other observers.

1.5.5 The witness looking toward the sun sees only a silhouette, while the witness whose back is toward the sun may note color and other details.

1.5.6 A witness located in a group may be influenced by the power of suggestion. An outspoken member of the group might exclaim, "Those two trains missed a collision by inches!" when, in fact, the lateral separation was 100 feet. The type of individual who dislikes being critical of others reports that the trains passed in close proximity when in reality the initial impression was that there was adequate separation.

## **1.6 Expediting the Interviewing of Witnesses**

1.6.1 Prompt arrival at the mishap site is probably the investigator's finest investigation aid. It affords the opportunity of examining the wreckage before excessive disturbance, and it permits questioning of witnesses before they reflect on their observations. The investigator is urged to visit the mishap site, survey the situation, and decide upon certain questions witnesses could answer. Witnesses forget as time elapses. Association with other witnesses and other people influences them. They read newspapers, listen to the radio, and watch television, and the news media has its effect on the witness. The witness, like the fisherman, may embellish the story when listeners are less attentive than when the story was originally told. The best solution for remedying these witness frailties is to interview the witness promptly. A memory experiment associated with time lapse was conducted by a group of psychologists and revealed the following facts of significance to the witness interviewer:

**1.6.1.1 Interviews taken immediately following an occurrence contained maximum detail and were generally more complete.**

1.6.1.2 After a 2-day delay the information was more general with fewer specifics, but the main or more vivid points remained.

1.6.1.3 After a 7-day delay a few of the more vivid events remained but there was considerably more conjecture, analysis, and opinion injected by the witness. Witnesses, when contacted promptly, are usually appreciative of the need for mishap investigation and the promotion of safety. Some witnesses may consider the interview an imposition and become indignant and impatient when asked to recount their observations. This situation is unfortunate, but preferable to the witness who complains about the complacency of the mishap investigators who never made a contact.

1.6.2 The intelligent witness is aware of voids or blanks in the statement (which the trained interviewer realizes exists in all observations) and endeavors to eliminate them

through the application of logic or reasoning. When a witness has time to reflect on the observations, there is more time to modify or supplement the facts in the interest of coherency. Maximum witness reliability can best be achieved by prompt interviewing.

1.6.3 Occasionally, subsequent evidence dictates that certain witnesses be re-questioned. The re-questioning of a witness does not necessarily indicate that the interviewer was remiss in the conduct of the initial interview. Instead, the investigator may employ this technique with the witness who appears to rationalize and analyze during the initial interview. The investigator would attempt to separate fact and analysis by observing whether or not the more vivid areas of observation were presented as they were initially, and whether areas of suspected conjecture and opinion were analyzed differently than when the witness was first interviewed. By this means, the investigator would attempt to separate fact and analysis and verify witness reliability. Re-questioning a witness may also be in order in confirming technical group findings.

## 1.7 Aids to Interviewing

1.7.1 Successfully interviewing the mishap witness is primarily an application of common sense. The interviewer should show the witness the same consideration that the interviewer would appreciate if the situation were reversed. The experienced interviewer usually finds and adopts an effective style or technique in interviewing witnesses. The following suggested interviewing tips for the novice interviewer also serve as a review or checklist for the experienced mishap investigation witness interviewer.

1.7.2 During the initial narration by the witness it is advisable to take notes. The **note taking should be unobtrusive, and only with the consent of the witness.** Even with the consent of the witness, discretion should be used, and note taking should cease if it is distracting to the witness. Notes should not be so extensive that the witness becomes absorbed with what the interviewer is doing. Explain to the witness that the notes are used to suggest areas that may require further explanation.

1.7.3 Frequently the witness has difficulty putting into words what was observed. In cases such as this, explanatory sketches or diagrams are valuable supplements to the witness statement. They should not be construed, however, as substitutes for the narrative statement. When there is doubt concerning the exact meaning of a statement, check the answer. The simplest method is to rephrase the answer and get the witness to confirm it.

1.7.4 Courtesy and consideration should be afforded the witness at all times. Be patient if the witness has difficulty in remembering details. Normal witness observations are expected to have periodic voids. If the witness is indefinite in a given area, record the statement that way. Do not insist that the witness give a straight "yes" or "no" answer.

