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Other emails to/from MJShuart up to Feb 16, 2003
March 5, 2003

Received my MJS

X-Sender: j.h.starnes@pop.larc.nasa.gov
Date: Mon, 3 Feb 2003 12:28:40 -0400
To: m.j.shuart@larc.nasa.gov
From: "CAMARDA, CHARLES J., PHD (JSC-CB) (NASA)"
<charles.j.camarda@nasa.gov> (by way of James Starnes)

Mark,

Here is a voice from the past.

Jim

Jim, Max, David,

Have you heard of any teams being formed at NASA Langley to support the investigation? If so, can you forward me a list of the people involved. I'm about ready to go to my management at JSC to ask to include me in the endeavor. I am currently backup to Expedition 8 which may fly via Soyuz. If the prime crew stays well I should not be needed as backup and would like to help. Let me know how Langley has been asked to help or if they have been asked to help?

Charlie

Shuart-1

X-Sender: p.d.arbuckle@express.larc.nasa.gov
Date: Tue, 4 Feb 2003 16:47:13 -0500
To: m.j.shuart@larc.nasa.gov
From: Doug Arbuckle <p.d.arbuckle@larc.nasa.gov>
Subject: Fwd: On-orbit tile repair

X-Sender: t.l.trexler@express.larc.nasa.gov
Date: Tue, 4 Feb 2003 16:15:07 -0500
To: "ARBUCKLE, P DOUGLAS" <P.D.ARBUCKLE@larc.nasa.gov>
From: "t.l.trexler" <tony.l.trexler@nasa.gov>
Subject: Fwd: On-orbit tile repair
Cc: "WEATHERED, BRENTON W" <B.W.WEATHERED@larc.nasa.gov>

Doug,

I received this from Dr.Rutledge, can you reply to the request and copy me.

Thanks,
Tony

X-Sender: prutledg@mail.hq.nasa.gov
Date: Tue, 04 Feb 2003 13:21:41 -0500
To: Tony.L.Trexler@nasa.gov
From: Pete Rutledge <prutledg@hq.nasa.gov>
Subject: On-orbit tile repair
Cc: prichard@hq.nasa.gov

Tony,

Pamela Richardson of my staff has informed me that Mr. John Gleason of your staff has knowledge of historical studies at the NASA Langley Research Center regarding Shuttle on-orbit tile repair. This has been the subject of recent discussions here and was the subject of a memo from John Young at JSC just a couple of months ago. This subject is even more important as a result of the Columbia mishap. Could you please authorize time for Mr. Gleason to search for this information and forward it as soon as possible to:

Pamela Richardson
NASA Headquarters, Code QE
300 E Street SW
Washington, DC 20546

I can be reached at 202-358-0579 if you have any questions.

Thank you very much,

Shuart-2

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!

--

Tony L.Trexler
Head, Aircraft Systems Branch
Airborne Systems Competency
NASA Langley Research Center

Bldg.1244, MS 255
6 E.Taylor St.
Hampton, Va. 23681-2199
Phone 757-864-3922
Fax 757-864-8294

X-Sender: p.d.arbuckle@express.larc.nasa.gov
X-Priority: 2 (High)
Date: Wed, 5 Feb 2003 09:13:14 -0500
To: prutledg@mail.hq.nasa.gov, prichard@mail.hq.nasa.gov
From: Doug Arbuckle <p.d.arbuckle@larc.nasa.gov>
Subject: Re: Fwd: On-orbit tile repair
Cc: d.c.freeman@larc.nasa.gov, d.l.dwoyer@larc.nasa.gov,
m.j.shuart@larc.nasa.gov, a.h.phillips@larc.nasa.gov,
fhandle@hq.nasa.gov

Dr Rutledge--

Mr John Gleason is currently an aircraft maintenance technician assigned to the Airborne Systems Competency. Many years ago he was a technician assigned to the Structures and Materials Competency, during which time he apparently participated in the studies that you describe.

LaRC's experts in this subject, and most matters relating to Orbiter tiles, are in the Structures and Materials Competency. To assure that LaRC provides the most-informed and most-timely product to Code Q, Mr Gleason will be assigned to pull together what information he has in hand and provide it to the Structures and Materials Competency as soon as possible. Mark Shuart, Director of the Structures and Materials Competency, will be responsible for the final product delivery to Code Q.

LaRC personnel stand ready to provide whatever expertise we have to support the Columbia mishap investigation.

Feel free to contact me at 757-864-1718 if you or Pamela have any questions.

Doug Arbuckle, Director
Airborne Systems Competency

X-Sender: prutledg@mail.hq.nasa.gov
Date: Tue, 04 Feb 2003 13:21:41 -0500
To: Tony.L.Trexler@nasa.gov
From: Pete Rutledge <prutledg@hq.nasa.gov>
Subject: On-orbit tile repair
Cc: prichard@hq.nasa.gov

Tony,

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Shuart -4

even more important as a result of the Columbia mishap. Could you please authorize time for Mr. Gleason to search for this information and forward it as soon as possible to:

Pamela Richardson
NASA Headquarters, Code QE
300 E Street SW
Washington, DC 20546

I can be reached at 202-358-0579 if you have any questions.

Thank you very much,

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!

--

Tony L.Trexler
Head, Aircraft Systems Branch
Airborne Systems Competency
NASA Langley Research Center

Bldg.1244, MS 255
6 E.Taylor St.
Hampton, Va. 23681-2199
Phone 757-864-3922
Fax 757-864-8294

X-Sender: p.d.arbuckle@express.larc.nasa.gov
Date: Wed, 5 Feb 2003 11:11:32 -0500
To: m.j.shuart@larc.nasa.gov
From: Doug Arbuckle <p.d.arbuckle@larc.nasa.gov>
Subject: Fwd: Re: Fwd: On-orbit tile repair

FYI. I also left a phonemail with Pam, who left me one back that said they don't care how they get the info, as long as they get it and it doesn't take too long. She made some statement about being results-oriented and not caring about LaRC's process...!

DougA

X-Sender: prutledg@mail.hq.nasa.gov
Date: Wed, 05 Feb 2003 10:56:59 -0500
To: Doug Arbuckle <p.d.arbuckle@larc.nasa.gov>
From: Pete Rutledge <prutledg@hq.nasa.gov>
Subject: Re: Fwd: On-orbit tile repair
Cc: prichard@hq.nasa.gov

Thank you very much. This is certainly relevant material at this time and probably as we move forward.

Pete

At 09:13 AM 2/5/2003 -0500, you wrote:
Dr Rutledge--

Mr John Gleason is currently an aircraft maintenance technician assigned to the Airborne Systems Competency. Many years ago he was a technician assigned to the Structures and Materials Competency, during which time he apparently participated in the studies that you describe.

LaRC's experts in this subject, and most matters relating to Orbiter tiles, are in the Structures and Materials Competency. To assure that LaRC provides the most-informed and most-timely product to Code Q, Mr Gleason will be assigned to pull together what information he has in hand and provide it to the Structures and Materials Competency as soon as possible. Mark Shuart, Director of the Structures and Materials Competency, will be responsible for the final product delivery to Code Q.

LaRC personnel stand ready to provide whatever expertise we have to support the Columbia mishap investigation.

Feel free to contact me at 757-864-1718 if you or Pamela have any questions.

Doug Arbuckle, Director
Airborne Systems Competency

Shuart-6

X-Sender: prutledg@mail.hq.nasa.gov
Date: Tue, 04 Feb 2003 13:21:41 -0500
To: Tony.L.Trexler@nasa.gov
From: Pete Rutledge <prutledg@hq.nasa.gov>
Subject: On-orbit tile repair
Cc: prichard@hq.nasa.gov

Tony,

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Pamela Richardson
NASA Headquarters, Code QE
300 E Street SW
Washington, DC 20546

I can be reached at 202-358-0579 if you have any questions.

Thank you very much,

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!

--

Tony L. Trexler Bldg. 1244, MS 255
Head, Aircraft Systems Branch 6 E. Taylor St.

X-Sender: e.r.generazio@pop.larc.nasa.gov
X-Priority: 1 (Highest)
Date: Thu, 6 Feb 2003 10:24:02 -0500
To: Paul Boellner <pboellne@hq.nasa.gov>
From: Ed Generazio <e.r.generazio@larc.nasa.gov>
Subject: Re: Rapid Response (NDE RRT)
Cc: Mark J Shuart <m.j.shuart@larc.nasa.gov>, P.A.LINK@larc.nasa.gov

Paul,

Everyone is deeply affected by the Columbia mishap. And I know that HQ feels this even more personally. Each of you wants do something more to help. The importance of what you do today and in the future, and what have done each day for many years to support our goals as an Agency and as a Nation have allowed us to make enormous strides in Aeronautics and Space. NESB will continue to help and be ready to help in understanding and fixing the issues that have resulted in the loss of the Columbia crew on STS-107.

I had to let the NDE RRT funding level go to zero in FY03. \$700K is just too little to work all the issues across the Agency.

First and foremost....we need the approval of \$260K FY03 for RRT immediately. The response team is in place now 'by retainer'. Included in the RRT FY03 request are these tasks:

- * External Tank SOFI bond integrity (per SSC request).
- * NDE for Orbiter wire insulation integrity (per JSC request)
- * Corrosion under Orbiter tiles (per JSC request)

We need to move quickly on this to ensure a timely resolution and restoration of Shuttle flights. We are still waiting to hear from some of the other Centers.

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FY03

RRT (LaRC) \$250K (first and top priority
now)

Total funding requested FY03 \$250K

**For out years FY04 - FY09 323-78 NDE Technical
Program (which includes all Centers' RRT efforts)
should have a guideline of \$2M/yr.**

Ed

Delegated NDE Program Manager, 323-78
(757-864-4970)

Ed,

Last week, I spoke with Jim Lloyd and Michael Greenfield about your proposal for Rapid Response (RRT). Needless to say we were caught off guard by the fact that funding for RRT in 03 was omitted from you level 2 which you submitted back in June 02.

Now the situation has changed, and Jim said that we will fund those tasks requests you recieve regarding the Shuttle mishap. We have limited funds, so please submit any request, you receive to me, with an estimate of costs and I will see that Jim Lloyd reviews them quickly.

NASA Headquarters

Office of Safety and Mission Assurance

Resources Analyst

Code Q

Phone: (202) 358-0548

Fax: (202) 358-2779

X-Sender: D.W.Sleight@express.larc.nasa.gov
Date: Thu, 06 Feb 2003 15:45:58 -0500
To: M.J.SHUART@larc.nasa.gov
From: "David W. Sleight"
<D.W.Sleight@larc.nasa.gov>
Subject: ITS in the wake of the STS-107 disaster

Mark,

Here is the email from Geoff Tennille regarding ITS and the STS-107 disaster.

David

Bob, Willard, Dave & Susan -

The NASA IT security managers had a hasty teleconference Wednesday afternoon to discuss some ITS issues surrounding the emergency field offices at Lufkin and Barksdale. It was noted that these field offices will not have the security that one would normally expect at the home Center. All information regarding Columbia should be treated as sensitive - which implies encryption.

I don't think that we yet know which Langley folks will be called on to work in this investigation - but it seems likely that most would come from your organizations. Before anyone heads out to the field, they should have both Entrust (LF-21) and the VPN client (LF-97) installed on any laptop. The OCIO stands ready to expedite the installation of PKI and

Shuart - 11

the issuance of PKI certificates and RSA tokens for the VPN to support any Langley personnel called onto work this problem. So please inform any of your folks who are called for this critical work of our offer.

