

# AEROSPACE SAFETY ADVISORY PANEL

ANNUAL REPORT  
FOR 2008



NASA AEROSPACE SAFETY ADVISORY PANEL  
National Aeronautics and Space Administration  
Washington, DC 20546  
VADM Joseph W. Dyer, USN (Ret.), Chair

April 15, 2009

The Honorable Christopher J. Scolese  
Acting Administrator  
National Aeronautics and Space Administration  
Washington, DC 20546

Dear Mr. Scolese:

Pursuant to Section 106(b) of the National Aeronautics and Space Administration Authorization Act of 2005 (P.L. 109-155), the Aerospace Safety Advisory Panel (ASAP) is pleased to submit the ASAP Annual Report for 2008 to the U.S. Congress and to the Administrator of the National Aeronautics and Space Administration (NASA). ASAP members believe that NASA and the new Administration stand at a critical crossroads for the Nation. Consequently, the ASAP decided to provide this brief, to-the-point letter report in lieu of the normal lengthier annual report issued by the Panel.

This letter report is based on the Panel's 2008 quarterly meetings (and public session minutes), fact-finding meetings, and recommendations as well as ASAP members' past experiences.

The Panel intends to provide a summary of key safety-related issues that the Agency confronts at this seminal point in its history. The ASAP hereby hopes to encourage key stakeholders to reflect the level of urgency that, in the opinion of Panel members, the times demand by immediately considering critical decisions concerning the NASA mission, vision, leadership, and funding.

As always, senior NASA leaders and staff members offered significant cooperation to support the completion of this document. I therefore submit the ASAP Annual Report for 2008 with both respect and appreciation.

Sincerely,



Joseph W. Dyer, VADM, USN (Ret.)  
Chair  
Aerospace Safety Advisory Panel

Enclosure

NASA AEROSPACE SAFETY ADVISORY PANEL  
National Aeronautics and Space Administration  
Washington, DC 20546

VADM Joseph W. Dyer, USN (Ret.), Chair

April 15, 2009

The Honorable Joseph R. Biden, Jr.  
President of the Senate  
Washington, DC 20510

Dear Mr. President:

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National Aeronautics and Space Administration  
Washington, DC 20546

VADM Joseph W. Dyer, USN (Ret.), Chair

April 15, 2009

The Honorable Nancy Pelosi  
Speaker of the House of Representatives  
Washington, DC 20515

Dear Madam Speaker:

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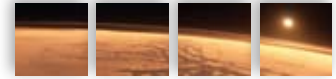
Joseph W. Dyer, VADM, USN (Ret.)  
Chair  
Aerospace Safety Advisory Panel

Enclosure

“The Panel shall review safety studies and operations plans referred to it, including evaluating NASA’s compliance with the return-to-flight and continue-to-fly recommendations of the Columbia Accident Investigation Board, and shall make reports thereon, shall advise the Administrator and the Congress with respect to the hazards of proposed or existing facilities and proposed operations with respect to the adequacy of proposed or existing safety standards, and with respect to management and culture related to safety. The Panel shall also perform such other duties as the Administrator may request.”

Section 106(b) of the National Aeronautics and Space Administration  
Authorization Act of 2005 | Public Law 109-155, 42 U.S.C. 2477(a)

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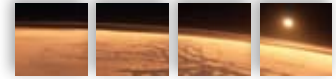


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## I. INTRODUCTORY REMARKS

### A. The Aerospace Safety Advisory Panel

Created by Congress in 1968, the Aerospace Safety Advisory Panel (ASAP) is an independent fact-finding body composed of nine members with exceptional safety, management, and engineering expertise and credentials (Attachment 1 on the enclosed CD). The ASAP advises the U.S. Congress and the National Aeronautics and Space Administration (NASA) Administrator on issues that have the most significant potential to directly or indirectly impact the safety of NASA astronauts, personnel and contractors, and programs and missions. The ASAP recommendations submitted to the Administrator during 2008 are summarized in Appendix 1 at the end of this report (and detailed in Attachment 2 on the enclosed CD) and are based on ASAP 2008 quarterly meetings (and public session minutes) and fact-finding meetings (documented in Attachments 3 and 4) as well as ASAP members' past experiences.

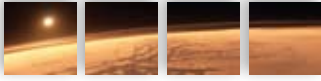
The Panel operates under a broad charter (Attachment 5), asking hard questions about difficult issues. However, this rigorous approach should not in any way detract from the ASAP's overall respect for, and approval of, NASA's performance under difficult and usually unique circumstances. The ASAP and NASA both recognize the value added from safe operations, which range from the immediate and ripple effects of preventing injuries to members of the NASA family to lower costs and better schedule performance.

### B. ASAP Observations about NASA Accomplishments in 2008

On balance, 2008 was a good year for NASA. The ASAP is optimistic about the future of the Agency and its mission based on NASA accomplishments in 2008.

- 1. Safe Shuttle and International Space Station Operations.** Today, NASA continues to make progress in flying safely.
  - Successful return to flight of the Space Shuttle following the loss of Columbia
  - Effective management of known safety issues in the reliable conduct of Shuttle flights
  - Ongoing development, buildout, and maintenance of the International Space Station (ISS)
  - Continual management effort to create and nurture open dialogue and discourse on technical differences
- 2. Processes to Fly Safely in the Future.** NASA is improving the technical and management processes that underlie safe operations and space flights.
  - Implementation of the matrix management governance model, creating links as well as checks and balances among program and institutional requirements, the management chain (including dual-track problem escalation reporting), and available resources





- Ongoing implementation of independent engineering, safety, and astronaut medical health technical authority (TA), including work by chief engineers, chief safety officers, technical and safety fellows, the NASA Engineering Safety Center (NESC), and the NASA Safety Center (NSC)
- Emergence of more cohesive and cooperative working relationships among Centers

As part of its fact-finding, the ASAP posed a number of key questions to then NASA Administrator Michael Griffin and NASA Associate Administrator (now Acting Administrator) Christopher Scolese. They both responded in candid and thoughtful detail, providing an excellent snapshot of the challenges now confronting NASA. These responses are included as Appendix 2 and Appendix 3 at the end of this report.

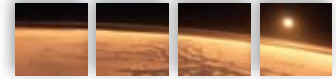
## II. CRITICAL ISSUES

The ASAP recognizes that this is a crucial time for NASA, the new Obama Administration, and the country. Important decisions lie ahead.

### A. Proposed Extension of the Space Shuttle Program

To maximize safety, minimize wasted effort, and bolster employee morale, any further debate regarding the future of the Shuttle should be undertaken immediately and completed without further delay. From a safety standpoint, the ASAP strongly endorses the NASA position on not extending Shuttle operations beyond successful execution of the December 2008 manifest, completing the ISS. Continuing to fly the Shuttle not only would increase the risk to crews, but also could jeopardize the future U.S. Exploration program by squeezing available resources (and, in the worst case, support) for the Constellation program.

- 1. Extension of the Space Shuttle Program.** Although continuing to fly the Shuttle would minimize the U.S. launch vehicle services gap (currently projected at 5 years) between Shuttle retirement and the beginning of Constellation flights, the ASAP does not favor this approach.
  - Shuttle support and manufacturing capabilities are dwindling and possibly not restorable.
    - The contractor manufacturing base and third-tier suppliers are starting to shut down.
    - The capability to manufacture and integrate specific long-lead items (e.g., the External Tank) will very soon be too degraded to restore efficiently, cost-effectively, and in a timely manner.
    - Key personnel positions are slated for elimination in the first half of 2009.
    - Supplier tiers and personnel skill mixes complicate retention of necessary infrastructure.
  - Continuing to fly the Shuttle requires reevaluation of crew and mission safety. Relatively high levels of inherent risk reside in the Shuttle design, and these risks rise as more flights are attempted. Indeed, the Columbia Accident Investigation Board (CAIB) recommended recertification of the Space Shuttle at the material, component, subsystem, and system levels if it flies beyond 2010.



- With limited resources, funding an extension of the Shuttle program will constrain available resources for the Constellation program, merely postponing or shifting the gap while exposing NASA to the increased risk of Shuttle flights and deferring the Constellation program.

**2. Acceleration of the Constellation Program.** The ASAP is not convinced that the Ares I and Orion initial operating capability (IOC) date can be improved appreciably by additional resources.

- NASA is developing a new system for the first time in years, so it needs sufficient time to identify and resolve problems and reiterate the process.
- The Constellation program requires management resources and personnel (many now working on the Shuttle program, others not yet hired and trained).
- The geographic dispersal of many involved organizations demands coordination and maturing of diverse programs (many with very long lead times) at the same time.
- Ares I and Orion designs are still in development and cannot be anchored in verifiable data (e.g., on thrust oscillation, stack control in flight) until NASA tests the Ares I-X in summer 2009.

**3. Private Sector.** The ASAP concludes that the private sector cannot bridge the gap.

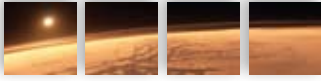
- There is no evidence that Commercial Orbital Transportation Services (COTS) vehicles will be completed in time to minimize the gap.
- COTS vehicles currently are not subject to the Human-Rating Requirements (HRR) standards and are not proven to be appropriate to transport NASA personnel.
- The capability of COTS vehicles to safely dock with the ISS still must be demonstrated.

## B. Safety and Reliability of Soyuz

Although the ASAP continues to be concerned about the safety of the Russian Soyuz vehicle, the Panel is satisfied that NASA is aware of and addressing the potential limitations involved in relying on Soyuz during the gap between Shuttle retirement and Constellation IOC.

**1. U.S./Russian Cooperation.** The United States and Russia have jointly conducted human space flight operations since the 1970s Apollo-Soyuz Test Project, and the ASAP is impressed by several facts.

- The Soyuz has been, still is, and will remain the only ISS emergency crew return vehicle.
- During the grounding of the Shuttle fleet, NASA essentially conducted a successful test run of relying on the Soyuz to transport U.S. astronauts.
- Although the U.S./Russian partnership can be politically challenging, the two nations depend on each other to continue ISS operations (currently the only significant Russian space mission).
- To avoid conflicts, NASA is carefully negotiating explicit contract terms with no loopholes.



- U.S./Russian cooperation on human space flight dates to the 1970s, when NASA and the Soviet space program cooperated on a limited exchange of medical research data for the Apollo-Soyuz preparations and flight.

**2. Soyuz Reliability.** Although Soyuz reliability issues remain, the ASAP is reassured by a number of factors.

- The Soyuz vehicle and the similar Progress launcher have a solid 40-year track record.
- The robust Soyuz design enabled it to survive and safely land despite recent pyrotechnical separation failures during two capsule reentries (admittedly a rough ride for the astronauts).
- NASA recognizes that its mission includes ensuring the safety of U.S. astronauts on any space vehicle, including the Soyuz.

### C. Direction of Exploration

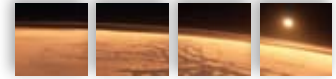
NASA is operating under a bipartisan directive to continue gathering data on Earth's climate and resources, support ISS operations until 2016, and return to the Moon as a precursor to exploring Mars and nearby asteroids. The ASAP understands that evaluation of these priorities is ongoing, but emphasizes several concerns.

**1. Stable Goals.** The ASAP suggests that stability of policy and technical goals is particularly crucial for complex, expensive, safe, long-term programs and for cost-efficient, cost-effective, and safe mission plans and workers.

**2. Staged Approach to Exploration.** The ASAP notes that precursor robotic missions can conduct initial fact-finding and data collection, enhancing the viability of human exploration and offering opportunities to improve safety. NASA currently envisions both robotic and human missions under the Constellation program and therefore is developing a more structured method (e.g., a decision tree) to encourage analysis and optimal use of alternatives for human, robotic, and human robotic-assisted missions, thereby diminishing the risk to NASA astronauts.

**3. Periodic Review of Architecture of Long-Range Programs.** The ASAP endorses the standard management and engineering practice of periodically reviewing architecture and program plans (including design assumptions, new developments, changing requirements, emerging technologies, and their impact on decisions). Such reviews are particularly useful for programs such as Constellation that extend over many years and are subject to external reassessments of fundamental goals.

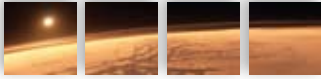
- For any new long-term and complex program, periodic and continuing management and engineering reviews of overall architecture are part of the normal technical evolution. Learning continues as the program proceeds, and plans are reevaluated in light of new knowledge, development problems, more advanced or emerging technologies, personnel with improved skill sets, advanced processes and systems, and modified objectives. Because change is inevitable over a 20-year life cycle, such course corrections are required.



- Constellation in particular should be subjected to periodic reviews and course corrections.
  - The Nation has committed substantial resources to this flagship program. This significant investment reasonably should be protected by assessing the probability that the current approach will continue to meet objectives given known limitations.
  - NASA can better control cost, risk, and schedule by leveraging these periodic reviews as a means to reinforce using the Constellation program as an opportunity to fortify the NASA safety culture, including weaving safety into program plans at all levels and across the life cycle.