1.7.5 Attempt to have witnesses confine their comments to personal observations. Avoid hearsay or areas not within their personal knowledge. If a witness reports that someone else described the mishap and thus provided the information, take the name of the individual and contact the person at a later date. Get the full meaning of each statement of the witness. Analyze each answer carefully for suggestions or leads to further questions.

1.7.6 After the witness has completed the narrative, proceed with specific questions relative to areas where notes were made. Keep questions simple and avoid jargon, slang, or terminology that could be foreign to the witness.

1.7.7 Use the straightforward and frank approach in questioning the witness as opposed to the shrewd or clever techniques such as what might be used by an attorney when the witness is hostile or not cooperative. The primary purpose is obtaining information from the witness and, in most instances, not tricking or trapping the witness in an unguarded statement.

1.7.8 **Avoid arguing with the witness concerning moral responsibility of the crew, operator, or public.** Witnesses have been known to regard the interview as a medium for voicing their opinions on operations, noise, and other activities that annoy them. Attempt to keep the witness confined to observations relative to the mishap.

1.7.9 Do not assist the witness when there is difficulty describing some technical phase. The statement should be in the words and terms the witness understands.

1.7.10 Percentages and fractions, when used by a witness in describing an event, should be translated into exact descriptions. There is a tendency to exaggerate in terms of percentages or fractions of the whole.

1.7.11 **The wording of the question is very important.** The following example illustrates how answers are affected by rewording the question. "Should the United States do all in her power to promote world peace?" Of the people questioned, 9796 answered, "Yes." The question was reworded: "Should the United States become involved in plans to promote world peace?" In this instance only 6096 answered, "Yes." The connotation of the word "involved" made the difference.

1.7.12 Qualifying the witness is important in establishing observation credibility. Witness vocation and experience should be established. When a mechanic describes the sound of an engine as surging or backfiring, this observation should be more reliable than a similar observation of a person totally unfamiliar with the operations in question.

1.7.13 **Use the individual versus the collective witness interview.** The collective witness interview allows witnesses to hear the statements of others. In hearing these statements, witnesses could possibly take information that is mentioned by others and use this information to fill blanks in their own observations. Many times the collective witness interview will result in one witness contradicting and correcting another. In the collective witness interview, one witness may be influenced by the statement of another. Believing one of the witnesses knows more about the operation may cause others to alter details to conform with the statement of the first witness. Conformity of witness observation is not necessarily what the mishap investigator desires.

1.7.14 Use of a tape recorder is a matter of individual interviewer preference. When determining whether to use a tape recorder, the interviewer should consider the following:

- a. **A signed written statement from the witness is desirable.**
- b. The tape must be transcribed and the transcription forwarded to the witness for signature.
- c. The witness must review his/her transcription and edit it for correctness .
- d. Some witnesses concentrate more on the microphone than on their observations.
- e. The environment may not be conducive to recording.
- f. The mechanics of operating the tape recorder may be a disadvantage; e.g., changing tape in the middle of an interview, faulty recording due to an inexperienced operator, or mechanical malfunction may cause loss of information.
- g. Each witness should be provided with a copy of his/her statement.

1.7.15 Courtesy is just as important in concluding the witness interview as it is in conducting it. **Thank the witness for cooperating**, providing the information, and preparing the signed statement; bear in mind that the statement was voluntary and, perhaps, given during the time that the witness may have allotted for something else. Provide a phone number and address where additional information can be called in or mailed if the witness recalls things to be added to the statement.

1.7.16 It is occasionally necessary to assist certain well-qualified, observant witnesses with the organization of their statements. A few minutes spent here will aid future readers in grasping the full significance of the information. Valuable witness



interviews have been wasted because an investigator has failed to obtain a recorded statement in an understandable manner. Application of the following suggestions may help avoid this problem.