Both Kendall Freeman (46670) and Maria K. Elliott (46150) can sign the LF-21 or LF-97 if I am not readily available. Kendall and I can also install the PKI software. Anyone on the ITS team (44200) can help with the VPN access. I am also authorizing John Lau (43461) to sign LF-21 for me for the next two weeks for anyone going on emergency travel.

Please call (45786) if you have questions.

Geoff

David W. Sleight
Telephone: (757) 864-8427
NASA Langley Research Center
Fax: (757) 864-8912
Analytical & Computational Methods Branch
<mailto:D.W.Sleight@larc.nasa.gov>
M/S 240 Building 1229, Room 236L
Hampton, VA 23681-2199

X-Sender: m.p.saunders@express.larc.nasa.gov
X-Priority: 1 (Highest)
Date: Tue, 11 Feb 2003 10:24:54 -0500
To: "Mark J. Stuart" <m.j.stuart@larc.nasa.gov>,
Ajay Kumar <a.kumar@larc.nasa.gov>
From: "Mark P. Saunders" <m.p.saunders@larc.nasa.gov>
Subject: Fwd: RE: Dr. John Buckley

Mark/Ajay,

This was the last e-mail that I sent to Bonnie. As noted below, I told her we would add people to her list as we thought appropriate. Please feel free to let me know if you would like changes.

Mark

Date: Mon, 10 Feb 2003 13:08:21 -0500
To: "DUNBAR, BONNIE J. (JSC-AC8) (NASA)" <bonnie.j.dunbar@nasa.gov>
From: "Mark P. Saunders" <m.p.saunders@larc.nasa.gov>
Subject: RE: Dr. John Buckley
Cc: "MILLER, GLENN J. (JSC-EA) (NASA)" <glenn.j.miller@nasa.gov>
Bcc:
X-Attachments:

Hi Bonnie,

Thanks for the quick response. Del Freeman has asked me to be the POC for LaRC so for now you can use me to arrange support you need. I am the Deputy Director for Space Access and Exploration Programs here at LaRC (there is no current Director).

We are holding two meetings a day to stay on top of our efforts to support the various investigation efforts. The first is with Del in the morning and then I have a technical tag-up in the afternoon. Consequently, it's easy to get activities started when required. Just let me know when you need something. I realize that good contact is being made at lower levels too. This is fine; they'll brief me on new activities as they arise.

I'm going to ask our Structures and Materials Director if he wants to add any other names to your TPS list. If so, I'll forward them to you and Glenn. Just as a side note, Carol and I have been friends for almost 20 years. She and my wife went to Virginia Tech together, and we all worked on the Navy's TRIDENT program. She is exceptional and great to work with.

Stuart - 16

I have passed on to everyone here (including John) that John is to be considered as an Investigation Team member and, as such, has access to any data needed. Don't hesitate to seek his assistance.

As you know, we are a research center focusing on expertise related to atmospheric flight. We have experienced engineers and researchers in aerodynamics, aerothermodynamics, flight mechanics, trajectory analysis, structures and materials, plus others. As you mentioned, we already have a strong working relationship in the aero/aothermal areas. If you need help in the other areas, let me know. Fred Gregory did ask Del if we would participate in the orbiter reconstruction, since we reconstructed the American Airlines flight 587 tail. Del agreed to this, but it isn't clear if anyone has spoken with you all about this.

Thanks and don't hesitate to e-mail or call me if you need anything. 757-864-9862 (O) or [REDACTED] (cell)

Mark

At 8:58 AM -0600 2/10/03, DUNBAR, BONNIE J. (JSC-AC8) (NASA) wrote:
Mark,

Thank you for your kind words. I hope the following will help explain how John was involved in our initial contacts, and our need for your support.

(1) John's involvement: I have been involved in the TPS development for over 30 years, since I was a student at the University of Washington. I later was employed by Rockwell in the 70's, participating in design, production, and installation of TPS at Palmdale. When I arrived at JSC, before becoming an astronaut, I was assigned by Mission Operations to follow the TPS, and worked on an on orbit tile repair concept. Throughout that effort there were a handful of NASA experts that worked with us. They included George Stroughal at JSC, Howard Goldstein at Ames, and John Buckley at LaRC.

Within a day of the accident, I started receiving calls from many of the retired engineers and technicians from Rockwell that had worked on Columbia and were offering their help. As a result we started a "greybeard" list of experts who could be used to support both the internal NASA board and the external investigation board. I contacted John as one of the former LaRC engineers who was intimately familiar with the shuttle thermal design requirements, and as former chair of the Cocoa Beach Advanced Ceramics Working Group where many of the TPS papers were presented. John was also part of an early materials review team made up of Howard, George, and Jim

Gangler, NASA Headquarters. We definitely need to have him be able to consult to the teams.

(2) Secondly, we do need to know how LaRC can support and we do need a Civil Servant Point of Contact (POC) who can be used to call up facility use/test data generation, etc. We have engaged Ames in this regard, specifically Carol Carroll's Technology Division for Aerothermal analyses. I presume that you are familiar with her and what they can do. Should we consider you the POC? The POC can be given directly to me or forwarded to Glenn Miller; Glenn is in the JSC Engineering Director's Office. By the way, we do have LaRC personnel supporting another group: they are Charles Miller, Tom Horval, and Bill Scallin.

I have attached the current working list of our contacts, which includes NASA support outside of JSC. Bill Lassiter is listed on that since John gave me his name.

Thank you for your support. Look forward to working with you.\

Bonnie

Bonnie J. Dunbar, PhD NAE
NASA Johnson Space Center
Assistant Director
(University Research and Affairs)
MC-AC8
Houston, TX 77058
281-483-6594 (PH)
281-483-3379 (FAX)
bonnie.j.dunbar1@jsc.nasa.gov
www.jsc.nasa.gov
To view ISS: www.spaceflight.nasa.gov

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

From: Mark P. Saunders [mailto:m.p.saunders@larc.nasa.gov]
Sent: Sunday, February 09, 2003 4:31 PM
To: DUNBAR, BONNIE J. (JSC-AC8) (NASA)
Subject: Dr. John Buckley

Hi Bonnie,

First, I'd like you to know that we are very sorry about what has happened. Everyone here at LaRC sends their thoughts and prayers to

you and your colleagues at JSC. We're available to help in anyway that is needed.

In that regard I'm a little confused about the role of John. I have received authorization to treat him as an Investigation Team member so that has been taken care of. However, I have seen him represented as leading the LaRC support for any TPS work we would contribute. Is this what is anticipated, or are you all just considering his expertise in support of the TPS group? At present we view John as just a consultant to your TPS group. If you want LaRC to participate, I need to know that so I can organize our civil servant staff to help as required.

If you wouldn't mind letting me know what you want and need, I'd appreciate it.

Thanks.

Mark

Attachment converted: Macintosh HD:Columbia - TPS database21.xls (XLS4/XCEL)
(00021152)

Attachment converted: Macintosh HD:Columbia_-_TPS_database21.xls (XLS4/XCEL)
(0002488A)

X-Sender: m.p.saunders@express.larc.nasa.gov
X-Priority: 1 (Highest)
Date: Thu, 13 Feb 2003 07:58:58 -0500
To: Ajay Kumar <a.kumar@larc.nasa.gov>,
"Mark J. Shuart" <m.j.shuart@larc.nasa.gov>,
"Alan H. Phillips" <a.h.phillips@larc.nasa.gov>,
Robert Barnes <r.s.barnes@larc.nasa.gov>,
Doug Dwoyer <d.l.dwoyer@larc.nasa.gov>
From: "Mark P. Saunders" <m.p.saunders@larc.nasa.gov>
Subject: Fwd: Version 6: TPS Resosurce Contact List

FYI

From: "DUNBAR, BONNIE J. (JSC-AC8) (NASA)" <bonnie.j.dunbar@nasa.gov>
To: "MILLER, GLENN J. (JSC-EA) (NASA)" <glenn.j.miller@nasa.gov>,
"SCHOMBURG, CALVIN (JSC-EA) (NASA)" <calvin.schomburg-1@nasa.gov>
Cc: "BENZ, FRANK J. (JSC-EA) (NASA)" <frank.j.benz@nasa.gov>,
"HANSEN, LAURI N. (JSC-EA1) (NASA)" <lauri.n.hansen@nasa.gov>,
"GRAHAM, LEE (JSC-AG11) (NASA)" <lee.graham-1@nasa.gov>,
"MURATORE, JOHN F. (JSC-EA3) (NASA)" <john.f.muratore@nasa.gov>,
"Madera, Pamela L" <pam.l.madera@usahq.unitedspacealliance.com>,
"WEISSKOPF, KATHY (JSC-AP) (NASA)" <kathy.weisskopf-1@nasa.gov>,
"GREENE, JAY H. (JSC-AG) (NASA)" <jay.h.greene@nasa.gov>,
"CARAM, JOSE M. (JOE) (JSC-EG) (NASA)" <jose.m.caram@nasa.gov>,
"KOWAL, T. J. (JOHN) (JSC-ES3) (NASA)" <t.j.kowal@nasa.gov>,
"Woolhouse, D L" <d.l.woolhouse@boeing.com>,
"CHAFFEE, NORMAN H. (NORM) (JSC-AH) (IDI)"
<norman.h.chaffee1@jsc.nasa.gov>,
"BELL, DANIEL R. (JSC-ES) (BOE)"
<daniel.r.bell1@jsc.nasa.gov>,
"LEVY, VINCENT M. (JSC-EG) (NASA)"
<vincent.m.levy@nasa.gov>,
"j.d.buckley" <jdbuck@exis.net>,
"James Arnold" <jarnold@mail.arc.nasa.gov>,
"RICKMAN, STEVEN L. (JSC-ES3) (NASA)" <steven.l.rickman@nasa.gov>,
"Howard Goldstein" <hgoldstein@mail.arc.nasa.gov>,
"Mark P. Saunders"
<m.p.saunders@larc.nasa.gov>,
"CURRY, DONALD M. (JSC-ES3) (NASA)"
<donald.m.curry@nasa.gov>
Subject: Version 6: TPS Resosurce Contact List
Date: Wed, 12 Feb 2003 20:46:41 -0600
Importance: high
X-Priority: 1

Shuart-18

To all:

Attached is version 6 of the TPS Resource List (2/12/2003) This list supercedes all prior lists. Please note the following:

- * Pages 1-3 contain most of the names previously provided with additional information. The engineers are predominantly retired NASA or Contractor, are ready to support if called, and have been vetted with respect to relevant technical expertise. LaRC and ARC POCs are also listed.
- * Pages 4 and 5 contain the following:
- * Current LaRC Structures and Materials Experts supplied by the LaRC POC, Mark Saunders. I do not yet see these individuals listed as supporting the Teams. They are organized and standing by.
- * LaRC experts listed by Pam Madera/USA and Joe Caram/EG as part of the Aerothermal Sensitivity Team. (Briefing 2/12/03)
- * JSC Experts supporting the Aerothermal Team. (Briefing 2/12/03)
- * The Aerothermal Team also includes support from Sandia National Labs and MSFC. These are not yet shown.

There are still "holes" in contact information. If you can help complete this spread sheet, please submit corrections to Ms. Kathy Weisskopf (4-7542) at kathy.weisskopf-1@nasa.gov.