#### D. Safety Improvements

- 1. Safety Hardwired into Constellation.** NASA has an important one-time opportunity to better interweave safety as a consistent and more powerful operating parameter by hardwiring safety into the fabric and procedures of the new flagship exploration program, Constellation. Accordingly, NASA should institutionalize safety programs, systems, processes, and reporting.
  - Robust, well-publicized safety programs that mirror industry best practices, including using current world-class systems and incentives at some NASA Centers, such as the Marshall Space Flight Center, as models
  - A safety management system that tracks accidents, mishaps, close calls, audit results, lessons learned, and data trends for these and other leading indicators
  - Consistent methodologies to identify hazards and to manage, articulate, and reduce risks
  - Defined, timely process for investigating, analyzing, and reporting on accidents
  - More rapid and thorough determination of root causes
  - Standardized accident report format, timeline, database, and metrics
  - Timely, possibly Web-based distribution of lessons learned to prevent mishap recurrences
- 2. Upgrading of NASA Facilities and Equipment.** During repeated visits to NASA Centers and Headquarters to hold quarterly and insight meetings, the ASAP has noted that deferred maintenance, modification, and upgrading of basic NASA infrastructure deserve higher priority.
  - **Facility Support.** The ASAP views facility support not only as actual essential physical plant (e.g., buildings, heating and cooling systems, water delivery systems, electrical generation systems), but also as information technology (IT), security, and other facility-wide services. The ASAP notes that, despite NASA's maintenance efforts, the more than 40-year-old institutional infrastructure is in serious need of timely repairs and upgrades.
  - **Aeronautics.** NASA not only flies its own planes for training and operational support (such as chase planes), but also uses these resources to conduct aeronautics research. The ASAP has concluded that NASA accomplishments are noteworthy, although the Agency nevertheless should fund a prompt and thorough assessment of its aging fixed-wing aircraft fleet and aircraft support facilities.



- NASA has a history of decades of contributions to general and military aviation, including dozens of now-standard hardware and software innovations.
  - NASA conducts cutting-edge and one-of-a-kind aeronautics research that underpins future national objectives.

NASA is making efforts to improve its flight operations across the board.

- The NASA aviation community had no fiscal year (FY) 2009 fatal accidents. Eight lesser mishaps, a decline of five from FY 2008, caused \$1.1 million in aircraft and property damage.
- To continue mitigating identified risks and to respond to ASAP recommendations, NASA is upgrading some of its aircraft with safety equipment (e.g., Traffic Collision Avoidance Systems).
- Rectifying a policy gap, NASA standardized minimum pilot qualifications across NASA by linking flight status eligibility to Office of Personnel Management pilot standards (GS-2181).
- In response to a previous ASAP recommendation in 2006, NASA is developing a standard aviation management cultural survey process.

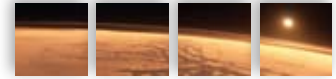
## E. Funding Consistent with Tasks and Schedules

The ASAP recognizes the need to balance and align funding with objectives, a basic tenet of financial management in all organizations. This operating principle and the consistency and reliability of funding assume greater significance for NASA because of its complicated mission.

- NASA is phasing out the Shuttle program and also ramping up the Constellation program.
- NASA operates on the technological cutting edge, frequently making schedule and cost projections based only on early evidence that may turn out to be in error.
- When funding varies, technically complex, long-term, often expensive programs must revise or redesign technical and/or management approaches, with associated increased risk.

**1. Cost-Schedule-Risk Interrelationship.** The ASAP cannot overemphasize the high-priority need for Congress and the Administration to understand the impact on NASA of the interrelationship among cost, schedule, and risk (which is ignored only at great risk to safety).

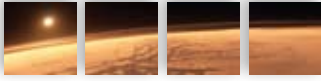
- If cost and schedule are rigidly fixed, any program changes due to unexpected problems will increase risk. NASA budget analyses should include projected impacts on schedule and risk.
- Risk is less easily measured than cost (funds expended) or schedule (performance tracked against time). The danger lies in risks that increase without quick detection by technical, operational, and management teams and without explicit assessment and acceptance.
- Risk measurements should emphasize the concept of acceptable risks (relative to the risks inherent in the entire space exploration enterprise), not only to enable program decisions, but also to underpin subsequent measurements of success or failure. This approach also requires that explicit risk limits are unambiguously defined so that appropriate decisions can be made.



2. Safety and Mission Assurance Funding. ASAP members are particularly sensitive to the need to balance safety and mission assurance (SMA) funding with associated objectives.
  - NASA should develop the Constellation SMA budget by defining SMA tasks and budgeting for them—including supporting rationales, safety impacts, and risk tradeoffs if not funded—rather than just accepting without negotiation a fixed SMA budget. If the funding does not match the necessary tasks, explicit mitigation should be required.
  - The ASAP stresses that the NASA budget is the most obvious statement of management expectations and priorities, so SMA funding should be consistent with safety priorities.

## F. Stability of Agency Management Approach

1. **Governance Structure.** The ASAP has observed the implementation of the new strategic management and governance model at Headquarters and the NASA Centers. The long-term effects are not immediately obvious, but the ASAP reports several important developments.
  - **Progress.** This new structure is evolving positively and is working relatively effectively during a complex transition period (Shuttle to Constellation). Senior managers and program managers increasingly understand the management approach and its advantages, but the integration of SMA at all program development and implementation stages has not yet permeated NASA.
  - **Emphasis on Institutional Requirements.** The ASAP observed a new management emphasis on institutional requirements for safety, engineering, facilities, and personnel in the planning process and, indeed, the entire project life cycle.
  - **Technical Authority.** The Panel is impressed with the new organizational emphasis on NASA-wide independent TA, accountability, and dissenting opinion processes. For example, technical or organizational decisions with SMA implications must have the formal concurrence of cognizant engineering, SMA, and health and medical TAs.
  - **Risk Assessment and Mitigation.** The ASAP recognizes that risk assessment and mitigation are standard practices in the modern management of complex, long-term, cutting-edge projects, particularly those with life-and-death implications. At NASA, risk cascades through all Agency actions. However, risk is a complicated and poorly understood concept, so the ASAP is focusing on the identification and mitigation of risk and on the consistency and effectiveness of risk-related communications throughout the management and personnel chain and to external stakeholders such as Congress and the Administration.
2. **Human-Rating Requirements Standards.** NASA recently revised the long-standing Human-Rating Requirements (HRR) standards, which will apply to the Constellation program and future NASA (or commercial or foreign) spacecraft that will carry a NASA crew. The ASAP is concerned about HRR substance, application, and standardization NASA-wide.
  - After several briefings, the Panel is just beginning to fully understand the changes (e.g., in failure tolerance, inadvertent actions, redundancy, and integrated design analysis) and the implications for future system development—an index of the challenge facing NASA.



- The new HRR standards move from validating compliance with mandatory failure tolerance requirements to an approach of designing to acceptable risk, but without any apparent clear and visible criteria for estimating “how safe is safe enough” for various mission categories.
- A direct linkage between current standards and engineering directives is missing.
- NASA training materials on the new HRR standards are still in development and should be accelerated to distribute information **before** new Constellation systems are developed.

### G. Workforce Development and Sustainment

The ASAP supports continued attention to workforce planning, development, and sustainment to ensure that technically qualified personnel are available for NASA and its contractors so that these people can identify, manage, and control the complex safety risks of NASA programs.

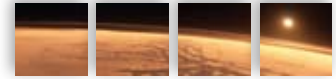
**1. Workforce Transition Planning.** NASA currently is managing the transition from the Space Shuttle program to the new flagship Constellation program as well as continuing the development of specific science missions. The ASAP has several observations.

- The morale of Shuttle personnel is still high and represents a fundamental and professional dedication to crew safety and mission assurance.
- The Constellation program is implementing a workforce strategy that includes an integrated design process, development of needed workforce skill sets, an inclusive team approach, and knowledge transfer from one generation of scientists, engineers, and managers to the next.
- NASA still must develop an Agency-wide personnel skills matrix to identify missing skill sets and to match needed skills with available personnel, including transferring or relocating Center and program personnel from declining-demand projects to new or expanding projects.

**2. Workforce Retention and Development.** Both the ASAP and the Agency recognize that the aging of the NASA workforce requires not only retention of experienced Shuttle engineers and leaders with Apollo expertise, but also the recruitment and task-specific training of the next generation.

- **Retention of Key Technical, Engineering, and Management Leaders.** ASAP concerns include (1) retention of experienced personnel for late-stage programs; (2) unique local workforce retention issues, such as post-Katrina housing expenses or a large influx of new Department of Defense Base Realignment and Closure (BRAC) positions (e.g., at Marshall Space Flight Center and the U.S. Army Redstone Arsenal); and (3) the need for the Office of Personnel Management to approve reemployment of retired Federal civil service annuitants without financial penalty to better enable NASA to retain needed expertise.
- **Educational Outreach.** The ASAP suggests that NASA continue focusing on its well-developed Cooperative Education (Co-op) program, but expand its reach and also recruit experienced candidates from industry or academia.





- **Workforce Training.** The ASAP is concerned that the NASA Safety Center, a key player in safety training, has experienced serious funding shortfalls that affect the training, development, and hiring of Technical Fellows. In addition, to date, NASA has not begun training managers, personnel, and contractor employees for the HRR standards initiative.

## H. NASA Culture That Values SMA Experience

**1. Improvements in Safety Organization and Culture.** The ASAP has monitored the evolution of the NASA safety culture for years and is impressed with recent developments.

- Safety leadership is on the rise, including an increasing focus on critically important open discussions that encourage dissenting opinions on risks.
- The Panel sees a positive change in workforce attitude, a more widespread awareness of safety levels and projects, metrics, and visible paths to achieve goals while reducing risks.
- The Engineering and SMA organizations are managing safety more cooperatively. The Engineering teams that design, build, test, and validate systems own the resulting safety (within project cost and schedule limits). The SMA teams establish and implement safety processes, identify hazards, and analyze relevant data to generate useful safety risk assessments, improve safety processes and standards, and mitigate risk.

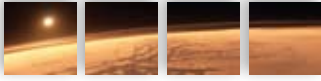
The ASAP believes that NASA still faces significant challenges, but additional opportunities (e.g., Constellation) are available to reinforce and cross-fertilize safety culture and engineering work processes. Moreover, the ASAP is pleased to report that several NASA Centers have developed SMA procedures, organizations, processes, metrics, and reporting systems that are genuinely world-class models and actually improve safety. NASA should leverage these tools by focusing more heavily on making them available for use at all Centers.

**2. Safety Experience as Qualification for Advancement.** The ASAP noted numerous NASA initiatives to educate its workforce on the inherent and career value of safety experience.

- NASA has elevated the status of assignments in SMA organizations by establishing chief safety officer positions at higher General Schedule (GS) grade levels, assigning top engineers (some by their own request), and emphasizing service on internal safety control boards and committees.
- NASA should institutionalize an organizational culture and requirement that values SMA experience as a significant criterion for promotions. Every time the Agency fills a major technical, systems engineering, or management position, hiring managers should review candidate resumes for direct SMA experience as a key if not required qualification.

**3. Enhancement and Measurement of Safety Culture.** To verify and continue improvements in safety culture and in the resulting safety of NASA operations, the ASAP encourages periodic internal and external measurements based on meaningful metrics. The Panel specifically notes the advantages of Centers making an active effort to periodically measure the esprit de corps of each facility, much like Centers now gather injury and mishap rate data.





## I. Technical Standards Program Focused on Safety and Risk

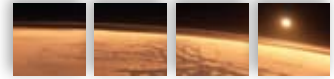
The ASAP is convinced of the value of implementing a technical standards program that includes the appropriate formal and explicit consideration of safety and risk. However, the Panel emphasizes that a critical component of successfully applying standards is rigorously capturing and sharing safety lessons learned both at the Agency level and at individual NASA Centers.

**1. Performance Standards.** More robust technical performance standards are necessary to fill the void created by cancellation in the 1990s of numerous military standards and specifications.

- **Need for Standards.** Agency-wide engineering directives and technical specifications can detail relevant requirements and processes, minimize miscommunications, link NASA institutional and programmatic elements, furnish a common framework for assessments, simplify relationships with contractors, and expedite personnel shifts among NASA Centers.
- **Content and Assessment of Standards.** The ASAP concludes that technical standards development and review should include rationales and history to support future application and tailoring and should incorporate SMA concerns at the most fundamental level. The judicious use of waivers can provide the flexibility needed to modify standards during emergencies or under specific well-documented and peer-reviewed circumstances.
- **Role of Chief Engineer.** The Chief Engineer is playing a central role in developing and implementing interim, test version, and consensus performance standards as well as using new modeling and simulation standards to establish a consistent basis for comparing and assessing the risks of applying simulation results (e.g., level of confidence; boundaries of regions in which the simulations are expected to, or do not, apply).

**2. Distribution of Best Practices.** The ASAP cannot overemphasize the logical and compelling argument that a robust process to capture and apply the often hard-won lessons of current and past generations of engineers and managers will help the current NASA workforce to enhance safety and prevent accidents and injuries.

- **NASA Golden Rules.** Many NASA Centers collect, document, and distribute Golden Rules. NASA not only should encourage each Center to do so, but also should assemble Golden Rules and processes across Centers and enable easy access to these materials.
- **Lessons Learned.** Most NASA projects and programs perform standard management debriefings at the end of work phases to identify, document, and distribute lessons learned and thereby prevent recurrences of problems. The ASAP has concluded that NASA should improve its documentation and distribution system to capture and share lessons learned with all NASA Centers, mission directorates at NASA Headquarters, and, when appropriate, the private sector.
- **Standardization and Innovation.** The ASAP understands the natural tension between process and practice standardization and full harnessing of innovative talent. However, the Panel strongly believes that standards need not hobble innovation if NASA reviews, applies, and modifies standards, including consulting its own experts (e.g., the NASA Safety Center and the NASA Engineering Safety Center).



## J. Standing Issues

1. **CAIB Recommendations.** As mandated by Congress (NASA Authorization Act of 2005), the ASAP is responsible for evaluating and reporting annually on NASA compliance with CAIB return-to-flight and continue-to-fly recommendations. The Panel is pleased with NASA's overall response.