- a. Assist the witness with the mechanics of organizing the written statement. Suggest the use of an outline if the witness appears to have difficulty in organizing the report and collecting related thoughts.
- b. Encourage the witness to use drawings, sketches, or photographs if they will help clarify the written statement. Drawings, sketches, or photographs are merely supplements to the report and do not take the place of a written statement.
- c. Assist the witness in organization only. Do not aid the witness with terminology; the statement should be the words of the witness.
- d. Witnesses tend to minimize or omit observations that, to them, have little significance. The investigator's background should provide guidance as to the significance of the information to be included in the statement of the witness. Frequently, relatively insignificant information becomes vital to determining the cause of the mishap once the pieces of information have been put together by the experienced interviewer.

1.7.17 A witness will occasionally omit information from a written statement that was included in an oral description of the mishap. Ensure that omissions are inserted in the written report.

1.7.18 A professional approach to witness interviewing requires that the witness be provided with a copy of his/her statement. This is a common courtesy which should be afforded the witness. The copy may bring to mind additional observations the witness made relative to the mishap when there is an opportunity to leisurely reread the statement.

## **1.9 Locating and Interviewing Witnesses-Review.**

Normally, witnesses will have been identified and located prior to the investigator's arrival at the point of investigation. It is important to secure information from witnesses as soon as possible after the mishap has occurred. Statements should contain as much detailed information as possible to minimize the necessity of recalling witnesses. Extensive use should be made of voice recorders and subsequent transcriptions.

1.9.1 Witness Location - Early witness location and interview are often important in establishing details of any mishap. This appendix provides helpful information concerning techniques and aids for conducting effective interviews. Names of witnesses should be obtained by safety representatives or other personnel who arrive at the site first (after doing everything reasonable to aid the injured and prevent further damage or loss of evidence). As part of preplanning, security and safety personnel and others likely to arrive early at mishap sites should be prepared to cope with traumatic circumstances and place an appropriate priority on the importance of protecting evidence and obtaining names, addressees, and telephone numbers of witnesses. Preplanning for catastrophic mishaps should provide for designated personnel to receive periodic training in emergency and disaster assistance; i.e., evacuation, emergency assistance to victims, protection of mishap/disaster scene,

threats and panic management, and collection and protection of evidence/witnesses. Instruction on the protection of hazardous areas should include factors such as toxic gas, radiation, explosives, electrical, flammables, breathing equipment, rescue equipment, and safety equipment.

1.9.2 Witness Identification - Witnesses should, for reference purposes, be identified by name, title, employer, and place of business. However, they may be given the option of not having their name published with the statement. Even so, the witnesses should be informed that their identities might have to be released in response to the courts or other requirements of law. If a witness has professional background, skill, or experience which is directly related to, or would aid in evaluating the testimony, this information should be recorded (written or voice recording).

**1.9.3 Information Provided to Witnesses - Witnesses shall be informed that their testimonies are to be documented and will be retained as part of the investigation report background files and will not be released as part of the investigation report unless the testimony is particularly important to the findings or it is necessary to release the testimony in response to the courts or other requirements of law.**

1.9.4 Witness Locations and Conditions - The location and conditions in which the witness viewed the events or occurrences should be entered on a witness location chart to be used in conjunction with the statement.

1.9.5 Witness Freedom to Describe - Witnesses should be allowed complete freedom in describing pertinent events relative to the mishap. Leading questions or interruptions may change the course of thought or association, causing the omission of important details.

1.9.6 Questions for Witnesses - When a witness has presented the factual evidence, specific questions should then be asked.

1.9.7 Corroboration of Testimony - Witness testimony should be corroborated whenever possible. It is advisable to interview all witnesses whose observations of the mishap were from different locations. Statements may then be compared to detect and discount inaccurate information. Statements and physical evidence at the scene of the mishap should also be correlated.

1.9.8 Privacy of Interview - Each witness should be interviewed privately since some witnesses may be influenced by the stories of others. Witnesses should be interviewed in the presence of other witnesses or supervisory personnel only if circumstances exist where it cannot be avoided.

1.9.9 Testimony Inaccuracies - Testimony by witnesses, especially those who have been injured or involved in the mishap, may contain inaccuracies. It is desirable to have verbatim transcripts of testimonies for evaluation.

1.9.10 Supplementary Statements - Witnesses should be encouraged to supplement their original statements if, upon reflection, they wish to supply additional information. Such additions, amendments, and corrections should be recorded without modifying the text of the original statement.