Bonnie

<<Columbia - TPS version 6.xls>>

Bonnie J. Dunbar, PhD NAE
NASA Johnson Space Center
Assistant Director
(University Research and Affairs)
MC-AC8
Houston, TX 77058
281-483-6594 (PH)
281-483-3379 (FAX)
bonnie.j.dunbar1@jsc.nasa.gov
www.jsc.nasa.gov
To view ISS: www.spaceflight.nasa.gov

Attachment converted: Macintosh HD:Columbia_-_TPS_version_6.xls (XLS4/XCEL)
(00024BB9)

Space Shuttle Columbia Thermal Protection System (TPS) Resource Contact List (Corporate Memory and Expertise)

Last Name	First Name	Relevant Experience (for retired NASA and Contractor contacts, CAIB Support)	Current position	Phone	e-mail	Contact w/AC8	Working Group Contact	Notes
Arnold	James	Retired chief of the Space Technology Division at ARC. The Space Technology Division includes the Thermal Protection Materials Branch and the Thermal Physics Facilities Branch. Was Division Chief from early 1980's until 2002. Expertise in aerothermal dynamics and	Works for the University of California, Santa Cruz, as a Senior Staff Scientist at ARC	██████████ 650-604-5265 (w)	jarnold@mail.arc.nasa.gov	Yes	CAIB Support	Supporting Dr. Hubbard
Beaker	Bill	NASA/MSFC - Liaison Rockwell on Shuttle TPS Development						
Beck	Robin	TPS Carbon/Carbon modeling expert. Worked aerotherm,		408-997-0391				Per J. Arnold
Bell	Dan		Current Boeing Subsystem Manager of TPS Materials at Cape./ES	321-223-1725			Aerothermal Panel/Impact Testing CAIB/ Pam Madera/Aerotherm al Specificity	
Bickel	T		Sandia National Labs					
Brown	Dan	Rockwell Dir of Production Operations		760-360-7265				
Buckley	Dr. John D.	NASA LaRC: Former Head of Heat Shield group. Chaired the Advanced Ceramics Working Group meetings in Cocoa Beach for 17 years through 1993. Has 17 volumes of the ACWG proceedings available which contain technical TPS development and test info. Information is	Organization: SYSTEMS ENGINEERING COMPETENCY: DISTINGUISHED RESEARCH ASSOCIATE	757-864-4557; cell: ██████████	J.D.Buckley@larc.nasa.gov	Yes		
Carroll	Carol		ARC: Acting Chief of the Space Technology Division since 2002. Technical background is TPS and Systems Analysis.	650-604-0267	Carol.W.Carroll@nasa.gov	Yes	Aerothermal Panel/Pam Madera	Ames Research Center POC, Also K. Kontinos and G. Chandler, U of
Chafee	Michele	Involved in TPS tile thermal analysis	Boeing HB. Works for Habib.					
Cooper	Dr. Paul	Led Study of tile loss from Orbiter, retired						Supporting LaRC per Mark Saunders
Cuzzupoli	Joe	Rockwell VP Production Operations/Palmdale	Retired Rockwell Management. Still working at Kistler Aerospace	425-889-2001 (w)	jcuzzupoli@kistleraero.com			Per Dunbar and Gresham
Diaz	George (Lorne)	Rockwell VP Engineering	Retired Rockwell Management?	562-693-9127				Per Gresham
Embde	Wendell	Former Rockwell TPS		714-434-6246				
Giles	Dr. Gary	Lead Analyst for Paul Cooper on Tile Loss, retired						Supporting LaRC per Mark Saunders
Glynn	Phil	NASA JSC Structures Branch Chief, retired		281-488-4453				From Norm Chaffee
Goldstein	Howard	Branch Chief of the Thermal Protection Materials Branch under Jim Arnold from the early 1980's to 1991, and then Chief Scientist of the Space Technology Division until 2002. Led Shuttle TPS work at Ames from the early	Senior Scientist for RIACS/USRA	408-252-7369	hgoldstein@mail.arc.nasa.gov	Yes		Consultation Per J. Arnold and Dunbar
Gordon	Mike	TPS Operations located at KSC	Employed by Boeing or USA	321-861-4608				Per J. Arnold
Hagen	George	Rockwell Space Div. Adv. Mfg. Tech. Responsible for the design, tooling and fabrication of precision measurement instrumentation for inspection of RSI tile surface, gap and bond integrity. Headed a team that worked on this effort	Retired in 1992.	714-522-6827	N/A			6094 Clark Way, Buena Park, CA 90620 Per . D. Leahy
Hammond	John	Rockwell Palmdale TPS Production						Per Gresham and Dunbar
Hanifin	Pat	Rockwell TPS design group Manager from 1972-86 (available for questions, retired for 10 years)		562-691-3733	N/A	Yes		1233 Oakcrest Ave., Brea, CA 92821 Per D. Leahy
Hinkle	Karrie		Subsystem manager for TPS Materials for several years through 2002 (Rockwell)	714-896-5271	karrie.a.hinkle@boeing.com			Works for Boeing in HB Per J. Korb
Hogenson	Peter	Former Rockwell Space Division - Lab & Test Engineer, TPS Shuttle development. Later at Boeing. Later with European Space Agency. Retired	May still be employed by oeing	562-439-3361				Per J. Arnold
Holden	Mike	Entry Physics Shock Tunnel Expert	Employed by CALSPAN					Per J. Arnold
Housner	Dr. Jerry	Nonlinear materials response of SIP for tile loss analyses, retired						Supporting LaRC per Mark Saunders
Jeffer	George	Chief Engineer/President Space, Rockwell		310-459-1767				
Jernigan	Dr. Tamara	Retired Astronaut, Five flights. TPS experience at Ames	Lawrence Livermore National Laboratory	925-422-0182				Per J. Arnold.
Jones	Frank	KSC TPS	Current KSC	321-861-3632			KSC Processing Panel	
Keese	David	TPS entry technology and entry systems. Worked on SHARP B1 and SHARP B2. Has access to classified DOD data.	Employed by Sandia National Labs	505-844-1899				Per J. Arnold.
Ketterer	Robert	Former KSC Chief of TPS Branch		321-773-7460				
Korb	Larry	Supervisor of TPS Materials and Development 1977-ST5-1 (1981). Supervisor of Metallurgy 1981-1988.	Consultant to Rockwell/Boeing manned space program from 1988-2002 on metallurgical and TPS problems.	714-538-2491		Yes		

Space Shuttle Columbia Thermal Protection System (TPS) Resource Contact List (Corporate Memory and Expertise)

Last Name	First Name	Relevant Experience (for retired NASA and Contractor contacts, CAIB Support)	Current position	Phone	e-mail	Contact w/AC8	Working Group Contact	Notes
Kreidel	Sam	Rockwell Director of Airframe Design (including TPS and Materials and Processes, as well as the purge, vent and drain subsystem) Established the EDW TPS tests on F-104 and F-15. Conducted all the structural trade studies for original design. Was also Chief of airframe design for	Retired-- Recommended by Steve Nagle/CC, Retired Astronaut					
Lassiter	William		NASA LaRC: STRUCTURAL AND THERMAL ANALYSIS BRANCH/SYSTEMS ENGINEERING COMPETENCY Retired	757-864-7022	William.S.Lassiter@nasa.gov			
Lee	Dottie (Dorothea)	Thermal Systems/NASA		281-333-4693		Yes		
Leahy	Dev	Rockwell Space Div. Supervisor, Av. Mfg. Technology - TPS	Retired 1984	805-647-8562		Yes		
Leger	Dr. Lubert	Lead Tile attachment systems, retired NASA JSC		281-486-0481				
Leiser	Dr. Daniel	Dan worked with Dr. Goldstein and is still working at Ames.	Responsible for Advanced Tile Research in the Thermal Protection Materials Branch and has been working with JSC and KSC to implement new developments,	650-604-6076	Daniel.B.Leiser@nasa.gov	Yes	Aerothermal Panel	
McBride	Don	Several years experience on Space Shuttle Orbiter Program. Expertise in the detailed thermal analysis of tiles.	Presently at Boeing	562-480-4517				
Moser	Tom	NASA JSC TPS Manager, retired		830-896-7688				
Muraca	Dr. Ralph	Lead loads engineer for Tile loss analyses, former Chief of Systems Engineering Division, retired						
Norwood	Lee	Rockwell Space Div. - Adv. Mfg. Tech. Design Engineer on tooling and fabrication techniques for application of RSI tiles, TPS blankets and high temperature composites to	Retired.	310-375-6418				Supporting LaRC per Mark Saunders Per D. Leahy
Prabu	Denish	Enrly Technology, Aerothermodynamics, Aero CFD	Employed by Eloret	650-604-1145				Per J. Arnold
Reid	Bob	TPS/Aerothermo/Systems. Former Division chief at JSC	Retired NASA JSC employee	281-482-7995				Consultation
Robertson	Al	Original designer of thermal barriers on Columbia, including the wheel well area. Continuous work on TPS over since at Rockwell/Boeing		714-372-2792				Per L. Korb
Rowe	James	Supervisor of TPS Stress Analysis until retirement in 1997	Still works at Boeing HB as a consultant in TPS design concepts and other stress problems	714-372-2931				Per L. Korb
Rubenstein	Sy (Seymor)	Rockwell Space Div. Shuttle Program Director/Division President - Retired	Retired.	714-637-2697				Highly recommended for analytical leadership
Saunders	Mark		LaRC Deputy Director for Space Access and Exploration Programs. POC for Thermal Analysis	757-864-9862	mark.p.saunders@nasa.gov			LaRC POC for Thermal Analysis
Schneider	Dr. William	Tile Analysis						
Smith	Jim	Thermal Systems/NASA - Retired						
St. Clair	Dr. Terry	Polymer Chemist and expert materials consultant on many teams. Former Head, Advanced Materials and Processing Branch, retired						Supporting LaRC per Mark Saunders
Stein	Bland	Lead of LaRC tiger team to study on orbit shuttle tile repair, former Asst. Chief of Materials Division, retired. Chaired the Long Duration Exposure Facility (LDEF) Materials Special Investigation Group. Retired		(h) Cell				Supporting LaRC per Mark Saunders Address: 732 Jouett Dr. Newport News, VA 23608-1914
Suitor	Mark		Boeing Engineering Team Manager of Wiring Installation	714-372-5823				
Thatcher	Conley	M&P Engineer responsible for the development of material concepts for thermal barriers and gap fillers, 1976-1981. Later became a TPS Supervisor.	Continuous service in the Rockwell/Boeing M&P TPS group ever since. He has covered all aspects of TPS materials.	714-372-5224				
Wade	Don	Retired Chief/ES NASA JSC Structures and Mechanics Division	Consulting for Blackhawk Management	281-244-6579				Per Norm Chaffee
Wykes	Don	Rockwell Space Div. Adv. Mfg. Tech. - Supervisor of group responsible for development of manufacturing techniques, processes and tooling for all Orbiter thermal protection systems including SI tiles, TPS insulation and high	Retired	562-865-8304				
Yoshino	Stan	Div Chief in Production Ops. Managed Palmdale TPS ops. Retired Rockwell		323-263-1338		Yes		
Zadeh	Habib Sharif	Senior Manager	Thermal Design - Boeing HB. Several years experience on the Space Shuttle Orbiter Program	714-372-0248				
Other								
Huntsman	Dave	Retired Shuttle Program Debris Mitigation Manager - STS-27 Post-Flight Report		cell:				Per Capt. John Young, Personal Correspondence
Gresham	Bev	Dir, Customer Relations, Rockwell Space Div	Retired/ Contact for Past Employees	714-899-5441		Yes		