- The NASA Associate Manager of the Space Shuttle program updated the ASAP in 2008 on the three remaining CAIB recommendations (Attachment 6).
- The ASAP knows that the remaining three CAIB recommendations cannot be completely eliminated without major redesign. The Panel thus recommends that NASA use its formal risk acceptance process to make a decision on how to close out the remaining actions.
- The ASAP will continue to monitor the situation, as required by its mandate.

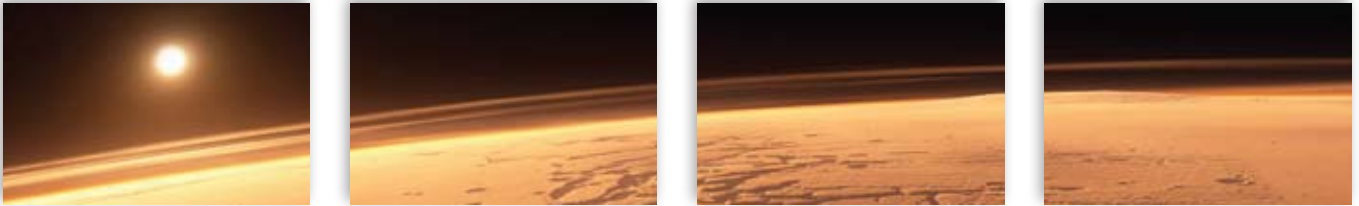
2. **Astronaut Health.** The ASAP made a commitment to monitor the NASA Astronaut Health Care Systems Review and is satisfied with NASA's progress in responding to associated report recommendations. Since the June 2007 report, NASA has undertaken several actions.

- Issuance of the Johnson Space Center Astronaut and Flight Surgeon Report (January 2008)
- Development and implementation of Astronaut Code of Conduct
- Addition of behavioral assessments to annual astronaut flight physicals
- Incorporation of psychological evaluations as part of the future astronaut selection process
- Improved communications about, and training in, related issues (e.g., alcohol and drug abuse and associated random testing for civil service employees and contractors)
- Pilot program at Kennedy Space Center to assess the cost-effectiveness of a cross-Agency draft policy on a drug-free workforce
- Processes to encourage NASA personnel to raise astronaut health concerns

## III. CONCLUSION

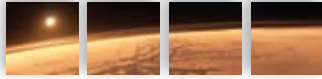
The Aerospace Safety Advisory Panel opened this 2008 annual report by declaring that important decisions confront NASA, the new Obama Administration, and the Nation. The Panel hopes that this summary of critical safety-related issues will help to stimulate and focus the discussion necessary to make those decisions.





## **APPENDIX 1:** **Summary and Status of ASAP 2008 Recommendations**

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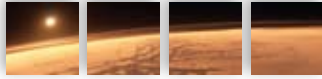
REC. #	DESCRIPTION OF RECOMMENDATION	STATUS
2008-01-01	<b>Mass Scrub Process.</b> The design team used a set of analysis gates to equip Orion with sufficient hardware to achieve acceptable safety for the crew, vehicle, and mission. This set of analysis gates has considerable engineering rigor. The Panel conceptually agrees with the process to meet the human-rating requirements and should snapshot it again.	Open*
2008-01-02	<b>NASA Approach to Orion Risk at Macro and More Detailed Level.</b> The Panel must ensure that as NASA personnel execute the decision processes and discussions in the Orion design process, they adequately document and track decisions and also track documents used in the design process.	Closed*
2008-01-03	<b>Communication of Risk.</b> NASA should consider a proactive Constellation communications plan based on risks, risk assessments, and failure tolerances to foster appropriate expectations. As the design advances, the risk process must be predicated on both realistic targets of achievement and minimally acceptable risk levels to maintain credibility.	Open*
2008-01-04	<b>NASA Safety Reporting System.</b> The ASAP reviewed the NASA Safety Reporting System (NSRS). The Panel would like to obtain more information about the system to determine whether the information provided might have value as part of the overall safety management information system.	Closed
2008-01-05	<b>NSRS Benchmarking.</b> NASA should perform a benchmarking of the NSRS, including clarification on the purpose of the NSRS (e.g., is it simply a safety valve, or does it have meaningful information as a vulnerability tool). Also, in benchmarking, the NSRS should review how to more clearly define its guarantee of anonymity.	Open*
2008-01-06	<b>NASA Headquarters Mishap Investigation.</b> NASA should reevaluate its mishap investigation process, focusing on producing timely report results and using appropriate experts to determine root causes. NASA should consider a 30-day deadline for delivering at least a preliminary mishap report.	Open*
2008-02-01	<b>Inclusion of NASA Safety Center in Standards Development.</b> The NASA Safety Center (NSC) should be included in the NASA process for evaluating whether new standards are needed and in the decision on whether to implement those standards.	Open*
2008-02-02	<b>NASA Golden Rules for Knowledge Management.</b> An Agency-wide set of NASA Golden Rules should be established to assist in the sharing of knowledge between Centers.	Open*

\* Updates and ASAP monitoring are required.



REC. #	DESCRIPTION OF RECOMMENDATION	STATUS
2008-02-03	<b>Modeling and Simulation.</b> On modeling and simulation, a NASA-wide matrix should be created to color-classify models as green, yellow, and red so that a statement of high confidence means the same thing from one NASA Center to another.	Open*
2008-02-04	<b>NASA Decision Tree for Optimizing the Use of Robotics in Exploration.</b> NASA should formulate a decision tree for optimizing the use of robotics in exploration and thereby diminishing the risks to humans. The decision tree should include all criteria relevant to the decision.	Open*
2008-02-05	<b>Addition of Traffic Collision Avoidance System to NASA Aircraft.</b> NASA should review the applicability of developing a formal policy to add Traffic Collision Avoidance Systems, advanced ground warning systems, and other advanced avionics programs to appropriate NASA aircraft.	Open*
2008-02-06	<b>Independent Audits of Private Charter Operators.</b> Prior to contracting with a private charter operator, NASA should consider requiring that all contractors be subject to an independent audit.	Closed
2008-02-07	<b>Accident Review Timeliness.</b> Accident reviews should be completed more quickly. A rigorous mishap trend analysis should be used to identify causal trends. Senior leaders should be briefed regularly and after initial causal analysis of major mishaps. A closed loop management tracking system should be developed to ensure lessons learned implementation.	Open*
2008-02-08	<b>NASA Fall Protection Standard.</b> The new NASA Fall Protection Standard (resulting from a 2006 fatal accident) should be accelerated to take effect well before the currently projected 2010-2011, and the key elements of this standard should be mandatory (with waiver capability) and NASA-wide rather than advisory.	Open*
2008-03-01	<b>Assessment of the Marshall Space Flight Center Industrial Safety Program.</b> The staff of the NASA Chief of Safety and Mission Assurance should assess the Agency-wide applicability of Marshall Space Flight Center approaches for implementing a successful industrial safety program.	Closed
2008-03-02	<b>Industrial Safety Performance Metrics.</b> To expedite ASAP visits, other Centers should present leading and lagging industrial safety performance metrics similar to those tracked by MSFC, giving opportunities to gain a better understanding of safety processes; improve the bases for comparing programs; and support cross-pollination of ideas.	Open*

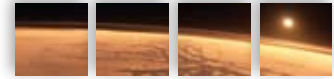
\* Updates and ASAP monitoring are required.



REC. #	DESCRIPTION OF RECOMMENDATION	STATUS
2008-03-03	<b>Constellation Approach to Integration.</b> The new Constellation Program approach to integration places NASA in the position of prime systems integrator, but is a high-risk proposition. Although NASA and MSFC deserve high marks for a good start, the ASAP and others should continue to closely monitor Constellation progress operations for years to come.	Closed*
2008-03-04	<b>Base Realignment and Closure Impact on Marshall Space Flight Center.</b> BRAC moves to Huntsville are life-critical at MSFC, so the Center should identify key and critical personnel who must be retained for Constellation and core programs, and MSFC should request waivers from term appointment constraints and retirement salary reduction offsets.	Open*
2008-03-05	<b>Open CAIB Recommendations.</b> The ASAP will continue to monitor the three CAIB recommendations that are not closed out, but does not have the resources necessary to conduct the extensive analysis necessary to recommend closeout. NASA must decide whether to accept the risks associated with the remaining three CAIB recommendations.	Open*
2008-03-06	<b>Human-Rating Requirements Briefing.</b> The ASAP requested a briefing at the appropriate time from NASA on the new, recently published NASA Human-Rating Requirements (NPR 8705.2).	Closed
2008-03-07	<b>Ares I Thrust Oscillation Risk-Based Analysis.</b> NASA should soon perform an updated risk-based analysis to assess the crew-performance impacts of Ares I SRM thrust oscillations. This timely analysis will enable NASA to quantify, manage, and if necessary mitigate operational risks associated with such oscillations.	Open*
2008-04-01	<b>NASA-Wide Understanding of Thrust Oscillation Concerns.</b> There is no consistent Agency-wide understanding of technical concerns associated with Ares thrust oscillation, especially immediate and residual crew performance impacts. NASA should ensure that all concerns are evaluated and communicated to stakeholders to build a consensus for solutions.	Open**
2008-04-02	<b>Human-Rating Requirements Graybeard Review.</b> NASA should obtain greater validation that the new Human-Rating Requirements standard meets the safety requirements of a broad range of future human space flight programs by scheduling an external review by an independent “graybeard” assessment panel.	Open**

\* Updates and ASAP monitoring are required.

\*\*NASA has not yet formally responded to this ASAP recommendation.

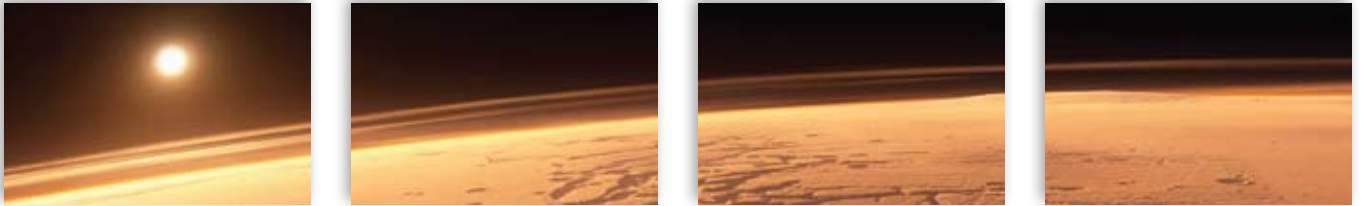


REC. #	DESCRIPTION OF RECOMMENDATION	STATUS
2008-04-03	<b>Human-Rating Requirements Guidelines and Training.</b> After review and validation of the Human-Rating Requirements, NASA should develop specific guidelines and tools, widely available training courses, and implementation evaluation criteria to support effective definition and application of the integrated design and safety analysis approach.	Open**
2008-04-04	<b>Champion for Human-Rating Requirements Implementation.</b> NASA should designate an office to serve as champion of the Human-Rating Requirements standards process, ensuring that every program and relevant subject-matter expert uniformly, objectively, and aggressively implements the new NPR 8705.2B standard.	Open**
2008-04-05	<b>Communications on Executive Safety Committee Activities.</b> The Executive Safety Committee (ESC) at each NASA Center should ensure that the Center Director is fully informed about ESC activities and conclusions.	Open**

\*\* NASA has not yet formally responded to this ASAP recommendation.







## **APPENDIX 2:**

### **Michael D. Griffin Response to ASAP Questions for NASA Transition**

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## Memorandum

10 November 2008

To: Adm. Joseph Dyer, USN (Ret.), Chair, NASA Aerospace Safety Advisory Panel

CC: Shana Dale, Deputy Administrator, NASA  
Christopher Scolese, Associate Administrator, NASA  
Paul Morrell, Chief of Staff, NASA

From: Michael D. Griffin, Administrator, NASA

Subject: ASAP Questions for NASA Transition

It is my understanding that the ASAP would like to meet with senior NASA officials to discuss agency transition issues prior to the presidential transition in January 2009. The questions below were offered as potential items for discussion. I believe these questions are good ones, and that they deserve a written response for the record. With this memo I am providing that response. I have asked those on the "CC" list to provide similar but independent responses to your panel, as I believe that the different viewpoints may be of assistance to you in your effort to help provide a smooth transition for the agency.

1) What do you view as prime progress?

The space shuttle was returned to flight with two planned tests involving considerably more difficulty than initially envisioned, but has flown well for nine operational ISS assembly and logistics missions since. The space shuttle program team is technically solid, starting at the very top of the Space Operations Mission Directorate.

In the category of "lessons learned", the difficulty of returning to flight was substantially aggravated by early decisions, principally in regard to the short planning horizon employed. We were always "X months from flight", where X was a varying number, but always too small to accommodate a strategic assessment of what needed to be done. As events progressed, we moved from one short-term "fix" to another for thirty months. I personally inserted a final three-month delay shortly after joining the agency, to accommodate what was in my judgment the necessary addition of heaters to the lox feedline bellows to prevent the formulation of especially hazardous ice debris. Yet, when STS-114 finally flew in July 2005, an unexpected loss of foam from the protuberance aerodynamic loads (PAL) ramp was experienced. Subsequent investigation revealed that the PAL ramp foam had undergone significant rework, that differing opinions existed as to its suitability for flight, and that none of these concerns had been discussed with senior management. Another year was spent reworking external tank (ET) foam loss issues before sufficient understanding was gained to allow STS-121 to be launched with confidence. (Part of the delay was due to hurricane Katrina, which greatly disrupted external tank production.) The STS-121 ET performed well, as have subsequent tanks, and especially those following the incorporation of a redesigned ice/frost ramp. The ability to dissect ET-120, not

because of foam problems but because of problems with the LH<sub>2</sub> low-level engine cutoff (ECO) sensors, proved to be extremely valuable. This was the first time that we were able to dissect the foam of a tank that been subjected to cryogenic loading. In addition to allowing us to resolve the ECO sensor problems we had experienced, the data obtained were the key to a better understanding of foam performance. Typically we not have done this type of test. We need to learn from this experience, and schedule invasive testing of this type as part of a development program. Progress continues to be made, but our understanding of ET debris shedding has undergone transformational improvement.