1.9.11 Signed Statement - It is desirable to have the witness sign the statement to verify the accuracy of the transcript. However, the witness may submit an unsigned statement or the interviewer may summarize a verbal statement.



To: Pete Rutledge <prutledg@hq.nasa.gov>  
From: Faith Chandler <fchandle@hq.nasa.gov>  
Subject: Re: Fwd: Data systems support for wreckage recovery at Barksdale  
Cc:  
Bcc:  
Attached:

Pete,

FYI...

I also recommended this to Bryan.  
He and I spoke about it on Sunday.

At 09:29 AM 2/4/2003 -0500, you wrote:

Yuri,

Yes, in fact we (Pat Martin) had gone to Theron Bradley (on Saturday) and asked if, based on his CONTOUR experience with IO, he would want us to call on ECS to support the Columbia AIB. He suggested we hold off a decision on that. We mentioned it to Bryan, as well, as a useful option, so it was on his mind, as well. I'm glad that connection ended up being made one way or the other. I think IO will be a valuable tool for the board.

Pete

At 09:14 AM 2/4/2003 -0500, you wrote:

Pete,

Just to give you a heads up we've sent a team down to Shreveport last night to support Vern and his folks. We've also assembled a tiger team at ARC to work some of the scaling and interface issues of IO based on the initial feedback from the CONTOUR mishap.

I'll keep you posted as events warrant.

tx, -yuri

-----

Vern,

be advised that James Williams and Ian Sturken from NASA Ames will arrive in Shreveport late tonight and will contact you on your cell in the morning.

They are bringing laptops that with web access will provide access to InvestigationOrganizer on the Ames server. They will also bring a copy of the software that can be loaded onto a local machine if necessary. They are ready to work with you and others to structure the data fields and data relationships to meet the requirements of the investigation. We can then work out the procedures and resources for training and data entry.

I'll be in contact with them throughout the days but feel to contact me directly as well.

take care,  
Tina

-----  
From: Ellingstad Vern <Ellingv@ntsb.gov>  
To: "Yuri Gawdiak (E-mail)" <ygawdiak@mail.arc.nasa.gov>  
Cc: "Tina L Panontin (E-mail)" <Tina.L.Panontin@nasa.gov>,  
"whill@hq.nasa.gov" <whill@hq.nasa.gov>,  
Benzon Robert  
<BENZONR@ntsb.gov>, Hilldrup Frank <HILLDRF@ntsb.gov>,  
"Richard.M.Keller@nasa.gov" <Richard.M.Keller@nasa.gov>,  
Clark John  
<clarkj@ntsb.gov>  
Subject: Data systems support for wreckage recovery at Barksdale  
Date: Mon, 3 Feb 2003 14:35:18 -0500  
X-OriginalArrivalTime: 03 Feb 2003 19:26:28.0625 (UTC) FILETIME=[2645A810:01C2CBBA]

As I indicated in our conversation, there is an urgent need to quickly implement a database to capture information pertinent to each piece of wreckage that is recovered from Columbia. I believe that the InvestigationOrganizer that Tina Panontin and her group at Ames have developed provides the proper infrastructure to accomplish this.

The most important immediate need is to implement a procedure to associate a unique identifier to each recovered piece (or collection of pieces) along with a basic set of descriptive information. It is my understanding that the MIT has implemented a tagging system that uses the name of the recovery team leader and a sequential number to uniquely identify each part, and records the following information:

- \* Lat/long
- \* Date tagged
- \* Rough description
- \* Hazardous material (yes/no)
- \* Photo # (will need to be tied to whatever photo db is established)
- \* Part Number (if present)
- \* Batch identifier for small parts.

Obviously we can broaden this set of variables if appropriate. It will also be important to provide hooks to other datasets, such as radar target tracks, etc.

I intend to fly to Shreveport in the morning. I would suggest that you launch two or three people from NASA Ames and that we tag up in the morning. I will let you know when I have found a place to stay. I assume that we will have facilities available at Barksdale and will try to work that out with our folks on the ground there (Benzon and Hilldrup) before I head out.