Space Shuttle Columbia Thermal Protection System (TPS) Resource Contact List (Corporate Memory and Expertise)

Last Name	First Name	Relevant Experience (for retired NASA and Contractor contacts, CAIB Support)	Current position	Phone	e-mail	Contact w/AC8	Working Group Contact	Notes
LaRC Experts			LaRC Structures and Materials Competency (SMC) POC: Mark Stuart					
Adelman	Dr. Howard		Head, Structural Dynamics Branch					Per LaRC POC
Ambur	Dr. Damodar		Head, Mechanics and Durability Branch					Per LaRC POC
Generazio	Dr. Ed		Head, Nondestructive Evaluation Sciences Br.					Per LaRC POC
Harrison	Dr. Joycelyn		Head, Advanced Materials and Processing Branch.					Per LaRC POC
Raju	Dr. Ivatury		Chief Technologist, Structures and Materials Competency					Per LaRC POC
Ransom	Dr. Jonathan		Head, Analytical and Computational Methods Branch					Per LaRC POC
Scotti	Dr. Steve		Head, Metals and Thermal Structures Branch: metals work and thermal management					Per LaRC POC
Starnes	Dr. Jim		Chief Engineer, Structures and Materials Competency, currently leads NASA investigation supporting NTSB investigation of AA587					Per LaRC POC
LaRC			LaRC Aerothermodynamics Support					
Hamilton	H						Aero/Thermal Sensitivity Team/Pam Madera	Reported at NASA/JSC Meeting on Feb. 12, 2003 Per Joe Caram/EG
Horvath	T						Aero/Thermal Sensitivity Team/Pam Madera	Per Joe Caram/EG
Miller	C						Aero/Thermal Sensitivity Team/Pam Madera	Per Joe Caram/EG
Scallion	B						Aero/Thermal Sensitivity Team/Pam Madera	Per Joe Caram/EG
Wurster	K						Aero/Thermal Sensitivity Team/Pam Madera	Per Joe Caram/EG
Zoby	V.						Aero/Thermal Sensitivity Team/Pam Madera	Per Joe Caram/EG
JSC Experts			Materials and Aerothermal Support					
Bouslog	S.		LMES				Aero/Thermal Sensitivity Team/Pam Madera	Per Joe Caram
Borrer	J		EG				Aero/Thermal Sensitivity Team/Pam Madera	Per Joe Caram
Campbell	C.		ES				Aero/Thermal Sensitivity Team/Pam Madera	Per Joe Caram
Curry	Don		ES				Aero/Thermal Sensitivity Team/Pam Madera	
Derry	S.		EG3				Aero/Thermal Sensitivity Team/Pam Madera	Per Joe Caram
Dries	K		ES6				Aero/Thermal Sensitivity Team/Pam Madera	Per Joe Caram
Fitzgerald	Steve		EG3				Aero/Thermal Sensitivity Team/Pam Madera	Per Joe Caram
Li	Dr. Chien		EG				Aero/Thermal Sensitivity Team/Pam Madera	Per Joe Caram

Space Shuttle Columbia Thermal Protection System (TPS) Resource Contact List (Corporate Memory and Expertise)

Last Name	First Name	Relevant Experience (for retired NASA and Contractor contacts, CAIB Support)	Current position	Phone	e-mail	Contact w/AC8	Working Group Contact	Notes
Lillard	R.		EG				Aero/Thermal Sensitivity Team/Pam Madera	Per Joe Caram
Paul	T		EC				Aero/Thermal Sensitivity Team/Pam Madera	Per Joe Caram
Schomburg	Calvin		EA				Aero/Thermal Sensitivity Team/Pam Madera	

X-Sender: l.e.jones@pop.larc.nasa.gov
Date: Thu, 13 Feb 2003 14:31:00 -0500
To: M.P.SAUNDERS@larc.nasa.gov
From: "Lisa E. Jones" <l.e.jones@larc.nasa.gov>
Subject: Fwd: IDRF Information
Cc: M.J.SHUART@larc.nasa.gov, S.J.SCOTTI@larc.nasa.gov,
H.M.ADELMAN@larc.nasa.gov, L.G.HORTA@larc.nasa.gov

My apologies everyone, I intended to attach a video clip to go with the other document.
Sorry for the double mailing.

Dear Mark Saunders,
Here is the information you asked me to put together on our capabilities at the IDRF. If
you have questions about the materials or want additional information, do not hesitate to
ask.

Sincerely,
Lisa E. Jones

Attachment converted: Macintosh HD:Mark_Saunders_Package.doc (WDBN/MSWD)
(00024D4F)

Attachment converted: Macintosh HD:BungeeAcc (VfW /TVOD) (00024D50)

Shuart-19

Sent by MJS

Date: Mon, 3 Feb 2003 17:17:37 -0500
To: "Alan H. Phillips" <a.h.phillips@larc.nasa.gov>
From: "Mark J. Shuart" <m.j.shuart@pop.larc.nasa.gov>
Subject: Re: Trying to get your issue right
Cc:
Bcc:
X-Attachments:

Alan,

All these questions are just fine. Thanks for representing them up-line.....Mark

Mark,

I am trying to phrase (and pass along to Bryan O'Connor) your issue in a correct manner. Would you please review (and edit) as you see fit so that I can respond?

- 1) Has corrosion of Orbiter components (from an aging aircraft perspective) been addressed and eliminated as a primary or contributing cause of the mishap?
- 2) Have inspections or maintenance activities identified any concerns?
- 3) What, if any, areas of the Orbiter do the current inspection plans not cover?

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

Shuart-22

Date: Tue, 4 Feb 2003 08:21:49 -0500
To: "Stephen J. Scotti" <s.j.scotti@larc.nasa.gov>
From: "Mark J. Shuart" <m.j.shuart@pop.larc.nasa.gov>
Subject: Re: Fwd: request for help with Columbia
Cc: d.l.dicus, t.e.noll
Bcc:
X-Attachments:

Steve,

This is fine. I will bring it up at our tag-up meeting today. Also, Kamran should document what he will stop doing when the time comes. Thanks for the note.....Mark

Mark

Per your instruction to be notified of subject requests, I am forwarding this to you FYI. This is actually an internal request for AB/AAAC and Kamran indicated that AB has not been contacted to do anything yet, but they anticipate that they might be.

-Steve

X-Sender: k.daryabeigi@pop.larc.nasa.gov
Date: Mon, 03 Feb 2003 13:48:05 -0500
To: s.j.scotti@larc.nasa.gov
From: Kamran Daryabeigi <k.daryabeigi@larc.nasa.gov>
Subject: request for help with Columbia

Steve,

Just to let you know that I may be requested to help with aerothermal testing related to the Columbia accident.

I received a phone call from Thomas J. Horvath, Aerothermodynamics Branch, AAAC, inquiring whether I could help him with aerothermal heating measurements on the Shuttle Orbiter's model at Langley's hypersonic wind tunnels in case his branch is requested to perform such work in support of the Columbia's accident investigation.

Aerothermodynamics Branch is in a bind because their standard phosphor thermography system is not operational and is not supposed to be operational till March 1, at the earliest. Therefore, Tom wanted to know whether we could use the IR thermography system that we have at MTSB. I used this system in support of wind tunnel tests when I was on detail assignment at AB.

In case such a request for help is made and accepted by you & SMC, I have to help set up the system, and somewhat automate my data manipulation software to expedite calculation of aeroheating rates from measured surface temperature distributions, so that AB researchers can get the actual heating rates within minutes of conducting wind tunnel tests to determine whether the test results are reasonable, or whether they should repeat

Shuart-23

the tests. I could probably make use of a good software programmer (such as David Mercer).

Kamran

--

Dr. Stephen J. Scotti (s.j.scotti@larc.nasa.gov)
Head, Metals and Thermal Structures Branch (MTSB)
MS 396
B1267, Rm 142
6 East Reid Street
NASA Langley Research Center
Hampton, VA 23681-2199
Branch Home Page: <http://smc.larc.nasa.gov/mtsb>
tel. (757) 864 - 5431
fax (757) 864 - 7943

Date: Wed, 5 Feb 2003 08:23:25 -0500
To: Wolf Elber <w.elber@larc.nasa.gov>
From: "Mark J. Shuart" <m.j.shuart@pop.larc.nasa.gov>
Subject: Re: MFR: My Involvement in '80-'81 Structures Team
Cc: d.l.dwoyer
Bcc:
X-Attachments:

Wolf,

Thanks for the information. I'll let you know if we need more details.....Mark

Doug/Mark:

For the record I want to put down what I remember of the Langley part of the Structures Team, headed by Dick Snyder & Ralph Murraca, and lead by Hearth and Holloway. I was recruited into the team by Dick Heldenfels out of the Fatigue and Fracture Branch.

In a meeting at Huston with Chris Kraft, I ended up with the mission of certifying the strength and durability of the tiles under parallel flow during the max-q condition after launch. We were to investigate both densified and undensified tiles from wind tunnel tests in the Unitary Tunnel at Ames, and were to report on the spectral density of combined forces and moments with respect to static tests.

I teamed with John? Coy (ret.) at Ames who was to conduct the wind-tunnel tests at Ames, in which we tested 9*9 tile patterns for which the center tile was instrumented with 16 point-load cells. We statically calibrated these cells to obtain F, Mx, My, Mxy, and recorded the response matrices for all available panels. I think it was eight panels.

We then tested the panels one-by-one in the max-q transonic condition and took readings while the shock wave repeatedly traversed the center tile. Other people at Ames understood the test sequence, I only collected dynamic loads.

On returning to Langley, I asked to use the hybrid analogue-digital computer in ACD and successfully converted both the static calibration tests and the dynamic data into useful engineering data for Chris Kraft. Both Hearth and Holloway cleared all briefings. Having seen the data in probabilistic form, Kraft agreed with the Langley data, and released Columbia for flight based on the tiles.

Thoughts Since Saturday:

Yes, we did a lot of work to clear Columbia for strength and durability of the tiles, but we never cleared the thousands of tiles in the '80s for damage tolerance (just strength and durability). For instance, we never knew, nor did we test for the oblique flow condition of full-elevon deflection at or near the max-q condition, nor did anyone suspect that solid objects might be contained in the air stream.

Shuart-24

Today, I have a lot of questions to ask myself and others, mainly about future solutions, most of which challenge the tank designers to quit shedding ice and insulation from the tank. If the foam needs to be closed-cell, can we not put a some-inch-spaced fiber wrap (like a hair-net) around the insulation, like a toe of Kavlar, to break the max fragments down to an inch or two, and even help to maximise the ice-sheets to that dimension?

Anything to help
Wolf

Date: Wed, 5 Feb 2003 13:53:11 -0500
To: John Dorsey <j.t.dorsey@larc.nasa.gov>
From: "Mark J. Shuart" <m.j.shuart@pop.larc.nasa.gov>
Subject: Re: Fwd: New Scientist query
Cc:
Bcc:
X-Attachments:

John,
Thanks for passing this on. I have advised all in SMC that any contacts from the media should be forwarded to the Office of External Affairs. Keith Henry, h.k.henry@larc.nasa.gov, (757) 864-6120. See you when you get back.....Mark

Don,

I am attending MIP-26 with Barry Geldzahler, and he recommended that I forward this to you. Please let me know if there is any further action I should take.

Thanks, John

E-mail withheld due to disclosure statement attached to message stating that information contained in message is privileged, confidential and protected from disclosure.

Shuart-25

E-mail withheld due to disclosure statement attached to message stating that information contained in message is privileged, confidential and protected from disclosure.