ISS assembly continues with what can only be considered startling success. Modules and equipment continue to be placed on-orbit and integrated with the ISS with a near-zero level of problems, other than a few minor software incompatibilities. It is hard to identify any actions that should have been taken to ensure success that were not. Exceptions do exist; the starboard solar alpha rotating joint (SARJ) degraded with use because of a manufacturing error in applying gold coating – a lubricant – to the load bearing surfaces of the trundle bearings. A solar array tore while being extended, and another failed to extend because extension cables hung up on their guides. But in the overall scheme of this enormous construction project, ISS assembly has been near perfect. I consider this to be directly attributable to present and prior ISS program management personnel at JSC: Suffredini, Gerstenmaier, Holloway, Greene, and numerous others. A lengthy string of the very highest quality people have helped to manage ISS, and it shows.

In keeping with the requirements of presidential policy and Congressional authorization, a logical and disciplined approach to space shuttle retirement by the end of 2010, and transition to planned Constellation systems, has been developed and is being implemented. The architecture selected for Constellation makes maximum possible use of existing space shuttle assets, easing the transition to the extent we believe possible. Deployment dates for Constellation systems are and have been controlled primarily by budget considerations. In 2005, with adequate funding, it was possible to field Ares 1 and Orion in support of ISS by 2011-12, with confidence. Today, our commitment date for IOC is mid-FY15. The lengthy gap between shuttle retirement and the availability of Constellation systems is one of my greatest concerns. During this interim, we will be dependent upon Russia for crew transport, and upon a combination and international (ESA, JAXA) and potential commercial providers for cargo delivery to sustain the ISS.

The agency governance structure was returned to that which was in use during the Apollo program within the Office of Manned Space Flight; i.e., a “matrix” approach, in which Center Directors and Mission Directors report equally to a single entity, in this case the Associate Administrator. The NASA AA functions in the manner of a “Chief Operating Officer” in industry, balancing programmatic and institutional imperatives. This approach provides agency-wide “independent technical authority”, as mandated by the Columbia Accident Investigation Board (CAIB), by allowing two independent chains of command (programmatic and institutional) from the lowest levels of the organizational hierarchy to the highest. Much work remains to educate all employees in the use of this command structure, but (in my view) tremendous progress has also been made.

2) If you could start over, what would do differently?

I have selected, or been directly involved in the selection of, at least several dozen high-level agency officials during my tenure. Two or three of those choices have been quite poor, and the responsibility for them lies absolutely with me. If I could “start over”, I would make better choices for those positions.

I would have eschewed any commentary on global warming. The interview I gave with NPR, where that was one of the topics on which I was pressed by the interview, went quite badly. Our role is climate research, we do it well, but climate-change policy is not part of NASA’s responsibilities. I should have left it at that.

3) What are the important “unrealized opportunities”?

Coming into this position, one of the thing most important to me personally, but which I realized I would probably not have sufficient time to address, is the issue of what I call “excess process” at NASA. I’m not going to elaborate extensively on exactly what I mean by “excess process”, as I think it is self-evident. Suffice it to say that, whether we are talking about flight-readiness reviews, resolution of on-orbit anomalies, milestone design reviews, or merely the machinery of bureaucracy, we at NASA spend far too much time generating “buy in” in all directions throughout the organizational hierarchy. Too many people who are minor stakeholders in any given decision believe, and are encouraged by custom to believe, that their particular voice is essential to the process. Almost never are they informed that such is not the case, that a good decision can be made with far less input from many fewer sources. This behavior is almost endemic to government, and is never entirely avoidable to the extent that can be attained in private enterprise, where efficiency in decision making is the lifeblood of an organization. But even in government it can be reduced. If I were to be asked to serve a second term at NASA, this would be my top institutional priority.

4) What was harder than you expected?

Honestly, nothing. I’ve really had few surprises, if any, in this job.

5) What was easier than you expected?

Same answer as (4) above. No surprises.

6) What is critical to preserve during transition?

The most critical thing to preserve during transition is the still-new fundamental “course change” at NASA, the specific enunciation of exploration beyond Earth orbit as the core purpose of NASA’s human spaceflight efforts. This policy change, the most significant since the

cancellation of the Apollo program by President Nixon, was motivated by the scathing assessment of the Columbia Accident Investigation Board (CAIB) concerning the lack of strategic vision and purpose for the U.S. space program. The newly established direction for our civil space program is still quite vulnerable, despite what I consider extraordinary bipartisan support in Congress in the form of two successive NASA Authorization Acts, in 2005 and again in 2008. It is simply not possible to obtain any significant value from investments in NASA if the purpose of these investments is altered at the whim of every successive presidential administration. This usually occurs without significant direct involvement by the president. Policy is changed or altered by relatively junior, and in any case non-accountable, staff. Space policy must be viewed on decadal timescales, not through the lens of presidential or Congressional electoral cycles, if it is to be of value.

As a direct result of the broad reexamination of civil space policy which occurred following the loss of Space Shuttle *Columbia*, and after extensive national debate, NASA is now on what I believe to be the proper path for our publicly-funded enterprise. This must be broadly recognized and supported across multiple presidential transitions, beginning with this one, and on both sides of the aisle in Congress. It is imperative that progress continue on the exploration strategy without a new round of soul-searching debate or another extensive study. Any delay will only serve to increase the gap in U.S. human spaceflight capabilities, and further erode our leadership in human space exploration. We have begun our journey along a multi-decade path, and the focus needs to be on sustaining that journey.

7) If you could write the "top five" goals for new administrator, what would be on the list?

(a) See #1, #3, and #6, above. We need to stay the course on Exploration strategy, retain the matrix management structure which has been reestablished, and work to remove excess process from the agency. If these things are not done, nothing else counts.

(b) NASA requires funding sufficient to accomplish the tasks we are being asked to perform, and to fix our 40+ year-old-infrastructure. Specifically, about \$3 B per year additional funding is required to repair and upgrade our institutional infrastructure, initiate sorely needed research and technology development efforts, and robustly execute those programs with which we are already charged. This would be without substantial additions to programmatic content. If new programmatic content is desired, then more money is necessary.

(c) Periodic direct involvement by the president himself with the NASA Administrator, who in fact reports to the president, to minimize and control attempts by, and the deleterious effects of, numerous White House EOP staff imposing their personal agendas on the conduct of NASA affairs. The NASA Administrator owes it to the president to manage NASA in accordance with stated presidential policy and Congressional authorization and appropriations law. The president owes it to his NASA Administrator to ensure that other voices and other agendas are not prevailing over that of the president, merely because they can. The "mattress mice" – many of them career civil servants, not political appointees – who serve on the EOP staff are always there. If the president is not personally involved, individual staff agendas will prevail over stated presidential policy. In an environment where the Administrator does not have reasonably regular

direct access to the president, this will absolutely occur. The oft-touted re-establishment of a so-called “National Space Council” – another staff office – is not a solution, it is an additional problem.

(d) Insistence on top-level technical and program management talent, as demonstrated by a track record of performance *in the space business*, as a precondition for holding any significant management position at NASA. Far too often in the past, numerous significant leadership positions at NASA have been fulfilled by people whose primary qualification for the job was their relationship with those in control of the selection process. Far too often in the past, such top-level jobs have been, literally, *the very first job* these individuals had ever held in the space business. We spent almost 15 years conducting an experiment at NASA, an experiment whose purpose seemed to be to demonstrate that it was possible for people without relevant domain expertise to manage a highly technical agency. It did not work. We should not repeat it.

(e) Re-establish the freedom to fail, now and then, without requiring that heads roll. Any reasonable understanding of what we do at NASA includes the realization that almost everything we do is done on the frontier. Much of what we do is being done for the very first time by any humans anywhere. If we don’t fail occasionally, we’re being too conservative. Yes, the cost of failure is high. When we lose hundreds of millions of dollars, or worse yet human lives, it is undeniably tragic. It is even more tragic when we fail to dare greatly because we are more concerned about the subsequent investigatory bloodletting than we are about the failure itself. In my opinion, it would be a good idea if every policymaker had to pass a regular test on the content of President Theodore Roosevelt’s famous “Man in the Arena” speech.

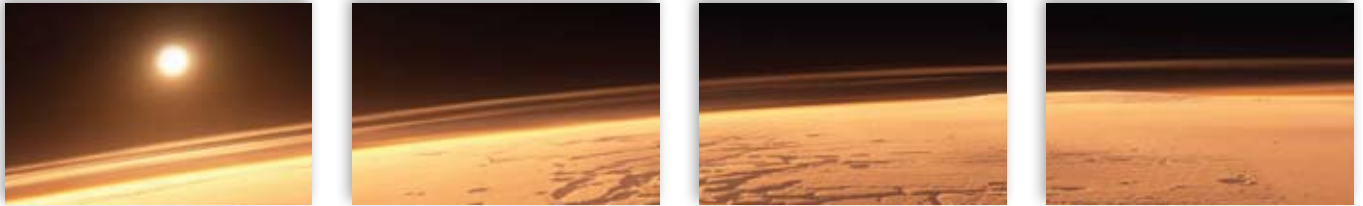
8) Who are the dozen people most essential to retain?

In approximate order of precedence, Bill Gerstenmaier, Chris Scolese, Doug Cooke, Mike Coats, Bob Cabana, Dave King, Steve Cook, John Shannon, Jeff Hanley, Mike Suffredini, Mike Hawes, and Ron Spoehel. If requested to do so, I could easily name another dozen, and they would be just as good and almost as crucial to retain as the first dozen.

9) How has ASAP helped you, and not helped you?

I have found the ASAP to be helpful in providing an independent view not otherwise available to me, and in relaying commentary, opinions, and “tone” from many sources throughout the agency that do not reach me directly.

I don’t know how to answer a question as to how the ASAP has “not helped”.



**APPENDIX 3:**  
**Christopher J. Scolese Response to ASAP Questions**

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## C J Scolese Response to ASAP Questions

*Preface: When this team came to NASA, there were significant challenges.*

- The NASA mission, as it was being executed, was not comprehensively compelling
  - While science was fairly solid, the focus of human exploration and of aeronautics was not clear.
- Significant organizational and cultural stove-pipes thrived between mission areas, between Centers, and between programmatic and institutional concerns.
- Risk to mission safety was difficult to assess as the technical staff did not have a route to bring concerns up the chain without repercussion and management did not yet recognize that the job was not just to listen to concerns from technical staff but to encourage them to speak out.
- Funding requirements for missions and infrastructure was inadequate and difficult to defend;
  - In some cases the needs of existing missions and associated infrastructure severely inhibited new development (e.g. and STS and ISS infrastructure)
  - In other cases the funding established was based on preliminary estimates and not adjusted as mission definition was established. This allowed more missions to be started but resulted in difficulties meeting commitments. This principally affected the science missions.
  - There was a concerted effort to reduce the size of the infrastructure through a combination of under funding the institution and workforce.
  - The result of the above examples constrained needed investments in basic research and development supporting the US presence in space, resulted in erosion of the infrastructure, and confusion among the workforce.
- The “one budget line approach to civil service labor” (R&PM) had been replaced with full cost accounting. While quite useful, it also made it increasingly difficult for several of the centers to compete for work (especially those with large test facilities, some of national importance, yet expensive to maintain at less than full capacity usage).
- NASA research tended toward Center sandboxes on one end of the spectrum, or being used as reserve for programs and projects on the other.

### 1. What do you view as prime progress?

- a. Organization: Today NASA has an organization that clarifies roles, simplifies communication, and provides a structure that is conducive to a single way of implementation. Specifically;
  - i. Organizational balance was created through Center Directors and Missions Directorates reporting to the Associate Administrator.
  - ii. Roles, responsibilities, and clear lines of decision-making were established.
  - iii. Key checks and balances were implemented – such as the role and separation of Technical Authority. Process-related checks and balances –independent life-cycle review, and a clear dissenting-opinion process – are codified now.

## C J Scolese Response to ASAP Questions

- iv. We are in the process of establishing consistent and similar rules for operating the Agency. This has come from things as simple as common reporting formats and forums as evidenced by the monthly Baseline Performance Review, or the improved broad acquisition process we are putting in place that aligns and make consistent strategic planning, program/project management processes and the budget process, to more complex structures like the Office of the Chief Engineer (NESC in particular) and its technical fellows, to establishing common standards and points of contact, to clearer documentation that articulates key fundamentals related to our organizational culture such as NPR 7120.5D (Space flight), NPR 7120.7 (IT and institutional infrastructure), NPR 7120.8 (research and technology), and NPR 7123.1A (System Engineering), and the new System Engineering handbook, SP6105A. The Life Cycle Review process has been strengthened and made much more consistent across the Programs and Projects.
- v. Implementation of high-level acquisition strategic planning and acquisition strategy meeting (ASP, ASM) reviews to ensure new initiatives are agreed to and support the Agency goals and capabilities.
- vi. Incorporating the institutional requirements for safety, engineering, facilities, and personnel in the planning process.
- vii. Assigning work to Centers based on Agency needs, Center capabilities, and personnel availability has significantly reduced the discord among the Centers and Mission Directorates. This has led to progress in integrating the Centers into a cohesive, cooperative team, with significantly more shared processes and practices, a common viewpoint, and common language. As an example, consider that in the last year MSFC has reached out to GRC and LaRC for help on Ares, and GSFC and ARC are partnering on a number of missions.
- viii. We have made significant progress in implementing and tuning NASA's strategic management system. This ensures that NASA's resources and actions align with its strategic goals, progress is measurable, and NASA delivers on its performance commitments.