I would suggest that the Ames people bring along whatever hardware they need to set up the data system and provide for data entry. We will probably need to anticipate training people to do data entry.

Please let me know if there are any difficulties with this plan. Thanks.

Vern Ellingtad

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Peter J. Rutledge, Ph.D.  
Director, Enterprise Safety and Mission Assurance Division  
Acting Director, Review and Assessment Division  
Office of Safety and Mission Assurance  
NASA Headquarters, Code QE, Washington, DC 20546

ph: 202-358-0579  
FAX:202-358-2778  
e-mail: [pete.rutledge@hq.nasa.gov](mailto:pete.rutledge@hq.nasa.gov)

**Mission Success Starts with Safety!**

To: prichard@hq.nasa.gov  
From: Faith Chandler <fchandle@hq.nasa.gov>  
Subject: witness interviews - Columbia  
Cc:  
Bcc:  
Attached: U:\q\_groups\QALL\NPG 8621Overview\Witness Interviews.doc;

Pam,

Here is the "interview notes" that were provide to the HCAT and distributed to the field over the weekend.

## Steps to Witness Interviewing

1. Identify the witness.
  - An initial list of witnesses may be provided to you by your lead. If you are not provided with a list, see NPG Appendix E-2, paragraph 1.4 (below) for guidance.
  - One witness may lead you to (identify) another witness.
  - Don't forget management/supervision can be a witness.
  - Don't forget to interview first responders and site security, who can also be witnesses.
2. Get familiar with the scene and the witnesses prior to the interview.
  - Review photographs of the scene.
  - Draw or get map of scene.
  - Review prior written statement from the witness (if one was taken).
3. Interview as soon as possible. (Preferred within 72 hours of accident).
  - Information may be forgotten if interviews are delayed.
  - As witnesses hear from other witnesses via the media, information that is remembered may include more conjecture or opinion and may be less accurate, so interview as soon as possible.
4. Prepare for the Interview.
  - Carefully select the location of the interview.
    - a. A comfortable place that is not too formal.
    - b. A location that provides privacy. (Interview witnesses individually).
  - Make sure all recording equipment is working before the interview.
  - Make sure you have all consumables (e.g., audio or video tapes, papers, pens) so that you do not have to leave an interview to obtain additional supplies.
  - Generate a set of questions for the interview to ensure basic & critical information is gathered. (During the interview, create, and document additional questions as needed.)
  - Have a map or sketch of the scene so that the witness can identify their location.
4. Record the interview.
  - **Obtain witness permission for note taking and/or recording.** (You may want to indicate that recording the interview will assist in ensuring accuracy of their statement).
  - Take detailed notes (e.g., transcribe) or record.
  - Transcribe quickly.
  - Note content of statement, gestures, and voice inflection.
5. Establish rapport with the interviewee.
  - Put witness at ease first and then stay at their level.
  - Insure their understanding of interview/mishap board goals (Read attached statement from NASA NPG Appendix E-1. Verify witness understanding).
  - Do not interrogate the witness.



- Always be non-confrontational.
  - Don't intimidate the witness.
  - Listen carefully to the details.
6. Get the facts.
- Identify the witness' name, title, employer, and place of business. (However, witness may be given the option of not having their name published with the statement.)
  - Identify information concerning the witness' location and the time of the events.
  - Obtain facts concerning what, when, who, where, why, and how.
  - Ask open-ended questions that allow the witness to describe the event.
  - Ask questions that lead to a narrative rather than a yes or no answer.
  - Avoid leading questions.
  - Don't refer to other witnesses or share information learned in other interviews.
  - Be patient.
  - Keep witness talking about and focused on the subject.
  - Make sure that you understand their answers to your questions (Ask follow-up questions, ask the same question in a different way, etc).
  - Be persistent, but open-minded. If they can't or won't answer, note and continue.
  - Always be courteous and considerate to the interviewee.
  - Document any reported injuries and/or complaints. (After interview, verify that these have been recorded).
7. Adjust to the types of witnesses.
- Injured witness – be diplomatic.
  - Timid witness – stress your need for their help.
  - Illiterate witness – avoid embarrassing them.
  - Opinionated witness – be sensitive to their attitudes, carefully sift what they say. Avoid arguing with the witness.
  - Talkative witness – request that they stick to the facts.
  - Know-nothing witness – may have some information. Don't dismiss too quickly.
8. Get witness agreement.
- Rephrase questions and repeat answers to insure that you understand correctly.
  - Read notes to witness to verify accuracy.
  - Ask witness to sign to verify that the notes are accurate (optional).
9. Conclude.
- Give witness a copy of his/her statements.
  - Sincerely thank the witness.
  - Advise them that they may be called back.
  - Provide them with a phone number and address if they recall additional information that they wish to communicate.