John T. Dorsey
Senior Research Engineer
Metals and Thermal Structures Branch
Mail Stop 396
NASA Langley Research Center
Hampton, VA 23681

e-mail: j.t.dorsey@larc.nasa.gov
Voice: 757.864.3108 Fax: 757.864.7943

Chinese Proverb

The person who says it cannot be done should not interrupt the person doing it.

Date: Thu, 6 Feb 2003 17:46:27 -0500
To: "SAUNDERS, MARK P" <M.P.SAUNDERS@LaRC.NASA.GOV>, "PHILLIPS,
ALAN H" <A.H.PHILLIPS@LaRC.NASA.GOV>, ADRT+Comp Directors
From: "Mark J. Shuart" <m.j.shuart@pop.larc.nasa.gov>
Subject: Fwd: SIAT

Cc:

Bcc:

X-Attachments: :Macintosh HD:148597:SIAT.pdf:

Attachment is available
on Columbia web site

Folks,

FYI.....Mark

at:
[http://www.hq.nasa.gov/office/pao/history/
siat.pdf](http://www.hq.nasa.gov/office/pao/history/siat.pdf)

Date: Thu, 6 Feb 2003 17:08:24 -0400
To: m.j.shuart@larc.nasa.gov
From: James Starnes <j.h.starnes@larc.nasa.gov>
Subject: Fwd: SIAT

Mark,

Here is a little goodie I got from Jim Newman today. Just in case your interested ...

Jim

X-Sender: newmanjr@ae.msstate.edu
X-Priority: 2 (High)
Date: Thu, 06 Feb 2003 14:29:31 -0600
To: j.h.starnes@larc.nasa.gov
From: Jim Newman <j.c.newman.jr@AE.MsState.EDU>
Subject: SIAT

Jim:

Attached is the final Shuttle Independent Assessment Team Report. Let me know if you
need anything else.

Thanks for your call.

Jim

Shuart -27

Date: Tue, 11 Feb 2003 13:12:18 -0500
To: "Mark P. Saunders" <m.p.saunders@larc.nasa.gov>
From: "Mark J. Shuart" <m.j.shuart@pop.larc.nasa.gov>
Subject: Re: Fwd: RE: Dr. John Buckley
Cc: a.kumar@larc.nasa.gov
Bcc:
X-Attachments:

Mark,

Some comments:

Retired Experts-

Dr. Paul Cooper- led study of tiles coming off the orbiter; now retired
Dr. Gary Giles- lead analyst for Cooper; retired
Dr. Jerry Housner- nonlinear materials response of SIP for Giles analysis; retired
Dr. Ralph Muraca- lead loads engineer for Giles analysis; former Chief of Systems Engineering Division and now retired
Bland Stein- already on the list; lead of LaRC "tiger team" to study on-orbit shuttle tile repair; former Asst. Chief of Materials Division and now retired
Dr. Terry St. Clair- polymer chemist and expert materials consultant on many teams; former Head, Advanced Materials and Processing Branch and now retired
There are others depending how far back you want to go and how focused you want to be. Many tests were conducted in the 8-ft High Temperature Tunnel and in the LaRC Arc Jet Facility (now closed).

Current Experts-

Dr. Joycelyn Harrison- current Head, Advanced Materials and Processing Branch; new materials (except for metals) work done in this branch
Dr. Steve Scotti- current Head, Metals and Thermal Structures Branch; metals work and thermal management (including metallic TPS, passive & active cooling) work done in this branch
Dr. Damodar Ambur- current Head, Mechanics and Durability Branch
Dr. Ed Generazio- current Head, Nondestructive Evaluation Sciences Branch
Dr. Howard Adelman- current Head, Structural Dynamics Branch
Dr. Jonathan Ransom- current Head, Analytical and Computational Methods Branch
Dr. Ivatury Raju- current Chief Technologist, Structures & Materials Competency; has participated in many studies as an expert structures/materials analyst
Dr. Jim Starnes- current Chief Engineer, Structures & Materials Competency; has participated in many studies as an aerospace structures expert; currently leads NASA investigation supporting NTSB investigation of AA587

All these Branches are in the Structures & Materials Competency (SMC) at LaRC. SMC has coordinated the Agency Center of Excellence for Structures & Materials that has been a useful way to coordinate structures and materials issues across NASA. I am the current point of contact for the Center of Excellence and can give points of contact at

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other Centers if needed (Glenn Miller and Irene Verinder[not sure of her new married name] at JSC are on my list).

Hope this helps to get us asking questions from experts instead of contacts.....Mark

Mark/Ajay,

This was the last e-mail that I sent to Bonnie. As noted below, I told her we would add people to her list as we thought appropriate. Please feel free to let me know if you would like changes.

Mark

Date: Mon, 10 Feb 2003 13:08:21 -0500
To: "DUNBAR, BONNIE J. (JSC-AC8) (NASA)" <bonnie.j.dunbar@nasa.gov>
From: "Mark P. Saunders" <m.p.saunders@larc.nasa.gov>
Subject: RE: Dr. John Buckley
Cc: "MILLER, GLENN J. (JSC-EA) (NASA)" <glenn.j.miller@nasa.gov>
Bcc:
X-Attachments:

Hi Bonnie,

Thanks for the quick response. Del Freeman has asked me to be the POC for LaRC so for now you can use me to arrange support you need. I am the Deputy Director for Space Access and Exploration Programs here at LaRC (there is no current Director).

We are holding two meetings a day to stay on top of our efforts to support the various investigation efforts. The first is with Del in the morning and then I have a technical tag-up in the afternoon. Consequently, it's easy to get activities started when required. Just let me know when you need something. I realize that good contact is being made at lower levels too. This is fine; they'll brief me on new activities as they arise.

I'm going to ask our Structures and Materials Director if he wants to add any other names to your TPS list. If so, I'll forward them to you and Glenn. Just as a side note, Carol and I have been friends for almost 20 years. She and my wife went to Virginia Tech together, and we all worked on the Navy's TRIDENT program. She is exceptional and great to work with.

I have passed on to everyone here (including John) that John is to be considered as an Investigation Team member and, as such, has access to any data needed. Don't hesitate to seek his assistance.

As you know, we are a research center focusing on expertise related to atmospheric flight. We have experienced engineers and researchers in aerodynamics, aerothermodynamics, flight mechanics, trajectory analysis, structures and materials, plus others. As you mentioned, we already have a strong working relationship in the aero/aerothermal areas. If you need help in the other areas, let me know. Fred Gregory did ask Del if we would participate in the orbiter reconstruction, since we reconstructed the American Airlines flight 587 tail. Del agreed to this, but it isn't clear if anyone has spoken with you all about this.

Thanks and don't hesitate to e-mail or call me if you need anything. 757-864-9862 (O) or [REDACTED] (cell)

Mark

At 8:58 AM -0600 2/10/03, DUNBAR, BONNIE J. (JSC-AC8) (NASA) wrote:
Mark,

Thank you for your kind words. I hope the following will help explain how John was involved in our initial contacts, and our need for your support.

(1) John's involvement: I have been involved in the TPS development for over 30 years, since I was a student at the University of Washington. I later was employed by Rockwell in the 70's, participating in design, production, and installation of TPS at Palmdale. When I arrived at JSC, before becoming an astronaut, I was assigned by Mission Operations to follow the TPS, and worked on an on orbit tile repair concept. Throughout that effort there were a handful of NASA experts that worked with us. They included George Stroughal at JSC, Howard Goldstein at Ames, and John Buckley at LaRC.

Within a day of the accident, I started receiving calls from many of the retired engineers and technicians from Rockwell that had worked on Columbia and were offering their help. As a result we started a "greybeard" list of experts who could be used to support both the internal NASA board and the external investigation board. I contacted John as one of the former LaRC engineers who was intimately familiar with the shuttle thermal design requirements, and as former chair of the Cocoa Beach Advanced Ceramics Working Group where many of the TPS papers were presented. John was also part of an early materials review team made up of Howard, George, and Jim Gangler, NASA Headquarters. We definitely need to have him be able to consult to the teams.

(2) Secondly, we do need to know how LaRC can support and we do need a Civil Servant Point of Contact (POC) who can be used to call up facility use/test data generation, etc. We have engaged Ames in this regard, specifically

Carol Carroll's Technology Division for Aerothermal analyses. I presume that you are familiar with her and what they can do. Should we consider you the POC? The POC can be given directly to me or forwarded to Glenn Miller; Glenn is in the JSC Engineering Director's Office. By the way, we do have LaRC personnel supporting another group: they are Charles Miller, Tom Horval, and Bill Scallin.

I have attached the current working list of our contacts, which includes NASA support outside of JSC. Bill Lassiter is listed on that since John gave me his name.

Thank you for your support. Look forward to working with you.\

Bonnie

Bonnie J. Dunbar, PhD NAE
NASA Johnson Space Center
Assistant Director
(University Research and Affairs)
MC-AC8
Houston, TX 77058
281-483-6594 (PH)
281-483-3379 (FAX)
bonnie.j.dunbar1@jsc.nasa.gov
www.jsc.nasa.gov
To view ISS: www.spaceflight.nasa.gov

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

From: Mark P. Saunders [mailto:m.p.saunders@larc.nasa.gov]
Sent: Sunday, February 09, 2003 4:31 PM
To: DUNBAR, BONNIE J. (JSC-AC8) (NASA)
Subject: Dr. John Buckley

Hi Bonnie,

First, I'd like you to know that we are very sorry about what has happened. Everyone here at LaRC sends their thoughts and prayers to you and your colleagues at JSC. We're available to help in anyway that is needed.

In that regard I'm a little confused about the role of John. I have received authorization to treat him as an Investigation Team member so that has been taken care of. However, I have seen him represented as leading the LaRC support for any TPS work we would contribute. Is

this what is anticipated, or are you all just considering his expertise in support of the TPS group? At present we view John as just a consultant to your TPS group. If you want LaRC to participate, I need to know that so I can organize our civil servant staff to help as required.

If you wouldn't mind letting me know what you want and need, I'd appreciate it.

Thanks.

Mark

See Stuart-16

Attachment converted: Macintosh HD:Columbia - TPS database21.xls (XLS4/XCEL)
(00021152)

Attachment converted: Macintosh HD:Columbia_-_TPS_database21.xls (XLS4/XCEL)
(0002488A)

Date: Wed, 12 Feb 2003 15:49:58 -0500
To: Pamela Richardson <prichard@hq.nasa.gov>
From: "Mark J. Shuart" <m.j.shuart@pop.larc.nasa.gov>
Subject: Re: Thank you
Cc:
Bcc: p.d.arbuckle
X-Attachments:

Pam,

Glad to help. Be sure to let me know if there is something else we can do....Mark

Mark --

We received the package of information today that you compiled about on-orbit repair concepts for the Shuttle. I wanted to pass along a hearty thank you to you and the staff members that put the package together. As we go through this process, we will include your input in our efforts. Any information that we can pass back to you about this contribution will sent gladly.

Pam Richardson

~~~~~  
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
~~~~~

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Shuart-29

Date: Thu, 13 Feb 2003 15:03:38 -0500  
To: Ed Generazio <e.r.generazio@larc.nasa.gov>  
From: "Mark J. Shuart" <m.j.shuart@pop.larc.nasa.gov>  
Subject: Re: Fwd: FW: EVA hand-held Eddy Current Inspection System - DRAFT  
PITCH  
Cc:  
Bcc:  
X-Attachments:

Ed,

Thanks for keeping me advised. Perhaps Buzz could ask these guys what "Team" they are supporting?