These improvements have significance for safety and mission success. NASA today is closer to a single unified Agency than it has been in many years. The historical difficulties in relationships driven by competition (or in some cases survival) are much reduced. Specifically, today the Centers tend to operate in a more cooperative multi-center environment that allows the full use of the Agency's talents and capabilities in support of NASA's overall mission. This keeps important and interesting work at individual Centers and also supports organizational survival. Both are strong motivators.

We clearly are not all the way there yet, but I think we have made great progress.

## C J Scolese Response to ASAP Questions

- b. From the programmatic perspective, a great deal has been accomplished. We reestablished NASA's long-term mission, and maintained progress on balanced goals as much as possible within the budget limitations.
  - i. The successful and *SAFE* continuity of Shuttle flights for construction of the ISS has been a top priority. ISS – NASA's best kept secret is just how hard it is, and will be, to keep station operating safely for the long run without a major adverse event. Whether it is the up/down transportation issue or giving the SARJ a real useful life, we really have to be on our toes.
  - ii. The Human and robotic spaceflight communities, while still distinct, have grown more aligned and collaborative.
  - iii. We have achieved successful continuity of the science program including the Mars Exploration Program, Astrophysics, Earth Science, and Heliophysics. Consider just a short list of recent successes; MRO, Phoenix, Stereo, Swift, Fermi, Messenger, New Horizons, Cassini, Jason 2, etc.
  - iv. The relationship between NOAA and NASA has dramatically improved leading to the possibility of more effective development of operational Earth monitoring satellites and continuity of research products at lower cost to NOAA and the nation. There is now recognition that NASA's experience developing instruments and spacecraft for use in Earth Orbit and planetary environments is directly applicable to Earth Science and operational missions thus reducing risk and cost while improving performance.
  - v. Successful initiation of the Constellation program to replace the Shuttle (STS) and transition to a safer, more cost-effective architecture for human exploration.
  - vi. Successful planning and preparation for the human servicing mission to HST (STS-125), with flexibility to repair an additional element of the HST.
- c. Increased acceptance of commercial capabilities to support NASA's prime mission. NASA has always used commercial capabilities for communication and launch services however we have stepped this up with the encouragements and acceptance of the commercial orbital transportation systems for crew and cargo.

### 2. If you could start over, what would do differently?

- a. An earlier emphasis on the budget and planning process, including the use of joint cost and schedule probabilistic analysis in planning and estimating so we can more clearly identify the risk associated with our activities and have a better means to articulate the risk and change in risk as the situation changes (in funding, industrial capability, or technical requirements).
- b. The loss of a common set of specifications (MIL-SPECS, FED-Specs, etc) in the early 1990's and the implementation of organizational standards resulted in a divergence among the various NASA entities as to how work is implemented. While we have made progress developing Agency standards

## C J Scolese Response to ASAP Questions

and establishing Agency discipline leaders (Technical Fellows, NESC, and NSC) we should have pushed earlier for an Agency set of engineering directives, specifications, and standards to minimize communication issues, clarify requirements and processes for projects and programs, and simplify relationships with the contractors. We have made considerable progress here establishing 'core' standards and technical fellows but we could have started earlier.

- c. Establish the Constellation program requirements earlier and include more representation from the robotics and aeronautics communities into the Constellation program earlier and in key positions. This includes;
  - i. Articulation of the block approach to development. Everything does not have to exist on day one. Of course this needs to be balanced with budget and political realities.
  - ii. Clearer articulation of the architecture with the broader space technical and policy community.
  - iii. Articulation of the role of science and international cooperation in the Constellation program. This was needed to correct the early, 2004 statements that excluded or minimized the science and international aspects of the program.
- d. Increase emphasis on the utilization of ISS for applied science and Earth sciences.
- e. Initiate a technology development activity at a few percent of the NASA budget to develop and implement new technologies and capabilities across NASA and with industry and academia. This would include development of the new capabilities as well as the tools and standards. Areas that could benefit from technology activities include EDL, reliability, operability, EEE parts, science instruments, power systems technologies, etc.
- f. Earlier implementation of the infrastructure changes required to address IT security, aging facilities, and coordinated facility upgrades.

### 3. What are the important "unrealized opportunities?"

- a. Greater coordination among the human space flight, science, aeronautics and institutional elements of the Agency to take advantage of overlaps and minimize duplications. For example, every mission to Mars provides opportunities for addressing critical questions required for human missions, aeronautics research in hypersonics is directly applicable to issues associated with atmospheric entry, and coordination with institutional elements to optimize facility usage within and outside of NASA. Some elements that we are currently implementing to address this opportunity follow;
  - i. We are developing a new NASA Acquisition Policy NPD that ties together NASA's strategic goals and objectives to the whole process of obtaining the systems, research, services, construction, and supplies that the Agency needs to fulfill its mission. When implemented this will impact how new missions are established, how Agency work assignments are made (including developing or sustaining critical NASA, academic, and industry capabilities), the

## C J Scolese Response to ASAP Questions

- budgeting and distribution of resources, management of programs and projects, and the flow down of oversight. One result of this integrated focus on acquisition should be fewer surprises and fewer instances where resource shortages can lead to poor decisions with safety implications.
- ii. Innovative utilization of ISS as a platform for advanced observations of Earth and the Universe via revolutionary technologies (an NMP-like program for ISS utilization)
  - iii. Leveraging the success of the Mars Exploration Program (MER's, MRO, etc.) to motivate the need for humans beyond LEO and to enable a sustained robotic presence at Mars for the purpose of understanding life's possibilities within the accessible Universe (the past 4 years have seen a large downturn in the MEP)
- b. Leveraging commonalities across NASA
- i. Encouragement of new IT solutions to enhance our robotic and human space flight capabilities (initially in test-beds) such as common design tools, product development software, and analytical tools.
  - ii. Firm embrace of optical telecommunication first for science and as a part of our evolving human exploration initiatives (Orion, Altair)
  - iii. Creative use of commercial Earth remote sensing capabilities to enhance NASA Earth Climate science research (and model development), including hyper-resolution platforms such as GeoEye-1 and Radarsat-2
  - iv. Utilization of ongoing mission measurement results (i.e., from EOS, HST, Spitzer, Mars program, Cassini, Dawn, MESSENGER, and even ISS) to minimize duplication of activities.
  - v. Revitalize the Aeronautics program consistent with the strategic plan, both to directly serve the aeronautics community and provide the research and technical base for the spaceflight community entry, descent and landing systems
- c. Leveraging the commercial and international capabilities that are being developed to allow NASA to focus on the more difficult ground breaking technologies and missions.
- i. Commercial crew and cargo opportunities for the ISS
  - ii. Commercial remote sensing satellites
  - iii. Increased cooperation with international partners for science and exploration

### 4. What was harder than you expected?

- a. Some program and project personnel do not support the use of independent assessments, and the attendant checks and balances. Without continual reinforcement from Agency, Center, and Program leadership these groups would tend to abandon these processes. The mid-level project management types are still too prone to just go to a contractor, and in all too many cases see institutional Engineering and S&MA as more baggage than resource.

## C J Scolese Response to ASAP Questions

- b. Implementing the SRB process has been difficult due to resistance from people at lower levels. This resistance has resulted in limited utility for human space flight.
- c. Defending our budget to the OMB and Hill. There is great support for most of the missions and focus areas but there is not understanding about the impacts of changes in priority on existing plans. These changes have direct and indirect effects on safety and mission success as the Agency now must make hard decisions to delay, defer, or change direction on not only programs but also on training, oversight, facilities, and tools. We also seem to be unable to articulate how these shifts affect not only the missions but the safety and probability of success for our missions.
- d. The USAF led NPOESS development delays represent a threat to NASA's science budget and ability to meet the Earth Science Decadal goals established by the NRC and endorsed by Congress.
- e. Maintaining 10 reasonably healthy Centers without crippling programs.
- f. Developing a single communication architecture from several stove-piped, independent communications programs, to a centrally managed, network service architecture, providing communications and navigation services to meet the needs of both robotic and human exploration for the next 30 to 40 years.
- g. Program and project cost estimation, especially for one-of-a-kind systems, with appropriate cost, schedule, and performance flexibility.
- h. Designing Ares and Orion to have improved operational characteristics over our Shuttle and EELV systems.
- i. Renewal of institutional infrastructure.
- j. Moving the NASA culture to where a decision is a decision, rather than a call to debate.

### 5. What was easier than you expected?

- a. Establishing a routine monthly reporting structure that captures Agency performance against plans, that also serves to communicate issues among different communities.
- b. Establishing stronger ties to the NASA engineering community through the Office of the Chief Engineer, the NESC, the Engineering Management Board, and technical fellows. Today the engineering community is more cohesive and cooperative than it has ever been.
- c. Implementing the principles, organizational structures, and checks and balances in NPD 1000.0 was much easier than expected. Most of the program and institutional elements understood it and implemented it quickly and effectively.
- d. Getting INSKA approved.
- e. Restarting plans for a human-based servicing of HST using STS.
- f. Landing on Mars with powered descent using non-throttleable engines (pulsed descent engines) as on PHOENIX.

## C J Scolese Response to ASAP Questions

- g. Establishing stronger ties between the engineering and SMA organizations across the centers

### 6. What is critical to preserve during transition?

- a. As much stability as possible. We have good management and policies in place that are being executed and are beginning to bear fruit. Too much change could easily halt the momentum we have and cause us to churn while we figure out where to go, and what to do next. Direction to go to Mars is a decadal timeframe, not a 3-4 year endeavor. This need for stability certainly includes all programs that are in critical Phase D (nearing launch readiness) during the next 6 months (i.e., LRO, MSL, Kepler, OCO, etc.). As a minimum stability is required through the HST Servicing Mission and then the fly out of the shuttle
- b. There is a need to nurture and support the changes we have made to improve our organizational culture. As stated above this has been a success but like all culture changes it needs time to take hold. The checks and balances established by the separate but equal programmatic and institutional responsibilities have been effective in identifying issues and resolving them effectively. Most of the organization and personnel fully understand and support the changes and have incorporated them, however, there is some difficulty as organizations deal with reorganizations and resistance by some in the organization to change either as a result of the diversity of NASA's mission or due to disagreement with the policy.
- c. Sustaining the technical workforce and its leadership so that NASA honors its commitments and improves on historical levels of cost control.
- d. Key technical leaders across the Agency must be retained and preserved so that programs in critical phases of development are not delayed (at great cost) or discontinued. Examples include ORION-Ares1, MSL, JWST, GPM, LRO, etc.
- e. Key competitive programs (Explorers, Discovery, Venture, Scout, etc) are necessary for NASA continuity in the decade ahead and must be sustained so that the Community at large retains its trust in NASA's promises. These are also important as venues for training the next generation of scientists and engineers, as they provide educational opportunities through participation.
- f. Institutional transition - We are on a reasonable path to rationalizing the needed future institution. This is hard since we can hurt our mission badly by either leaving the institution too weak for the long run, or taxing too much programmatic content.
- g. Commitment to a continued human presence in space including a path out of low Earth orbit to the Moon and Mars.
- h. Constant focus on operational flight safety with the Shuttle and ISS program.

### 7. If you could write the "top five" goals for new administrator, what would be on the list?

- a. Safely fly out the shuttle – I think the safety culture is much better, even over the last 2 years since I have been a direct participant. I see a very different



## C J Scolese Response to ASAP Questions

attitude and a much more widespread “why are we safe and how do we know” attitude. It is critical that this not be perturbed, especially as we get to the last few flights. It is inevitable that there will be brain drain as good people get permanent offers elsewhere and we will need everyone on their toes.

- b. Re-establish NASA-wide research for science, human exploration, robotic exploration, aeronautics, and technologies that have breakthrough potential managed through oversight boards representative of the respective community, for example:
  - i. higher TRL reviewed and selected by program and project management
  - ii. lower TRL peer reviewed in the broad scientific and technological community
  - iii. innovation through partnership with venture capital
- c. Reinvigorate a program of ambitious measurements of our home planet Earth, starting with a new class of Earth Explorer missions relevant to Climate, Hazards, and sustainability of human resources (and potentially related to energy policy). This must be done in collaboration with NOAA, USGS, and other Agencies.
- d. Complete and utilize the ISS to its fullest potential and continue to develop innovative mechanisms for funding research with our partners and fellow agencies.
- e. Encourage and utilize commercial capabilities and innovative markets to expand the exploration of space and reduce Agency overhead.

### 8. Who are the dozen people most essential to retain?

- a. Key personnel: First, an overarching comment — I cannot name a single person in the senior leadership cadre who is not contributing solidly, either at HQ or the Centers. They work well together and bring a good balance of implementing NASA’s goals and taking care of their immediate responsibility.