**Text from  
NPG 8621.1: NASA Procedures and Guidelines for Mishap Reporting,  
Investigating and Recordkeeping**

**Appendix E-1. Statement to Witnesses**

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The purpose of this safety investigation is to determine the root cause(s) of the mishap that occurred on \_\_\_\_\_, and to develop recommendations toward the prevention of similar mishaps in the future. It is not our purpose to place blame or to determine legal liability. Your testimony is entirely voluntary, but we hope that you will assist the board to the maximum extent of your knowledge in this matter.

Your testimony will be documented and retained as part of the mishap investigation report background files but will not be released as part of the investigation board report.

NASA will make every effort to keep your testimony confidential and privileged to the greatest extent permitted by law. However, the ultimate decision as to whether your testimony may be released may reside with a court or administrative body outside NASA.

For the record, please state your full name, title, address, employer, and place of employment.

**Appendix E-2. Locating and Interviewing Witnesses**

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**1.1 Introduction**

**The category of eyewitnesses in this section will be interpreted as persons in the vicinity of the mishap site at the time of the mishap.** Such persons as designers, manufacturers, physicians, maintenance personnel, mechanics, metallurgists, crewmembers, and other experts in specialized fields shall not, for purposes of this section, be considered as eyewitnesses unless they observed the mishap firsthand.

**NOTE:** Witness statements include all factual statements obtained during the course of the investigation from any party providing evidence or testimony.

**1.2 Philosophy**

1.2.1 The NASA philosophy of questioning witnesses to mishaps is to **interview rather than interrogate**. "Interview" connotes a cooperative meeting where the interviewer approaches the interviewee as an equal. The cooperation of the interviewee is sought; encouragement is given to tell the story freely without interruption or intimidation. An interview is usually conducted informally with a voluntary or cooperative answering of questions although safety investigation teams also occasionally conduct formal interviews. Even in those cases, witnesses are not sworn in.

1.2.2 "Interrogation" is considered questioning done on a formal or authoritative level such as a lawyer/witness situation, or a police officer/suspect session.

1.2.3 It is the interview rather than the interrogation philosophy which is desirable in the questioning of witnesses by mishap investigators. **Witnesses shall be informed that their testimonies are to be documented and will be retained as part of the investigation report background files but will not be released as part of the investigation report.** Witness shall also be informed that NASA will make every

To: jlemke <jlemke@hq.nasa.gov>  
From: Faith Chandler <fchandle@hq.nasa.gov>  
Subject: Re: Supporting Bryan on the Columbia Accident Investigation Board (CAIB)  
Cc: prutledg@hq.nasa.gov  
Bcc:  
Attached: C:\Documents and Settings\fchandle\My Documents\Columbia\Faith's possible tasks.doc;

See attached for my possible contribution.

At 04:49 PM 2/4/2003 -0500, you wrote:

At 07:49 PM 2/2/2003 -0500, Pete wrote:

Attached is a rough list we prepared today of investigative areas--for the most part these are areas in which the SMA community has some special expertise. For each area we have tentatively named an OSMA lead (and in some cases more than one person to work together). If you can think of other areas that we have not captured, and should, let me know. If we've associated you with the wrong area(s) or failed to associate you with the right area(s), let me know. We don't want to disrupt the investigation--we want to be prudent; we want to help Bryan. Think about whether and how you might be able to be helpful in these areas; then, before you take any action, write down your plan in a clear, concise manner, and send it to me--state what you might be able to do and how you would propose to do it. Then wait for a go-ahead from Jim or me. Keep in mind that we have asked the SMA directors at JSC, MSFC, KSC, LaRC, ARC, and SSC to work with us as needed, so this can be part of your plan, if appropriate.