Mark

Mark,  
This task request has come from JSC. It's not clear whether this is a Return-to-Flight request.  
Ed

X-Sender: r.a.wincheski@pop.larc.nasa.gov  
Date: Thu, 13 Feb 2003 10:02:56 -0500  
To: e.r.generazio@larc.nasa.gov, d.m.heath@larc.nasa.gov  
From: Buzz Wincheski <r.a.wincheski@larc.nasa.gov>  
Subject: Fwd: FW: EVA hand-held Eddy Current Inspection System - DRAFT  
PITCH

this is the previous email.

Buzz

From: "STANLEY, DAVID M. (JSC-ES) (LM)" <david.m.stanley1@jsc.nasa.gov>  
To: "r.a.wincheski@larc.nasa.gov" <r.a.wincheski@larc.nasa.gov>  
Subject: FW: EVA hand-held Eddy Current Inspection System - DRAFT PITCH  
Date: Fri, 7 Feb 2003 12:40:18 -0600

Buzz,

I apologize for the delay. George Studor walked into my office the minute we hung up and then I had to run to another meeting which was followed by a high priority action from my boss.

Anyway, George wants us to build the probe itself, he will handle everything else in the pitch. The probe needs to have the sensor coil(s), the good/bad indicator lights, the necessary electronics to operate the coil

Shuart-33

**SOFI NDE Team**  
Ralph LeBoeuf and Robert Thom Co-chairs

**Telecon Agenda (2/19/03):**

| <b>Agenda Item</b>                     | <b>Responsible</b> |
|----------------------------------------|--------------------|
| Status                                 | LeBoeuf/Thom       |
| Anticipated Schedule for Bipod Test(s) | LeBoeuf            |
| Bipod Mockup Design                    | Spencer/Willick    |
| Review Capability Matrix               | Spencer            |
| Review NDE Method Assessment Progress  | Team               |
| Shearography                           | Suits/Santos       |
| Radiography                            | McEvoy/Beshears    |
|                                        |                    |
|                                        |                    |
| Review Actions and Close               | Spencer            |



and log data, and the battery. At the end of the project he wants a probe that's as ready to fly as possible.

George already has a company in mind to build the over all probe (Invocon?). We would simply work with them to incorporate whichever sensor and electronics technology is best.

Dave

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

From: STUDOR, GEORGE F. (JSC-ES2) (NASA) Sent: Friday, January 31, 2003 4:47 PM

To: STANLEY, DAVID M. (JSC-ES) (LM); RUFFINO, NORMAN P. (JSC-ES4) (LM)

Cc: HERNANDEZ, JOSE M. (JSC-ES4) (NASA)

Subject: EVA hand-held Eddy Current Inspection System - DRAFT PITCH

Stan, Norm, Jose,

This is my draft pitch, could we talk Monday to see how far off I am?

I am at the doctor the first part of the morning - I'll call when I get back.

Thanks,

George <<EVAEddyCurrentSensorSystem.ppt>>

*See "Stewart-37"*

Attachment converted: Macintosh HD:EVAEddyCurrentSensorSystem.ppt (SLD3/PPT3)  
(00024C27)

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SOFI NDE Technology Assessment Matrix

| Technology              | Description of Approach(s)                                                                                                                         | Technology Readiness Level | Defect Type |           |           |      |          |            |       |          |        | Comment                                                                                                                                                                                                                                                                                                                 |
|-------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------|-------------|-----------|-----------|------|----------|------------|-------|----------|--------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                         |                                                                                                                                                    |                            | Voids       |           | Debonds   |      |          | Inclusions |       | Porosity | Cracks |                                                                                                                                                                                                                                                                                                                         |
|                         |                                                                                                                                                    |                            | Voids       | Wormholes | Substrate | Weak | Knitline | Heavy      | Light |          |        |                                                                                                                                                                                                                                                                                                                         |
| Film Radiography        | Standard film x-ray using multiple angle shots                                                                                                     | 5                          | MH          | M         | L         | L    | ML       | H          | M     | M        | MH*    | * Depends upon orientation; (MSFC)                                                                                                                                                                                                                                                                                      |
| Digital Radiography     | Phosphor plate detector<br>Digital x-ray camera                                                                                                    | 5                          | MH          | M         | L         | L    | ML       | H          | M     | M        | MH*    | Digital x-ray does very well on Shuttle tile during manufacturing. Excellent contrast sensitivity and resolution. May be useful for some locations but not a general solution. * Depends upon orientation; (MSFC)                                                                                                       |
| Backscatter Radiography | Collimated x-ray source and detectors images material that scatters x-rays. Provides density within a small region.                                |                            | H*          | MH        | M         | L    | M        | H          | M     | H        | M      | Particularly good for finding voids. Philips makes a commercial unit that may be adaptable. *Information acquired from two vendors, AS&E and Xylon                                                                                                                                                                      |
| Shearography            | Vacuum and acoustic stimulation                                                                                                                    | <3" 8; >3" 5; 7*           | H*          | L         | H         | L    | H        | L          | L     | M        | M      | May be useful for the detection of disbonds, cracks, voids on ET at factory; i.e. without and with ET pressurization. Stimulation by local vacuum or heating may also be of some use; Low pod for weak bonds; * Based upon Delta IV Testing and ET Foam panel testing; (Vanaria)                                        |
| Thermography            | Measuring Thermal response of material using wave flow differential analysis (front side heating); heated substrate analysis; analysis during cure | 2                          | ML          | ML        | L         | L    | L        | ML         | L     | L        | ML     | These rankings are for the flaw detection. Process monitoring is High to Medium based on the specifics of closeouts or acreage foam; May be applicable for in-process, NDE at factory, NDE at Cape, while the ET is being filled with LH and Lox, and after the ET is filled. Thermography of ET can be modeled; (MSFC) |
| Acoustic Emission       | Active technique using a sensor array to monitor changes in the TPS acoustic response due to the presence of debonds.                              | 2                          | L           | L         | L         | L    | L        | L          | L     | L        | L      | Passive acoustic emission may detect spectrum from cryo-pumping; (MSFC)                                                                                                                                                                                                                                                 |
| Microwave               | microwave signal is transmitted into dielectric materials and signal losses are measured. Greater losses are measured when defects are encountered | 4                          | M           | M         | M         | M    | M        | M          | M     | M        | M      | The interaction of microwave with moisture or gases condensed within voids could lead to the development of a method; (MSFC)                                                                                                                                                                                            |
| Laser UT                | UT technique using laser stimulus                                                                                                                  | 4                          | L           | L         | M         | L    | M        | L          | L     | L        | M      |                                                                                                                                                                                                                                                                                                                         |
| Laser Vibrometry        | Need definition                                                                                                                                    |                            |             |           |           |      |          |            |       |          |        |                                                                                                                                                                                                                                                                                                                         |
| UT                      | High frequency sound for flaw detection                                                                                                            | 4                          | L           | L         | M         | L    | M        | L          | L     | L        | M      | All though not currently being used, air coupled UT should not be ruled out-Jack Bellin (LM_ATC); (MSFC)                                                                                                                                                                                                                |
| Neutron Radiography     | Standard film x-ray or digital capture                                                                                                             | 2                          | ?           | ?         | ?         | ?    | ?        | ?          | ?     | ?        | ?      | (Vanaria)                                                                                                                                                                                                                                                                                                               |
|                         |                                                                                                                                                    |                            |             |           |           |      |          |            |       |          |        |                                                                                                                                                                                                                                                                                                                         |
|                         |                                                                                                                                                    |                            |             |           |           |      |          |            |       |          |        |                                                                                                                                                                                                                                                                                                                         |
|                         |                                                                                                                                                    |                            |             |           |           |      |          |            |       |          |        |                                                                                                                                                                                                                                                                                                                         |

Smart-35

File name: Technology-  
Capability-  
Matrix-



| Technology              | Description of Approach(s)                                                                                                                         | Contacts with Experience                                                                                                                                                                | Experience Environment                                                                | Technology Readiness Level | Wormholes | Comment                                                                                                                                                                                                                                                                                                                 |
|-------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------|----------------------------|-----------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                         |                                                                                                                                                    |                                                                                                                                                                                         |                                                                                       |                            |           |                                                                                                                                                                                                                                                                                                                         |
| Backscatter Radiography | Collimated x-ray source and detectors images material that scatters x-rays. Provides density within a small region.                                | Marion Barker (LM_ATC)                                                                                                                                                                  | Aerospace materials                                                                   | 3                          | 4         | Particularly good for finding voids. Philips makes a commercial unit that may be adaptable. *Information acquired from two vendors, AS&E and Xylon                                                                                                                                                                      |
| Film Radiography        | Standard film x-ray using multiple angle shots                                                                                                     | Shan McEvoy (MAF LMC) Bill Ford (M&FC-Orlando), Ron Beshears (MSFC)                                                                                                                     | Aluminum Welds Composites                                                             | 5                          | 3         | * Depends upon orientation; (MSFC)                                                                                                                                                                                                                                                                                      |
| Digital Radiography     | Phosphor plate detector Digital x-ray camera                                                                                                       | Warren Ussery (MAF LMC); Lee Klynn (LM_ATC); Ron Bashears (MSFC)                                                                                                                        | Aluminum Welds; Composites; Aerospace materials.                                      | 5                          | 3         | Digital x-ray does very well on Shuttle tile during manufacturing. Excellent contrast sensitivity and resolution. May be useful for some locations but not a general solution. * Depends upon orientation; (MSFC)                                                                                                       |
| Microwave               | microwave signal is transmitted into dielectric materials and signal losses are measured. Greater losses are measured when defects are encountered | Frank Hepburn (MSFC)                                                                                                                                                                    | composites, ceramics, plastics & rubber, metal surfaces & graphite composite surfaces | 4                          | 3         | The interaction of microwave with moisture or gases condensed within voids could lead to the development of a method; (MSFC)                                                                                                                                                                                            |
| Thermography            | Measuring Thermal response of material using wave flow differential analysis (front side heating); heated substrate analysis; analysis during cure | Carl Bouvier (MAF LMC); Jeff Gray (MAF LMC); Bob Cervero (M&FC-Orlando); Lee Klynn(LM_ATC); James Walker (MSFC); Sam Russell (MSFC)                                                     | Composite                                                                             | 2                          | 2         | These rankings are for the flaw detection. Process monitoring is High to Medium based on the specifics of closeouts or acreage foam; May be applicable for in-process, NDE at factory, NDE at Cape, while the ET is being filled with LH and Lox, and after the ET is filled. Thermography of ET can be modeled; (MSFC) |
| Shearography            | Vacuum and acoustic stimulation                                                                                                                    | Chris Davis (KSC NASA); Jeff Gray (MAF LMC); Warren Ussery (MAF LMC); James Walker (MSFC); Matt Lansing (MSFC); Sam Russell (MSFC); Fernando Santos (KSC NASA); Phil Vanaria (KSC NASA) | SOFI                                                                                  | 6                          | 1         | May be useful for the detection of disbonds, cracks, voids on ET at factory; i.e. without and with ET pressurization. Stimulation by local vacuum or heating may also be of some use; Low pod for weak bonds; * Based upon Delta IV Testing and ET Foam panel testing; (Vanaria)                                        |
| Laser UT                | UT technique using laser stimulus                                                                                                                  | LMC Ft. Worth                                                                                                                                                                           | Composite                                                                             | 4                          | 1         |                                                                                                                                                                                                                                                                                                                         |
| UT                      | High frequency sound for flaw detection                                                                                                            | Bill Ford (M&FC-Orlando); Mike Suits (MSFC)                                                                                                                                             | Aluminum Welds; Composites                                                            | 4                          | 1         | All though not currently being used, air coupled UT should not be ruled out-Jack Bellin (LM_ATC); (MSFC)                                                                                                                                                                                                                |
| Acoustic Emission       | Active technique using a sensor array to monitor changes in the TPS acoustic response due to the presence of debonds.                              | Ron Reightler (MAF LMC); James Walker (MSFC)                                                                                                                                            | Composite                                                                             | 2                          | 1         | Passive acoustic emission may detect spectrum from cryo-pumping; (MSFC)                                                                                                                                                                                                                                                 |
| Laser Vibrometry        | Need definition                                                                                                                                    |                                                                                                                                                                                         |                                                                                       |                            |           |                                                                                                                                                                                                                                                                                                                         |
| Neutron Radiography     | Standard film x-ray or digital capture                                                                                                             | Tony Corack (KSC USA)                                                                                                                                                                   | Pyrotechnics                                                                          | 2                          | ?         | (Vanaria)                                                                                                                                                                                                                                                                                                               |
|                         |                                                                                                                                                    |                                                                                                                                                                                         |                                                                                       |                            |           |                                                                                                                                                                                                                                                                                                                         |
|                         |                                                                                                                                                    |                                                                                                                                                                                         |                                                                                       |                            |           |                                                                                                                                                                                                                                                                                                                         |
|                         |                                                                                                                                                    |                                                                                                                                                                                         |                                                                                       |                            |           |                                                                                                                                                                                                                                                                                                                         |