### 9. How has the ASAP helped you?

- a. Ensured we kept our eye on the ball.
- b. After the Columbia accident, the ASAP was very supportive of the CAIB recommendations, including the setting up of the SMA pool for funding independent of the programs and the structural independence of the SMA organization. This approach also supported the implementation of Technical Authority independent of the program/project
- c. ASAP has consistently challenged us to centralize best practices into agency standards, and even when we disagreed, the debate has always been helpful.
- d. ASAP has been very helpful to us as we develop better agency approaches to fall protection and drug and alcohol testing.
- e. Ideally the ASAP can provide perspective and feedback to the present-leaders of NASA at a time of change (and obvious political transition).
- f. The ASAP process could help stabilize transitions and retain expertise so that loss of continuity is not an issue.



## C J Scolese Response to ASAP Questions

- g. The ASAP has been very helpful in pointing out to us when people they interview at the centers have not yet “gotten the word” on important strategic or governance matters.

### 10. How has the ASAP not helped you?

- a. The ASAP could help by explaining the relationship between prior approved Agency priorities and budget stability to mission success (see 4.c. above).
- b. The ASAP has not been helpful when challenging us to respond to irresponsible press reports...we could probably help by being more proactive in informing the ASAP when we see these reports.
- c. Constellation operational transition. It is not too early to consider best means of transitioning the Cx from development to flight operations. We have some of our top people engaged in planning now, and we would invite the ASAP to give us their thoughts on this topic.

### 11. Risks

- a. Shuttle extension – I see this as the single biggest threat to the US future in space. There are people availability implications, spare parts availability etc. that have safety implications. There will never be a painless time to end the shuttle and extending it now won't make it any easier to end it gracefully later. To cast off my Pollyanna persona for a minute, extending the shuttle now makes it likely that we will end the shuttle only when we have another serious accident or at best, a close call that wakes everyone up. Frankly, a much better strategy is to go to a real “ISS Block 1/Lunar Block 2” strategy and accelerate the capability as much as possible.

# AEROSPACE SAFETY ADVISORY PANEL

Vice Admiral Joseph W. Dyer, USN (Ret.), Chair

Dr. James P. Bagian

Major General Charles F. Bolden, Jr.

Deborah L. Grubbe, P.E.

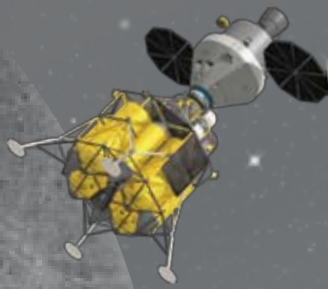
John C. Marshall

John C. Frost

Joyce A. McDevitt, P.E.

Dr. Donald P. McErlean

Brock R. "Randy" Stone



## SUPPORTING MATERIALS

## AEROSPACE SAFETY ADVISORY PANEL MEMBERS AND STAFF

### ASAP Members



#### **Vice Admiral Joseph W. Dyer, USN (Ret.)**

- Chair, Aerospace Safety Advisory Panel
- President, Military Government & Industrial Division, iRobot Corporation
- Former Commander, Naval Air Systems Command

Vice Admiral Joseph W. Dyer currently serves as President of the Military Government & Industrial Division of iRobot Corporation and works closely with the U.S. Department of Defense to develop reconnaissance robots, which will change the way that wars are fought in the future.

Admiral Dyer served as Commander of the Naval Air Systems Command from June 2000 until his retirement in 2003. He previously was assigned as Commander of the Naval Air Warfare Center Aircraft Division at Patuxent River in July 1997 and a month later assumed additional responsibilities as the Assistant Commander for Research and Engineering of the Naval Air Systems Command.

From January 1994 to April 1997, Admiral Dyer served as F/A-18 Program Manager, leading engineering and manufacturing development efforts on the new F/A-18E/F, continued production and fleet support of the F/A-18C/D, and all F/A-18 foreign military sales. Under his management, the F/A-18 program won the Department of Defense Acquisition Excellence Award and the Order of Daedalian.

From April 1991 to December 1993, Admiral Dyer was the Chief Test Pilot for the U.S. Navy. After receiving his wings in March 1971, he was selected as one of the first Nuggets, the first tour aviators, to fly the Mach 2 RA-5C Vigilante. He flew nationally tasked reconnaissance missions in both the eastern and western hemispheres.

Admiral Dyer received his commission through the Aviation Reserve Officer Candidate Program following his graduation from North Carolina State University with a B.S. in chemical engineering. He subsequently earned an M.S. in financial management from the Naval Postgraduate School in Monterey, California.



### **Dr. James P. Bagian**

- Director, National Center for Patient Safety, Veterans Health Administration, U.S. Department of Veterans Affairs
- Medical Consultant and Chief Flight Surgeon, Columbia Accident Investigation Board
- Former Space Shuttle Astronaut

Dr. James P. Bagian is a physician and researcher who combines his medical expertise with a variety of other disciplines. He currently serves as Director of the National Center for Patient Safety (NCPS) in the Veterans Health Administration of the U.S. Department of Veterans Affairs (VA). He previously held positions as a NASA physician and astronaut, U.S. Air Force flight surgeon, and engineer at the U.S. Department of Housing and Urban Development, U.S. Navy, and Environmental Protection Agency.

When the VA established the NCPS in 1999, Dr. Bagian became its first Director and still holds that position. He developed and implemented an innovative NCPS program, aimed at protecting patients from hospital-based errors, that the VA now has implemented at all 173 VA hospitals. Moreover, this program is the benchmark for patient safety in hospitals worldwide and earned the Innovations in American Government Award in 2001 from the John F. Kennedy School of Government at Harvard University.

During his 15-year tenure with NASA, Dr. Bagian flew on two Space Shuttle missions. He led the development of a high-altitude pressure suit for crew escape as well as other crew survival equipment. In addition, he was the first physician to successfully treat space motion sickness, and his approach has been the standard of care for astronauts since that time. He served as an investigator in the inquiry following the 1986 Challenger accident and was appointed as Medical Consultant and Chief Flight Surgeon for the Columbia Accident Investigation Board (CAIB).

Dr. Bagian's contributions to military service include advancing new methods of military aircraft ejection seat design and serving as a colonel in the U.S. Air Force Reserve. As the Special Consultant for Combat Search and Rescue to the Air Command Surgeon General, he was a leader in standardizing pre-hospital combat rescue medical care across all Air Force major commands.

Dr. Bagian was elected as a member of the National Academy of Engineering in 2000 and as a member of the Institute of Medicine in 2003. He received a B.S. in mechanical engineering from Drexel University in 1973 and earned an M.D. from Thomas Jefferson University in 1977.



### **Major General Charles F. Bolden, Jr., USMC (Ret.)**

- Chief Executive Officer, JACKandPANTHER LLC
- Former Commanding General, Third Marine Aircraft Wing
- Former Space Shuttle Astronaut

Major General Charles F. Bolden, Jr., currently is the Chief Executive Officer of JACKandPANTHER LLC, a small business that provides leadership, military and aerospace consulting, and motivational speaking services. He previously served as a NASA pilot and astronaut for 13 years, flying four Space Shuttle missions, and as the NASA Assistant Deputy Administrator from 1992 to 1993. Following the Shuttle Challenger accident in 1986, in his assignment as the Chief of the Safety Division at Johnson Space Center, he oversaw efforts to ensure crew and mission safety as the Shuttle Program returned to flight.

After leaving the U.S. space program, General Bolden resumed his career with the operating forces of the U.S. Marine Corps, serving in 1997 as the Deputy Commanding General of the 1 Marine Expeditionary Force (MEF), Marine Forces, Pacific. From February to June 1998, he was Commanding General, 1 MEF (Forward) for Operation Desert Thunder in Kuwait. In July 1998, he was promoted to Major General, serving as the Commanding General of the Third Marine Aircraft Wing.

General Bolden retired from the U.S. Marine Corps on January 1, 2003, after 34 years of service. His awards include a number of military and NASA decorations, and he was inducted into the U.S. Astronaut Hall of Fame in May 2006.

General Bolden holds a B.S. from the U.S. Naval Academy and an M.S. in systems management from the University of Southern California. He is a graduate of the U.S. Naval Test Pilot School at Patuxent River, Maryland, and has received honorary doctorate degrees from several distinguished universities.



### **John C. Frost**

- Former Chief, Safety Office, U.S. Army Aviation and Missile Command
- Former Chief, Safety Office, U.S. Army Missile Command

Mr. John C. Frost is an independent safety consultant who retired from Federal service with 33 years of safety engineering experience. He served as the Chief of Safety for the U.S. Army Aviation and Missile Command (AMCOM), holding worldwide responsibility for missile and aircraft safety.

At AMCOM, a major high-technology organization, Mr. Frost directed and implemented a comprehensive system safety program that encompassed all aspects of developing, fielding, and supporting state-of-the-art Army aircraft and missile/rocket systems worldwide as well as furnishing facilities and services for approximately 20,000 residents, workers, and visitors at the Redstone Arsenal. He previously served as the Chief of the Missile Command (MICOM) Safety Office and supervised various MICOM system safety, radiation protection, explosive safety, test safety, and installation safety program elements. He began his Federal career in the Safety Office of the Army Electronics Command at Fort Monmouth, New Jersey, where he advanced to Chief of System Safety Engineering.

Mr. Frost is a Senior Member of the International System Safety Society and a Professional Member of the American Society of Safety Engineers. He also remains active in various system safety organizations and initiatives.

Mr. Frost earned a B.S. in electrical engineering from the University of Virginia, where he was a DuPont Scholar. He holds an M.S., specializing in safety engineering, from Texas A&M University, where he also completed an additional year of advanced safety engineering training.



**Deborah L. Grubbe, P.E.**

- Safety Consultant and Owner, Operations and Safety Solutions, LLC
- Former consultant, Columbia Accident Investigation Board
- DuPont Corporate Director, Safety and Health (Ret.)

Ms. Deborah L. Grubbe currently is the owner and principal of Operations and Safety Solutions, advising organizations on safety culture and change management. Formerly, she was Vice President of Group Safety for BP, based in London. She previously spent almost three decades at DuPont in Wilmington, Delaware, where she held corporate director positions in safety, operations, and engineering.

Ms. Grubbe is past chair of the National Institute of Standards and Technology Visiting Committee and is a member of the International Board of the National Safety Council. She previously served on the oversight committee for the Demilitarization of the U.S. Chemical Weapons Stockpile and was a board member of the Center for Chemical Process Safety.

Ms. Grubbe is a registered professional engineer and was named the 2002 Engineer of the Year for the State of Delaware. She graduated from Purdue University with a B.S. with highest distinction in chemical engineering. She received a Winston Churchill Fellowship to attend the University of Cambridge in England, where she received a certificate of postgraduate study in chemical engineering.





## **John C. Marshall**

- President, JMAR Consulting, LLC
- Former Vice President, Corporate Safety and Compliance, Delta Airlines

Mr. John C. Marshall currently is President of JMAR Consulting, which provides services and expertise in aviation and transportation operations, aircraft accident investigation, regulatory compliance and safety audits, airline operations, maintenance oversight, and technical support. JMAR Consulting clients include state and Federal agencies, charter operators, international and domestic passenger and cargo carriers, and corporate aviation groups.

Mr. Marshall formerly served as Vice President of Corporate Safety and Compliance for Delta Air Lines, holding responsibility for the flight safety, industrial safety, environmental services, emergency planning and operations, safety analysis and quality assurance, and security departments. These departments all operate compliance-driven programs that respond to Federal requirements related to accident prevention, accident investigation, accident response, and a wide range of security concerns. He also held collateral responsibilities for integrating safety, compliance, and security programs of wholly owned subsidiaries into mainstream Delta programs. Under his leadership, Delta routinely received recognition for industry-leading programs that focused on reducing aircraft mishaps, employee injuries, and aircraft ground damage while enhancing environmental compliance programs and fostering the highest security standards.

Mr. Marshall served as the industry co-chair of the Commercial Aviation Safety Team, a joint industry-Government program to develop and implement an integrated, data-driven strategy to reduce the U.S. commercial aviation fatal accident rate by 80 percent by 2007. Participants include aircraft and engine manufacturers, passenger and cargo airlines, labor unions, Flight Safety Foundation, Air Transport Association, Regional Airline Association, NASA, Department of Defense, and Federal Aviation Administration. He is past chair of the Safety Council of the Air Transport Association of America and former chair of the Aerospace Symposium of the Society of Automotive Engineers. He served on boards for the Military Subcommittee of the National Defense Transportation Association, Safe America (a nationwide nonprofit group focusing on safety awareness), Flight Safety Foundation, and International Leadership Council of the Nature Conservancy.

For the U.S. Air Force, Mr. Marshall served as the U.S. Director of Security Assistance for the Middle East and was responsible during and immediately after the Gulf War for all sales, marketing, training, and logistical support among the United States and 11 countries in the Middle East, Africa, and Southwest Asia. He previously was the Inspector General of the Pacific Air Forces and the Director of Operations of the Pacific Air Forces, overseeing the safe and efficient operation of more than 400 combat aircraft. His early Air Force assignments included duties as a fighter pilot, special assistant to the Air Force Vice Chief of Staff, fighter squadron commander, base commander, and fighter wing commander. He primarily flew F-4s, F-15s, A-10s, and F-16s, but also has experience in a variety of other aircraft.

Mr. Marshall received a B.S. in civil engineering from the U.S. Air Force Academy and is a graduate of the National War College. He holds an M.A. in personnel management from Central Michigan University and an M.S. in civil engineering (environmental) from the University of Hawaii.



**Joyce A. McDevitt, P.E.**

- Systems Safety Consultant
- Former Safety Program Manager, Futron Corporation and Computer Sciences Corporation
- Former NASA System Safety Engineer (Ret.)

Ms. Joyce McDevitt is a systems safety consultant who recently worked with the Applied Physics Laboratory (APL) at Johns Hopkins University to develop and launch the Pluto-New Horizons mission spacecraft.