There have been some questions about the attachment to the above email. Therefore I'd like to parse and restate Pete's direction. The specific **action** asked of us is:

1. "Think about whether and how you might be able to be helpful in these areas." If your name is next to the item, this means we are asking YOU if you think there is something to be done that would be helpful. If the answer is NO--so advise your boss.
2. If the answer is YES: "then, before you take any action, write down your plan in a clear, concise manner, and send it to me--state what you might be able to do and how you would propose to do it." Do not work the action--explain how it could be worked--including who, what, etc. (For QS--please run the plan by me before you send to Pete.)
3. "Then wait for a go-ahead from Jim or me (Pete)." (Pete--please run the QS go-aheads through me with a copy to Sylvia for tracking purposes.)

Easy as 1-2-3. (QS: can we do ours by COB Thursday? Thanks.)

johnl

John Lemke  
Manager, System Safety Engineering

**jlemke, 11:31 AM 2/5/2003 -0500, Re: Supporting Bryan on the Columbia Accident Investigation Boa**

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**

## **Brief Description of Faith's Possible Contributions to the Investigation**

### **Fault Tree / Root Cause Analysis**

Provide assistance by:

- Creating fault trees and/or performing root cause analysis for the investigation.
- Checking logic/flow of fault trees created by others.
- Ensuring that trees are comprehensive and include all possible areas by using the IAT-M and other investigation tools.
- Verify that fault trees/root cause analysis has adequately included and analyzed human error and unsafe actions.
- Verify that the analysis has gone beyond the identification of proximate causes and has identified root causes.

### **Mishap Investigation Methodology & Protocol**

Provide assistance by:

- Developing and providing training briefings for the CAIB.
- Assist CAIB work through the investigation process ...create three column list, create time line (or evaluate time line for completeness), create fault trees, create event causal-factor tree, perform change analysis, perform barrier analysis, complete root cause analysis, organize report per NPG.
- Verify that the report contents have desired elements and facts flow to findings and recommendations.
- Assist CAIB interview witnesses (e.g., prepare questions for interviews).

### **Human Factors**

Provide assistance by:

- Evaluating the impact of human actions/ errors in the processing, operations, and decision making of Columbia's launch.
- Assist in the development of branches of the fault tree/event tree and root cause analysis that indicates human action was a factor.
  - Evaluate potential errors that could have occurred in the foam processing (e.g., development of a Human Factors FMEA for foam processing, HF FMEA for decision making leading to acceptance of risk, or perform similar analysis for legs of the tree that appear to be significant).
  - Assist in the evaluation of team errors and performance that may have contributed to the accident.
- Coordinate the Human Factors analysis in the investigation... identify and lead a team of seasoned (e.g., from FAA, NTSB, DOD, etc) to evaluate the accident from a human factors perspective.

To:  
From: Faith Chandler <fchandle@hq.nasa.gov>  
Subject: Re: Columbia Investigation  
Cc:  
Bcc:  
Attached:

Thanks.

This has been forward to the Headquarters Contingency Action Team

At 07:46 AM 2/7/2003 -0700, you wrote:

**FAITH:**

Please add \_\_\_\_\_ to the list for consideration as a potential investigation team member. Credentials and background are listed below:

\_\_\_\_\_ is a registered Professional Electrical Engineer. He has a Degree in Electrical Engineering from the University of Utah. He is also a Certified Crime Scene Investigator. He has conducted hundreds of accident investigations for over the past forty years, and has taught thousands of people the principles of accident investigation and mishap analysis.

\_\_\_\_\_ is currently the director of the System Safety Development Center (SSDC); a continuation of the SSDC established by the Atomic Energy Commission (AEC). The SSDC has developed and taught the principles of accident investigation to The AEC, IAEC, DOE, DOE Contractors, NASA, OSHA, MSHA, NTSB, other governmental agencies, and industry in the United States and other countries. The SSDC developed the investigation techniques of MORT Charting, Fault Tree Analysis, Barrier Analysis, Change Analysis, Events and Causal Factors Charting, and Root Cause Analysis. The SSDC has been the leader in causal factor determination and corrective action implementation for over three decades.