| Technology              | Description of Approach(s)                                                                                                                         | Contacts with Experience                                                                                                                                                                | Experience Environment                                                                | Technology Readiness Level | Substrate Debonds | Comment                                                                                                                                                                                                                                                                                                                 |
|-------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------|----------------------------|-------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Shearography            | Vacuum and acoustic stimulation                                                                                                                    | Chris Davis (KSC NASA); Jeff Gray (MAF LMC); Warren Ussery (MAF LMC); James Walker (MSFC); Matt Lansing (MSFC); Sam Russell (MSFC); Fernando Santos (KSC NASA); Phil Vanaria (KSC NASA) | SOFI                                                                                  | 6                          | 5                 | May be useful for the detection of disbonds, cracks, voids on ET at factory; i.e. without and with ET pressurization. Stimulation by local vacuum or heating may also be of some use. Low pod for weak bonds; * Based upon Delta IV Testing and ET Foam panel testing; (Vanaria)                                        |
| Microwave               | microwave signal is transmitted into dielectric materials and signal losses are measured. Greater losses are measured when defects are encountered | Frank Hepburn (MSFC)                                                                                                                                                                    | composites, ceramics, plastics & rubber, metal surfaces & graphite composite surfaces | 4                          | 3                 | The interaction of microwave with moisture or gases condensed within voids could lead to the development of a method; (MSFC)                                                                                                                                                                                            |
| Laser UT                | UT technique using laser stimulus                                                                                                                  | LMC Ft. Worth                                                                                                                                                                           | Composite                                                                             | 4                          | 3                 |                                                                                                                                                                                                                                                                                                                         |
| UT                      | High frequency sound for flaw detection                                                                                                            | Bill Ford (M&FC-Orlando); Mike Suits (MSFC)                                                                                                                                             | Aluminum Welds; Composites                                                            | 4                          | 3                 | All though not currently being used, air coupled UT should not be ruled out-Jack Bellin (LM_ATC); (MSFC)                                                                                                                                                                                                                |
| Backscatter Radiography | Collimated x-ray source and detectors images material that scatters x-rays. Provides density within a small region.                                | Marion Barker (LM_ATC)                                                                                                                                                                  | Aerospace materials                                                                   | 3                          | 3                 | Particularly good for finding voids. Philips makes a commercial unit that may be adaptable. *Information acquired from two vendors, AS&E and Xylon                                                                                                                                                                      |
| Film Radiography        | Standard film x-ray using multiple angle shots                                                                                                     | Shan McEvoy (MAF LMC) Bill Ford (M&FC-Orlando), Ron Beshears (MSFC)                                                                                                                     | Aluminum Welds Composites                                                             | 5                          | 1                 | * Depends upon orientation; (MSFC)                                                                                                                                                                                                                                                                                      |
| Digital Radiography     | Phosphor plate detector Digital x-ray camera                                                                                                       | Warren Ussery (MAF LMC); Lee Klynn (LM_ATC); Ron Beshears (MSFC)                                                                                                                        | Aluminum Welds; Composites; Aerospace materials.                                      | 5                          | 1                 | Digital x-ray does very well on Shuttle tile during manufacturing. Excellent contrast sensitivity and resolution. May be useful for some locations but not a general solution. * Depends upon orientation; (MSFC)                                                                                                       |
| Thermography            | Measuring Thermal response of material using wave flow differential analysis (front side heating); heated substrate analysis; analysis during cure | Carl Bouvier (MAF LMC); Jeff Gray (MAF LMC); Bob Cervero (M&FC-Orlando); Lee Klynn(LM_ATC); James Walker (MSFC); Sam Russell (MSFC)                                                     | Composite                                                                             | 2                          | 1                 | These rankings are for the flaw detection. Process monitoring is High to Medium based on the specifics of closeouts or acreage foam; May be applicable for in-process, NDE at factory, NDE at Cape, while the ET is being filled with LH and Lox, and after the ET is filled. Thermography of ET can be modeled; (MSFC) |
| Acoustic Emission       | Active technique using a sensor array to monitor changes in the TPS acoustic response due to the presence of debonds.                              | Ron Reightler (MAF LMC); James Walker (MSFC)                                                                                                                                            | Composite                                                                             | 2                          | 1                 | Passive acoustic emission may detect spectrum from cryo-pumping; (MSFC)                                                                                                                                                                                                                                                 |
| Laser Vibrometry        | Need definition                                                                                                                                    |                                                                                                                                                                                         |                                                                                       |                            |                   |                                                                                                                                                                                                                                                                                                                         |
| Neutron Radiography     | Standard film x-ray or digital capture                                                                                                             | Tony Corack (KSC USA)                                                                                                                                                                   | Pyrotechnics                                                                          | 2                          | ?                 | (Vanaria)                                                                                                                                                                                                                                                                                                               |
|                         |                                                                                                                                                    |                                                                                                                                                                                         |                                                                                       |                            |                   |                                                                                                                                                                                                                                                                                                                         |

**4. Validation of laser shearography testing for fixed foam insulation bonds**

AEO 92-00 9213561A NDN- 011-0129-3220-5



ENGEL, J. E.; BURLEIGH, D. D., (General Dynamics Co., Space Systems Div., San Diego, CA)

IN: Review of progress in quantitative nondestructive evaluation. Vol. 9A (A92-13526 03-38). New York, Plenum Press, 1990, p. 569-576.

**DOCUMENT TYPE-** COLLOQUIA PAPER

**AUTHOR AFFILIATION-** (General Dynamics Co., Space Systems Div., San Diego, CA)

**GRANT NUMBER-** F40701-88-C-0042

**SUPPLEMENTARY NOTE(S)-** Validation of laser shearography testing for fixed foam insulation bonds

**SOURCE OF ABSTRACT-** R.E.P.

**LANGUAGE-** English

Laser shearography was examined as an NDE method for the inspection of adhesive bonds on fixed foam insulation for Atlas-Centaur cryogenic fuel tanks. A test program was performed that evaluated the capability of electronic laser shearography to detect disbonds under field conditions of a full-scale development test article. Test results validated laser shearography as a useful technique for the inspection of adhesive bonds in the test article configuration.

**IDENTIFIER(S)-** ADHESIVE BONDING; FOAMS; LASER APPLICATIONS; NONDESTRUCTIVE TESTS; STRAIN MEASUREMENT; THERMAL INSULATION

**SECONDARY IDENTIFIER(S)-** ATLAS CENTAUR LAUNCH VEHICLE; CRYOGENIC FLUID STORAGE; FUEL TANKS

**COUNTRY CODE(S)-** UNITED STATES

## 8. Laser Shearographic Testing of Foam Insulation on Cryogenic Fuel Tanks.

ASM 94-01 199401-22-0030 NDN- 100-0108-1008-1



Burleigh, D. D.; Engel, J. E.; Kuhns, D. R.

**CONFERENCE PROCEEDINGS-** Review of Progress in Quantitative Nondestructive Evaluation. 12A  
1993

**PP.** 411-418

7 reference(s)

**DOCUMENT TYPE-** Conference Paper

**AUTHOR AFFILIATION-** General Dynamics, (All Authors)

**PUBLISHER-** Plenum Press

**PUBLICATION PLACE-** 233 Spring St., New York, New York 10013, USA

**PUBLICATION COUNTRY-** USA

**CONFERENCE DATE-** 19-24 July 1992

**CONFERENCE LOCATION-** La Jolla, California, USA

**LANGUAGE-** English

A difficult NDT problem was presented, that of detecting disbonds in the adhesive bondline between a 0.6 in. thick PVC foam insulation and a 10 ft diameter 0.016 stainless steel cryogenic fuel tank. Various NDT techniques were evaluated and laser shearography was identified as a unique solution to the problem.

**DESCRIPTOR(S)-** Adhesive joints --Nondestructive testing; Conference Paper; Fuel tanks --Nondestructive testing; Interferometry; Stainless steels --Nondestructive testing; Thermal insulation --Nondestructive testing

**SECTION HEADING CODE-** 22

**SECTION HEADING-** Testing and Control .

**19. Microwave nondestructive evaluation of thick sandwich composites.**

EMA 95-07 199507-B2-D-0375 NDN- 104-0020-2593-8



Ganchev, S. I.; Runser, R. J.; Qaddoumi, N.; Ranu, E.; Carriveau, G.

**JOURNAL NAME-** Mater. Eval.

53, (4)

1995; Apr. 1995

**PP.** 463-467

11 reference(s)

**DOCUMENT TYPE-** Journal Article

**ISSN-** 0025-5327

**AUTHOR AFFILIATION-** Colorado State University; Colorado State University;  
Colorado State University; Colorado State University; TRI/Austin

**LANGUAGE-** English

This paper examines a microwave nondestructive testing experiment and the theoretical modeling results obtained from a study of thick sandwich composite materials. Two samples, foam and honeycomb, each made of fiberglass epoxy laminate skin and core material backed by a conducting sheet were prepared, and special defects, including two delaminations, were created in the samples. Two different microwave measurement setups were used: in the first, a fixed diode detector provided information about standing wave properties; the second approach utilized a single reflectometer using a directional coupler. The results of this study clearly demonstrate the potential of microwaves as nondestructive tools for inspecting thick composite sandwich structures. The measurements provided detailed information about each defect, such as the raised edges associated with the manufacturing of the delaminations, the shape of the indentations caused by the impact fatigue defects, and surface skin fiber bundle orientations. As expected, higher frequencies provided better spatial resolutions.

**DESCRIPTOR(S)-** Glass fiber reinforced plastics --Nondestructive testing; Journal Article; Nondestructive testing; Sandwich construction

**SECTION HEADING CODE-** B2

**SECTION HEADING-** Testing and Quality Control .



**20. Compton Backscatter X-Ray Imaging: an Alternative Method for Non-Destructive Testing.**

EMA 93-01 199301-B2-D-0013 NDN- 104-0016-8185-8



Kosanetzky, J. M.