Ms. McDevitt previously served as a program manager with Futron Corporation and Computer Sciences Corporation, where she furnished range safety and system safety support to Government and commercial clients and held project safety responsibilities for the APL Midcourse Space Experiment Spacecraft. She also supported the Commercial Space Transportation Licensing and Safety Division of the Federal Aviation Administration. In addition, she served as a National Research Council committee member for studies of space launch safety and the safety of tourist submersibles.

During her nearly 30 years of civil service at NASA Headquarters, the Air Force Systems Command, and the Naval Ordnance Station, Ms. McDevitt acquired and applied safety expertise in space, aeronautical, facility, and weapons systems and in propellant, explosive, and chemical processes. She developed and managed safety programs, hazard analyses, safety risk assessments, safety policies and procedures, investigations of mishaps, and safety training.

Ms. McDevitt received a B.S. in chemical engineering from the University of New Hampshire and an M.S. in engineering from Catholic University. She is a registered professional engineer in safety engineering and a senior member of the International System Safety Society.



### **Dr. Donald P. McErlean**

- Director, Strategic Initiatives (Platform Integration Division), L-3 Communications, Integrated Systems Group
- Former Chief Engineer, Naval Aviation

In 2007, Dr. Donald P. McErlean joined L-3 Communications, where he currently serves as Director of Strategic Initiatives for the Platform Integration Division of the Integrated Systems Group. He holds responsibility for the management of research and development, technical assessment of new business opportunities, and development of technical personnel and policy strategies in support of the division. He formerly held the position of Director for Federal Programs, with responsibility for modification and heavy structural maintenance of the Navy P-3 and EP-3 aircraft as well as aircraft from the U.S. Army and the Department of Homeland Security.

After Dr. McErlean left Federal service in 2005 after a career of more than 35 years, he became President and Chief Executive Officer of the Center for Strategic Analysis, which provides high-level expertise to both industry and government in areas of national interest, emerging technology, and public policy.

In 2003, Dr. McErlean was appointed Deputy Assistant Commander for Research and Engineering (Naval Aviations Chief Engineer). He previously served as the Deputy Assistant Commander for Logistics and Fleet Support and oversaw the Naval Aviation buildup for operations in Iraq and Afghanistan. He joined the engineering management team of the Naval Air Systems Command in 1990 and served as Head of the Air Vehicle Engineering Department, Executive Director for Command-Wide Test and Evaluation, and Executive Director of the Naval Air Warfare Center Aircraft Division. During this period, he served in a joint assignment when in 1994 the Navy and Air Force jointly selected Dr. McErlean to serve as Technical Director for the Joint Strike Fighter Program. Originally appointed a member of the Federal Senior Executive Service (SES) in 1987, he initially was the Director of Air Vehicle and Crew Systems Technology at the Naval Air Development Center.

While serving with the Air Force, Dr. McErlean held the position of Systems Program Office Director, leading a wide variety of Air Force propulsion programs and applications, at the Air Force Aeronautical Systems Division. He joined that organization in 1979 as a systems engineering manager. He previously worked at the Air Force Aeropropulsion Laboratory as an aerospace engineer after serving on military active duty as an aerospace engineering officer at the U.S. Air Force Systems Command from 1970 to 1973.

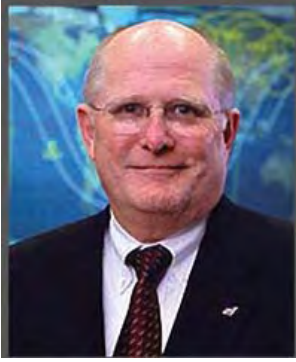
Dr. McErlean is the recipient of several SES awards for exceptional performance. He received the Presidential Rank Award from President George W. Bush in 2005 and from President William J. Clinton in 1993 and 1999. In 1987, he received the Exceptional Civilian Performance Medal from the Air Force. He is the recipient of the Navy Superior

Civilian Performance Medal and the Navy Distinguished Civilian Performance Medal, the Navy's highest civilian award for performance.

Dr. McErlean was named to the U.S. delegation to the Flight Vehicle Integration Panel of the NATO Advisory Group for Aerospace Research and Development (AGARD) and eventually was elected vice chair of that group. He also served as the Navy member of the U.S. delegation to the Aerospace Group of the Technology Cooperation Program.

Dr. McErlean has served on numerous technical advisory panels for NASA, the Department of Defense, and the Office of Science and Technology Policy and was chair of the Tri-Service Science and Technology Reliance Panel on fixed-wing aircraft research. He currently serves as a member of the Board of Directors for the North Texas Center for Innovation and Commercialization and the Alliance for Higher Education. He previously was a member of the Board of Directors of the International Federation for Telemetry. The Governor of Maryland appointed him to both the Commission for the Development of High-Technology Business and the Board of the Southern Maryland Higher Education Center.

Dr. McErlean received his Ph.D. in aerospace engineering (fluid dynamics major, applied mathematics minor) from Rutgers University and an M.B.A. from the Sloan School of Management at the Massachusetts Institute of Technology (MIT).



### **Brock R. "Randy" Stone**

- President, Cimarron Software Services, Inc.
- Former Deputy Center Director, Johnson Space Center
- Former Director of Mission Operations, Johnson Space Center

Mr. Randy Stone is the President of Cimarron Software Services, Inc., based in Houston, Texas. He retired from NASA in 2004 after 37 years of experience in human space flight operations, spanning Apollo, Apollo-Soyuz, Skylab, Space Shuttle, and International Space Station missions.

From 2001 to 2004, Mr. Stone served as Deputy Center Director of the Johnson Space Center. He previously was Director of Mission Operations from 1997 to 2001, overseeing all human space flight operations, including astronaut training, flight planning, mission control center development and operations, and vehicle simulator development and operations. From 1992 through 1996, he served as the Assistant Director for Operations and was responsible for the planning and execution of all Space Shuttle missions. His earlier assignments included Chief of the Flight Director Office and Flight Director for numerous Shuttle missions.

Mr. Stone is a 1967 graduate of the University of Texas at Austin and holds a B.S. in aerospace engineering.

## **ASAP Staff Members**

Kathy M. Dakon, ASAP Executive Director

Susan M. Burch, ASAP Administrative Officer

Sallie Birket Chafer, ASAP Annual Report Editor

**ASAP 2008 RECOMMENDATIONS AND STATUS**

<b>Recommendation #</b>	<b>Title</b>	<b>Status</b>
2008-01-01	Mass Scrub Process	Open
2008-01-02	NASA Approach to Orion Risk at Macro and More Detailed Level	Closed
2008-01-03	Communication of Risk	Open
2008-01-04	NASA Safety Reporting System	Closed
2008-01-05	NSRS Benchmarking	Open
2008-01-06	NASA Headquarters Mishap Investigation	Open
2008-02-01	Inclusion of NASA Safety Center in Standards Development	Open
2008-02-02	NASA Golden Rules for Knowledge Management	Open
2008-02-03	Modeling and Simulation	Open
2008-02-04	NASA Decision Tree for Optimizing the Use of Robotics in Exploration	Open
2008-02-05	Addition of Traffic Collision Avoidance System to NASA Aircraft	Open
2008-02-06	Independent Audits of Private Charter Operators	Closed
2008-02-07	Accident Review Timeliness	Open
2008-02-08	NASA Fall Protection Standard	Open
2008-03-01	Assessment of the Marshall Space Flight Center Industrial Safety Program	Closed
2008-03-02	Industrial Safety Performance Metrics	Open
2008-03-03	Constellation Approach to Integration	Closed
2008-03-04	Base Realignment and Closure Impact on Marshall Space Flight Center	Open
2008-03-05	Open CAIB Recommendations	Open
2008-03-06	Human-Rating Requirements Briefing	Closed
2008-03-07	Ares I Thrust Oscillation Risk-Based Studies	Open
2008-04-01	NASA-Wide Understanding of Thrust Oscillation Concerns	Open
2008-04-02	Human-Rating Requirements Graybeard Review	Open
2008-04-03	Human-Rating Requirements Guidelines and Training	Open
2008-04-04	Champion for Human-Rating Requirements Implementation	Open
2008-04-05	Communications on Executive Safety Committee Activities	Open



## ASAP 2008 RECOMMENDATIONS, NASA RESPONSES, AND STATUS

### 2008-01-01, MASS SCRUB PROCESS

The design team used a set of analysis gates to equip Orion with sufficient hardware to achieve an acceptable safety requirement for the crew, vehicle and mission success. The ASAP believes that this set of analysis gates has considerable engineering rigor and the Panel conceptually agrees with the process the project is using to arrive at a vehicle that is acceptable to the human rating requirements. The ASAP would recommend to the project that the Panel once again snapshot this process.

#### Status

Open

#### NASA Response

Concur with recommendation. The proposed time for the review is in the August 2009 Orion PDR timeframe.

### 2008-01-02, NASA APPROACH TO ORION RISK AT MACRO AND MORE DETAILED LEVEL

The Panel must ensure that as NASA goes through the decision processes and discussions in the Orion design process, that they adequately document and keep track of decisions, as well as track the documents used in the process of doing design.

#### Status

Closed

#### NASA Response

Concur with recommendation.

The Orion project, operating under the authority of the Constellation Program, utilizes a formal system and structured process for capturing design data, decision packages, and configuration- controlled documents consistent with Directorate and Agency requirements. These processes comply with Federal records retention requirements for Program Management Data. All elements of the Constellation Program utilize a common tool called the Integrated Collaborative Environment (Windchill) that is the medium for document distribution and repository for permanent data capture. In the case of the decision packages related to the Orion Mass Scrub process for which the question refers, all of that data was stored on Windchill during the process and will be maintained.

Each of the project decision bodies likewise maintains formal Windchill records of the agendas, discussion materials, background data items, and formal minutes of decisions and actions as established in the program and project requirements and implementation plans. For Orion, the decision boards include the CEV Project Control Board as the top-level NASA project board authority, and Lockheed maintains two boards, Program Control Board and Engineering Review Board, which maintain the technical and contract baselines for the program. All boards maintain appropriate configuration control history and data background for all decisions as required in the established Configuration Management Requirements.

As design progresses, all design data will be stored on Windchill in appropriate locations with all formally configuration-controlled data resident in the Windchill Library where document revisions and traceability information are also maintained. The Orion Project will provide any additional details of these processes as required by the ASAP.

### 2008-01-03, COMMUNICATION OF RISK

The Panel recommends NASA consider a proactive communications plan for the Constellation Program around risks, risk assessments, and failure tolerances. The Panel believes that it is important for NASA to outline this process to its major stakeholders so that people and all the major stakeholders have appropriate expectations. As the design advances, the risk process must be predicated on both realistic targets of achievement and minimally acceptable risk levels so as to maintain credibility in communicating risks internally and externally.

**Status**

Open

**NASA Response**

Reference ESMD-RMP-04.06 Rev 2 Exploration Systems Risk Management Plan, and CxP 70056 Constellation Program Risk Management Plan.

The risk management processes in place both at the Exploration Systems Mission Directorate (ESMD) and the Constellation Program ensure proactive development of risks and communication. Regular risk reviews are held at all levels (project, program, ESMD), and rationale for the acceptance of any risk must be presented and accepted by appropriate leadership in these forums. All risk reviews are open meetings, with stakeholders represented and encouraged to participate. Independent review teams, such as Standing Review Boards, often participate. The Integrated Risk Management Application (IRMA) tool used for risk management facilitates online access and a standardized approach to all program risk data for identifying, assessing risk issues, escalating as necessary, tracking, and ultimate closures or acceptance. Because risk management as outlined in the referenced plans is an ongoing activity, risk assessment evolves as the designs mature up until Certification of Flight Readiness (CoFR) for flight. This process also enables effective communication with external stakeholders regarding risk analysis and dispositions.

NASA concurs with the recommendation to have a proactive communication plan for Constellation risks. The risk management processes defined in the Exploration Systems and Constellation Program's risk management plans, including regular and open risk review forums at all levels, ensure thorough communication and debate among stakeholders about risk assessment and acceptance through all phases of design up through and including CoFR.

**2008-01-04, NASA SAFETY REPORTING SYSTEM**

The ASAP reviewed the NASA Safety Reporting System (NSRS). The Panel would like to obtain more information about the system to see if the information that is being provided might have value as part of the overall safety management information system.

**Status**

Closed

**NASA Response**

In February 2008, the NASA Safety Reporting System (NSRS) Program Manager provided the ASAP with a complete briefing on the NSRS. This briefing explained the purpose and philosophy behind the NSRS, how reports were received and acted upon, and how investigations were conducted and results were conveyed to the reporter.

As part of the procedures designed to protect reporter anonymity, NASA cannot release NSRS reports for review. Unlike other reporting systems, such as the Aviation Safety Reporting System and the Patient Safety Reporting System, NASA does not consolidate report data for outside review. This is also an intentional approach designed to protect reporter anonymity.

The NSRS is considered to be a safety reporting channel of last resort. This channel is to be used when normal safety reporting channels have been exhausted or if a reporter fears reprisal for raising the concern. Though important, the NSRS is but a very small component of NASA's safety information system.

The NASA response to Tracking Number 2008-01-05 - NSRS Benchmarking recaps the NSRS program information.

**2008-01-05, NSRS BENCHMARKING**

The Panel recommends NASA to do a benchmarking of the NSRS. In discussing benchmarking, clarification will be needed on policy as to what the purpose of the NSRS really is. Is it simply a safety valve or does it have meaningful information as a vulnerability tool? Also, in benchmarking, the ASAP recommends that the NSRS review how to define more clearly its guarantee of anonymity.