System Safety Development Center  
2540 Woodhill Way  
Pocatello, ID 83201-2635

To: Mkowales@hq.nasa.gov, jloyd@hq.nasa.gov, prutledg@hq.nasa.gov  
From: Faith Chandler <fchandle@hq.nasa.gov>  
Subject: CAC meeting notes  
Cc: Pepper Phillips <pphillip@mail.hq.nasa.gov>  
Bcc:  
Attached: C:\Documents and Settings\fchandle\My Documents\Columbia\Action Plan\Columbia Action Committee.doc;

Here are the notes that I took during the Friday (2-7-03) Columbia Action Committee meeting (CAC).

Note the CAC will meet each day at 2:00.

To: "Alan H. Phillips" <a.h.phillips@larc.nasa.gov>  
From: Faith Chandler <fchandle@hq.nasa.gov>  
Subject: Re: Analysis for the CAIB's Consideration  
Cc:  
Bcc:  
Attached: C:\Documents and Settings\fchandle\My Documents\Columbia\Action Plan\Agency Contingency Action Plan for Space Operations 1.doc;

Alan,

I have included the document from Daniel Mazanek in Bryan O'Connor's folder (we expect to give the folder to him tomorrow when he visits DC tomorrow).

Attached you will find a copy of the Contingency Plan that describes the HCAT's roles & responsibilities.

At 11:06 AM 2/7/2003 -0500, you wrote:

Enclosed is an observational analysis that one of our employees has offered for consideration. Please forward to the responsible parties for their use.

Thanks.

Alan

--

\*\*\*\*\*

Alan H. Phillips  
Director, Office of Safety and Mission Assurance  
NASA Langley Research Center  
5A Hunsaker Loop  
Building 1162, Room 112C  
Mail Stop 421  
Hampton, VA 23681

(757)864-3361 Voice

(757)864-6327 Fax

\*\*\*\*\*



To: "BOYER, ROGER L. (JSC-NC) (SAIC)" <roger.l.boyer1@jsc.nasa.gov>  
From: Michael Stamatelatos <mstamate@hq.nasa.gov>  
Subject: RE: Code M Question  
Cc: "RAILSBACK, JAN (JSC-NX) (NASA)" <jan.railsback-1@nasa.gov>, "ROELANT, HENK (JSC-NC) (NASA)" <henk.roelant-1@nasa.gov>  
Bcc:  
Attached:

Thanks, Roger. I will let you know if I need more detail. Michael

At 12:48 PM 2/12/2003 -0600, BOYER, ROGER L. (JSC-NC) (SAIC) wrote:  
Michael,

Michael,

Here's what we pulled from the Critical Items List (CIL) for each of the Shuttle elements. I have more detail, but not electronically.

- 1) 1687 single point (Crit 1/1) failures for the Shuttle
- 2) By element, they are follows:

Orbiter	688
ET	453
RSRM	90
SRB	143
SSME	313
Total	1687

The attached table also provides the number of failure modes requiring multiple failures for each element (Crit 1R). I hope this answers the mail.

Roger

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

From: Michael Stamatelatos [<mailto:mstamate@hq.nasa.gov>]  
Sent: Monday, February 10, 2003 7:49 AM  
To: RAILSBACK, JAN (JSC-NX) (NASA); BOYER, ROGER L. (JSC-NC) (SAIC)  
Subject: Code M Question  
Importance: High

Jan/Roger:

I need the answer to the following urgent questions:

1. How many single point failures are there in the entire Space Shuttle?
2. Do you have a breakdown of single point failures by Shuttle system (e.g. Orbiter, ET, SRB, etc.)? If so, what is it?

Michael

\*\*\*\*\*

Dr. Michael Stamatelatos  
Manager, Agency Risk Assessment Program  
NASA Headquarters - Mail Code QE  
Office of Safety and Mission Assurance  
300 E Street, SW  
Washington, DC 20024  
Phone: 202/358-1668 Fax: 202/358-2778  
E-mail: Michael.G.Stamatelatos@nasa.gov  
(Please note change in e-mail address)

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"Mission success starts with safety"