**CONFERENCE PROCEEDINGS-** New Alternative Materials for the Automotive Industries

1992

**PP.** 503-509

3 reference(s)

**FIGURES-** Graphs.

**DOCUMENT TYPE-** Conference Paper

**AUTHOR AFFILIATION-** Philips Industrial X-Rays

**PUBLISHER-** Automotive Automation Limited

**PUBLICATION PLACE-** 42 Lloyd Park Ave., Croydon CR0 5SB, UK

**PUBLICATION COUNTRY-** UK

**CONFERENCE DATE-** 1-5 June 1992

**CONFERENCE LOCATION-** Florence, Italy

**LANGUAGE-** English

A method was described based on the measurement of Compton back-scattered X-rays for the inspection of low atomic number materials like Al, steel wire reinforced rubber and glass fiber/foam sandwich. Due to attenuation effects, this method is limited to surface near regions, but it offers some important benefits: increased safety, as it facilitates position and depth resolved detection of defects; inspection of material combinations of very different density values; the free choice of the imaging geometry, especially a back-scatter system. Therefore, large bulky objects can be inspected without any problems just from one side.

**DESCRIPTOR(S)-** Automotive components --Nondestructive testing; Conference Paper; Elastic scattering; Glass fiber reinforced plastics --Nondestructive testing; Inspection; Plastic foam --Composite materials; Sandwiches --Nondestructive testing; X ray analysis

**SECTION HEADING CODE-** B2

**SECTION HEADING-** Testing and Quality Control .

**30. SIMPLE MODEL FOR SIZING UNBONDS IN FOAM-ADHESIVE BONDED LAMINATES FROM SHEAROGRAPHIC FRINGES**

RPA 94-07 505020 NDN- 131-0104-2052-6



Shang, H. M.; Chau, F. S.; Tay, C. J.; Toh, S. L.; Tham, L. M.

**ABBREVIATED JOURNAL TITLE-** Composites Engng.

1994

4, No.2, 1994, p.233-45

**DOCUMENT TYPE-** Journal

**CORPORATE AUTHOR-** Singapore,National University

**SUBFILE CODE-** RR; AA

**TRADE NAME(S)-** MYLAR

**ISSUE OF ORIGINATION-** 9404

**LANGUAGE-** English

The use of double-exposure shearography in detecting and assessing unbonds in foam-adhesive bonded laminates is demonstrated. Unbonds are created artificially by placing Mylar sheets between the foam adhesive and the adherends. When the laminates are vacuum-stressed, the unbonds are revealed from perturbations in the fringe patterns. As the foam is highly elastic, the apparent unbond size, described by the boundary of the perturbed fringes, is grossly larger than the actual size of the unbond. A simple model is developed, enabling a reasonably accurate estimation of the unbond size. The findings also suggest that the depth of an unbond may be estimated from shearograms of both sides of the laminate. 10 refs.

**ADHESIVES SUBJECT INDEX (A)-** ADHESION --debonding; ADHESION --foams; ADHESION --laminates; DEBONDING --foams; DEBONDING --laminates; FOAMS --adhesion; FOAMS --debonding

**DESCRIPTOR(S)-** ADHEREND; ADHESIVE; BONDED; COMPOSITE; DATA; DEBONDING; EQUATION; FOAM; GLASS FIBRE-REINFORCED PLASTIC; GRAPH; GRP; INSTITUTION; LAMINATE; MECHANICAL PROPERTIES; MODEL; PLASTIC; REINFORCED PLASTIC; SHEAROGRAPHY; SHEET; SIZING; STRESS; TABLES; TECHNICAL; TEST; THEORY; THERMOPLASTIC; THERMOSET

**IDENTIFIER(S)-** ADHESION --debonding; ADHESION --foams; ADHESION --laminates; ADHESIVES --adhesion; ADHESIVES --debonding; ADHESIVES --foams; DEBONDING --foams; DEBONDING --laminates; FOAMS --adhesion; FOAMS --adhesives; FOAMS --debonding

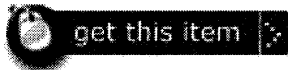
**GEOGRAPHIC DESCRIPTOR(S)-** SINGAPORE

**SECTIONAL CLASSIFICATION CODE-** 9(12)4T; 6124; 626; 6272

**SECTION HEADING CODE-** UM; QB; OC; OK; AUM; ARB .

### 31. INSPECTING ADHESIVE BONDLINES

RPA 93-09 472319 NDN- 131-0100-9819-7



NO-AUTHOR

**ABBREVIATED JOURNAL TITLE-** Eur.Adhes.& Seal.  
1993

10,No.1,March 1993,p.43

**DOCUMENT TYPE-** Journal

**NAMED COMPANY-** LASER TECHNOLOGY INC.

**SUBFILE CODE-** RR; AA

**ISSUE OF ORIGATION-** 9306

**LANGUAGE-** English

It is reported that adhesive bondlines on the cryogenic liquid fuel tanks of the Atlas Centaur were inspected by laser shearography in less than eight hours with equipment designed for field inspection on the launch pad. Inspection of the new fixed foam insulation marks the first application of Advanced Shearography NDT on an Atlas II flight vehicle. Very brief details are noted.

**ADHESIVES SUBJECT INDEX (A)-** AEROSPACE APPLICATIONS --non destructive testing; NON DESTRUCTIVE TESTING --aerospace applications

**DESCRIPTOR(S)-** ADHESIVE; AEROSPACE APPLICATION; BOND STRENGTH; COMPANY; NON-DESTRUCTIVE TESTING; PLASTIC; PRODUCT ANNOUNCEMENT; SHORT ITEM; TEST EQUIPMENT; TESTING

**IDENTIFIER(S)-** ADHESIVES --aerospace applications; ADHESIVES --non destructive testing; AEROSPACE APPLICATIONS --adhesives; AEROSPACE APPLICATIONS --non destructive testing; NON DESTRUCTIVE TESTING --adhesives; NON DESTRUCTIVE TESTING --aerospace applications

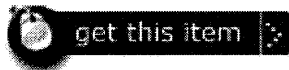
**GEOGRAPHIC DESCRIPTOR(S)-** USA

**SECTIONAL CLASSIFICATION CODE-** 63Tr.Sp; 6A1; 29(12)5T; 29(12)4

**SECTION HEADING CODE-** UN; QB; QN; AUA; ALE .

## 32. ELECTRONIC SHEAROGRAPHY IN USE AT GDSS

RPA 90-12 397007 NDN- 131-0079-1357-6



NO-AUTHOR

**ABBREVIATED JOURNAL TITLE-** Composites Adhes.Newsletter  
1989

6, No.2, Dec.1989/Jan.1990, p.8

**DOCUMENT TYPE-** Journal

**NAMED COMPANY-** GENERAL DYNAMICS CORP., SPACE SYSTEMS DIV.; LASER  
TECHNOLOGY INC.

**SUBFILE CODE-** RR; AA

**ISSUE OF ORIGATION-** 9007

**LANGUAGE-** English (DEF)

General Dynamics Space Systems Div. is using electronic shearography with vacuum excitation to evaluate the bonding of insulation used in the manufacture of the Centaur upper-stage launch vehicle. This vehicle requires a layer of rigid, closed-cell plastic foam, adhesively bonded to a thin-gauge stainless steel cryogenic fuel tank. The NDT equipment is produced by Laser Technology Inc.

**NON POLYMER-** METAL; STAINLESS STEEL; STEEL

**ADHESIVES SUBJECT INDEX (A)-** Same as ID

**DESCRIPTOR(S)-** ADHESION; AEROSPACE APPLICATION; CELLULAR MATERIAL;  
CLOSED-CELL; COMPANIES; COMPANY; CRYOGENIC; DEBONDING; FOAM; FUEL  
TANK; NDT; NON-DESTRUCTIVE TESTING; PLASTIC; PRODUCT ANNOUNCEMENT;  
SHEAROGRAPHY; SHORT ITEM; SPACECRAFT; TEST; TESTING; THERMAL  
INSULATION; VACUUM

**IDENTIFIER(S)-** ADHESION, --aerospace applications; AEROSPACE APPLICATIONS,  
--adhesion; AEROSPACE APPLICATIONS, --shearography; CELLULAR MATERIALS, --  
adhesion; CELLULAR MATERIALS, --shearography; ADHESION --cellular materials;  
AEROSPACE APPLICATIONS --cellular materials; CELLULAR MATERIALS --aerospace  
applications; NON DESTRUCTIVE TESTING --shearography; NON DESTRUCTIVE  
TESTING, --aerospace applications; NON DESTRUCTIVE TESTING, --cellular  
materials

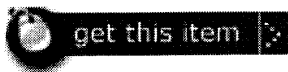
**GEOGRAPHIC DESCRIPTOR(S)-** USA

**SECTIONAL CLASSIFICATION CODE-** 6124-63Tr.Sp-9(12)4T; 6124-63Tr.Sp-  
9(12)5T

**SECTION HEADING-** UM; QN; OC; AUM; ARG; ALE .

**35. Acoustic-Optic Measurement of Micromechanical Resonance for Adhesive Bond Integrity.**

USG 89-00 DE89005416 NDN- 059-0137-8719-8



Barna, B. A.; Allemeier, R. T.; Rodriguez, J. G.; Tow, D. M.

1988

6p page(s)

**CORPORATE AUTHOR-** EG and G Idaho, Inc., Idaho Falls.

**CORPORATE AUTHOR CODE-** 046580000 9507781

**SPONSOR-** Department of Energy, Washington, DC.

**CONTRACT/GRANT NUMBER-** Contract AC07-76ID01570

**AVAILABILITY NOTE-** Portions of this document are illegible in microfiche products.

**REPORT NUMBER(S)-** EGG-M-88442CONF-880760-8

**NTIS PRICE(S)-** PC A02; MF A01

**SUPPLEMENTARY NOTE(S)-** Review of progress in quantitative nondestructive evaluation, La Jolla, CA, USA, 31 Jul 1988.

**ISSUE OF ORIGINATION-** u8911; n1400

Traditional **nondestructive evaluation** (NDE) of bonding flaws has generally used either ultrasound or x-rays as a directed energy source to image or otherwise detect the discontinuity of an improper bond. While this approach has broad applicability, it is inadequate where the material is highly attenuating or anisotropic, or when it is impossible to achieve an adequate interrogation due to geometrical constraints. These difficulties are seen in materials such as the silica fiber composites used for the thermal protection tiles on the Space Shuttle Orbiter, insulating rubber liners used for solid rocket motors, and rubber or **foam** coating materials. This paper discusses a method for determining bond condition in these types of materials by exciting the component as a whole and analyzing its micromechanical response. The concept is that the bond region forms a boundary of a physical system whose dynamic response is governed by a deterministic set of equations of motion. As the boundary conditions change, the system response will change. The problem then reduces to verifying that a given dynamic response can be uniquely correlated with a specific bond condition. This approach has a distinct advantage in that it can potentially survey the bond condition of a component or region with a single rapid measurement and provide the basis for a "go/no-go" decision. 2 refs., 5 figs. (ERA citation 14:013346)

**DESCRIPTOR(S)-** \*Adhesives; Acoustic Testing; Frequency Response Testing; Laser Targets; Lasers; Mechanical Vibrations; \*Nondestructive Testing; Optical Modes

**IDENTIFIER(S)-** ERDA/420500

**NTIS SUBJECT CATEGORY CODE(S)-** 41G; 94J; 71B .