## Status

Open

## NASA Response

The NASA Safety Reporting System (NSRS) is a unique system that has been designed to function as an auxiliary, high-level safety valve to help identify and fix specific hazards or safety problems that could not be adequately resolved at lower, more localized reporting levels. It is neither designed nor intended to be a close call reporting system for purposes of identifying future problems through high-volume trending of data. The NSRS offers the NASA community a means to report specific concerns anonymously and the assurance that the highest levels of NASA's safety management team will give prompt attention to those concerns and work to resolve them. It is neither intended nor advertised to be a place for initial safety reporting except in rare cases where the reporter fears reprisal. The NSRS is not the only vehicle for anonymously reporting safety concerns at NASA. Many NASA Centers have instituted local reporting systems that are designed to accept anonymous tips, and the NASA Inspector General also accepts anonymous reports. If an NSRS reporter is dissatisfied with the results of an NSRS investigation, the NASA community also has the option of reporting problems elsewhere, such as to the Office of Federal Agency Safety and Health Programs at the Occupational Safety and Health Administration in the Department of Labor. More detailed information about the NASA safety reporting hierarchy and the NSRS program's fit within that hierarchy may be found at the following Web site: [http://www.nasa.gov/audience/safety/reporting/Safety\\_reporting.html](http://www.nasa.gov/audience/safety/reporting/Safety_reporting.html).

Unlike the NSRS, the Aviation Safety Reporting System (ASRS – run by NASA for the Federal Aviation Administration) is intended as a high-volume close call incident reporting service (for U.S. pilots, air traffic controllers, flight attendants, mechanics, and ground personnel) that provides incentives for initial reporting of close call information. The ASRS is intended to identify generalized deficiencies in the national aviation system and recommend future safety improvements, as opposed to the NSRS which is not intended to be a primary reporting system (except in rare cases where reporters fear reprisal) and is designed to fix specific, individual safety problems on a case-by-case basis when the situation was not remedied previously at lower, localized reporting levels. The ASRS is designed to ensure confidentiality and anonymity and will not release or make available any information that might reveal the identity of any party involved in a close call occurrence. The ASRS can offer “confidentiality” because it operates under unique provisions granted to the Federal Aviation Administration by Congress. Congress has not granted NASA those same privileges, so NASA cannot guarantee NSRS report confidentiality. Instead, the NSRS is designed to ensure that each reporter's identity is never shared with or known to NASA.<sup>1</sup>

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<sup>1</sup> The NSRS process for protecting reporter identities is as follows:

- 1) When an NSRS reporter completes the NSRS report form, they are prompted to provide their name and point of contact information on the form, but this information is not required. All incoming reports are treated equally regardless of whether or not this personally identifying information is provided.
- 2) Mailed reports are retrieved from our NSRS mailbox by our NSRS support contractor; our policy prohibits the NSRS program manager or any other NASA civil service employee from retrieving this mail, and only the NSRS support contractor has the combination code to the locked mailbox.
- 3) The NSRS support contractor processes the incoming report in a secure location at their offsite facility. The contractor removes all personal identifying information and forwards only a summary of the concerns to the NSRS Program Manager or the designee for immediate analysis and investigation. If the reporter provided their name and mailing address, the contractor mails the reporter a letter to let the reporter know that their concern has been received and has been forwarded to NASA for immediate review and analysis. A reporter's identity is never shared with NASA at any point. NASA civil service employees never see the original mailed report which could contain a reporter's identity.
- 4) If the NSRS program manager or the designee requires further clarification of the hazard from the reporter, it is the NSRS support contractor who is asked to directly contact the reporter and provide the clarified information back to NASA.
- 5) Once the NSRS program manager or his designee is satisfied that no further information is required to understand the nature of the hazard, the NSRS program manager instructs the NSRS contractor to mail the reporter's original identity strip (the top portion of the report form where the reporter provided their personally identifying information) back to the reporter with a letter that includes the specific number assigned to their NSRS report case and which explains the existence of a blind public web site (<http://www.hq.nasa.gov/office/codeq/status>) where the reporter may occasionally check to see the status of his/her NSRS report case. The letter to the reporter provides the key to these status codes, which are as follows:
  - a. Code A – Investigation open.
  - b. Code B – Investigation closed, corrective action pending.
  - c. Code C - Investigation closed, no corrective action warranted.
  - d. Code D – Investigation closed, reported concern could not be substantiated/validated.
  - e. Code E – Investigation closed, physical/product corrective action completed.

Much like the ASRS, the Patient Safety Reporting System (PSRS - jointly managed by NASA and the Department of Veterans Affairs) is designed to be a high-volume close call incident reporting service meant to identify and track systemic vulnerabilities, but is not intended or designed to provide detailed solutions to specific problems as the NSRS does. The PSRS removes all personal names, facility names and locations, and any other potentially identifying information before entering information in its database. Alternatively, the NSRS only protects reporters' identities, but must retain information about facilities and locations in order to conduct an investigation and substantiate the facts of the specific safety hazard and implement a solution when needed.

Of course, despite the thorough procedures that the NSRS program has in place to protect reporter identities, there is always the possibility that people will speculate as to who might have authored a particular NSRS report. To reduce that possibility, the NSRS program carefully limits the number of senior safety managers who actually have a need to know that the origin of a particular safety investigation stems from an NSRS report. By decoupling the origin of the report with the investigation of the report content, most safety reports of NSRS origin are openly investigated as independent assessments at NASA so that their findings can be coordinated with other NASA systems designed to track corrective actions or trend safety information.

Given that we continue to see a sustained level of reporting over time, we believe the NASA community continues to have confidence that, should they ever need it, this reporting "safety valve" is in place and standing by to serve their reporting needs.

### 2008-01-06, NASA HEADQUARTERS MISHAP INVESTIGATION

The ASAP has recommended that NASA reevaluate its mishap investigation process with an eye to producing report results in a timely manner, and utilizing the appropriate experts for determining root cause. NASA should consider a 30-day hard number for delivering at least a preliminary mishap report, to enable dialogue to begin within the affected organizations.

#### Status

Open

#### NASA Response

NASA acknowledges and accepts the ASAP recommendation. In response to the ASAP recommendation, NASA initiated the following actions:

*Action 1:* NASA evaluated the NASA Procedural Requirements (NPR) 8621.1 that states a mishap investigation board has 75 work days to complete their investigation to determine if the duration could be reduced to 30 work days while still determining root cause. After evaluation and input from all Centers and the NASA Safety Center (NSC), NASA concluded that the majority of investigations for Type C mishaps, Type D mishaps, and close calls can be completed successfully and shared with management within 30 work days. Due to the complexity and scope of Type A and Type B mishaps, Agency Safety and Mission Assurance personnel determined that a minimum of 45 work days would be needed for the trained investigators to successfully reach root cause. (*Action 1: Completed*).

*Action 2:* NASA will make the following changes to NPR 8621.1:

- a. For Type C mishap, Type D mishap, and close call reports, NASA will reduce the time allotted to complete the mishap report from 75 work days to 30 work days.
- b. For Type A mishap and Type B mishap reports, NASA will reduce the time allotted to complete the mishap report from 75 work days to 45 work days.

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- f. Code F – Investigation closed, policy/procedural corrective action completed.
  - g. Code G – Investigation closed, education/awareness corrective action completed.
  - h. Code H – Out of scope, referred to another functional area for investigation/analysis.
  - i. Code I – Out of scope, involves waste/fraud/abuse. Referred to the NASA Inspector General.
  - j. Code J – Investigation closed; insufficient information provided to perform an investigation.

NOTE: No record of a reporter's identity is retained by the NSRS support contractor once this second letter has been sent (except for reports of criminal activity, which are provided to the Office of the Inspector General).

- 6) If, during the course of NASA's subsequent investigation into an NSRS case, someone involved with the investigation were to inadvertently discover or suspect the identity of the NSRS reporter, that person is requested to recuse himself/herself from further involvement in the case.

- c. For Type A mishaps and Type B mishaps, NASA will change the requirement for a 30-work day publicly releasable status report to a 15-work day publicly releasable status report.
- d. The NSC will post all 15-work day publicly releasable status reports on the NSC web site.
- e. All mishap reports will be posted in the Incident Reporting Information System within two work days of their completion in a location that is available to all Government employees. The NSC will verify that this has been completed. (Action 2: Projected Completion Date - June 2009).

**2008-02-01, INCLUSION OF NASA SAFETY CENTER IN STANDARDS DEVELOPMENT**

The ASAP recommended that the NSC be included in the NASA process for evaluating whether new standards are needed and the decision on whether to implement those standards.

**Status**

Open

**NASA Response**

The NASA policy for the development, maintenance, and adoption of standards is NASA Policy Directive (NPD) 8070.6C, Technical Standards. The process for the development, maintenance, and adoption of NASA Technical Standards is divided into those developed by the Office of the Chief Engineer (OCE) and those developed by the Office of Safety and Mission Assurance (OSMA).

1) Standards under the responsibility of the Office of the Chief Engineer (OCE):  
 The OCE has established the NASA Technical Standards Program (NTSP) at the Marshall Space Flight Center to manage the OCE’s standards. Standards either being recommended for adoption or development/maintenance are vetted through the NASA Technical Standards Working Group (now known as the NASA Engineering Standards Panel (NESP)) for participation in the adoption/review/development process. The NESP has membership from the engineering organizations at each Center/Facility as well as representatives from the OCE. Additionally, the NESP has membership from the OSMA and the Office of the Chief Information Officer. For engineering standards, OSMA will engage the NSC on a case-by-case basis as appropriate to the subject matter.

2) Standards under the responsibility of the Office of Safety and Mission Assurance (OSMA):

Safety and Mission Assurance (SMA) Standards are controlled by NASA Headquarters Office Work Instruction (HQOWI) 1410-GD02 (Rev F) [[http://nodis3.gsfc.nasa.gov/HQDQMS\\_Docs/QMS/HQ\\_OWI\\_1410\\_GA000\\_002\\_F\\_.pdf](http://nodis3.gsfc.nasa.gov/HQDQMS_Docs/QMS/HQ_OWI_1410_GA000_002_F_.pdf)]. This HQ OWI describes the process in detail in section 6 and mandates that the Director of the NSC is a part of the process for the review, update, and approval for all standards (as well as NASA policy documents and handbooks). Throughout the documentation process, the HQ OWI treats the NSC as one of the OSMA Divisions and places on it the same responsibilities and opportunities to participate as it does on the other two OSMA Divisions.

The OSMA believes that the NSC participates in the standards development process, as explained above, and does not see any need for changing how SMA documents are already processed.

**2008-02-02, NASA GOLDEN RULES FOR KNOWLEDGE MANAGEMENT**

The ASAP recommended that an Agency-wide set of NASA Golden Rules be established to assist in the sharing of knowledge between Centers.

**Status**

Open

**NASA Response**

NASA currently uses a formal lessons learned process that is described in detail in NASA Procedural Requirements (NPR) document 7120.6, Lessons Learned Process. This NPR states, in paragraph P.1, “This NASA Procedural Requirement (NPR) establishes the requirements for the collection, validation, assessment, and codification of lessons learned submitted by individuals, NASA directorates, programs, and projects, and any supporting organizations and personnel.” Paragraph 1.4 of this NPR requires that NASA Headquarters and each NASA Center

establish a Lessons Learned Steering Committee, that the lessons learned process be followed, and that lessons be entered into the Lessons Learned Information System (LLIS) (found at: <http://llis.nasa.gov/>).

We are aware that several of our Centers have a set of “Golden Rules” related to best practices in design, environmental testing and operation, coupled with specific best practices to be followed during the deployment phases of the mission. By their very nature, these documents not only describe the “what,” but also the “how” and the “who” at a particular Center, and consequently, developing a generic set of these for the Agency and the myriad of affected, implementing organizations presents special challenges.

However, to assist in sharing this good knowledge between the Centers, NASA will encourage its Centers to enter those “Golden Rules” that are applicable for Agency-wide application into the LLIS so that the knowledge is visible and accessible across the Agency. In addition, it is the express intent of the Engineering and Safety Mission Assurance Disciplines to help ensure that lessons, both formal and informal, get shared appropriately among the discipline members through a variety of venues including technical interchange meetings, discipline working group meetings, life-cycle appropriate key decision point reviews, etc. We believe this approach will serve the Agency best in sharing important lessons and not repeating failures of the past.

When lessons learned are of the nature indicating a need for change in policy or procedures then lessons learned are incorporated into the Agency’s policy and procedural set of directives. Changes to these requirements are fed by not only lessons we learn from mishaps but through our systematic process of institutional and program assessments and audit. Lessons frequently are captured as additions or changes to our NASA Policy Directives and NPRs. In addition, there are a number of standards that are promulgated by the NASA Office of Safety and Mission Assurance, and lessons learned are used for changes to these documents as well. NASA directives and standards that relate to Safety and Mission Assurance are accessible on a NASA Web page and can be accessed at <http://www.hq.nasa.gov/office/codeq/doctree/qdoc.htm>.

### **2008-02-03, MODELING AND SIMULATION**

The ASAP recommended that on Modeling and Simulation, a NASA-wide matrix be created to classify models as “green,” “yellow,” and “red,” so that the statement “high confidence” means the same thing from one Center to another.

#### **Status**

Open

#### **NASA Response**

While NASA agrees that the statement “high confidence” should mean the same from one Center to another, NASA does not believe that using a stop light approach is the best way to convey credibility of the results of Models and Simulations (M&S).

On July 11, 2008, NASA published a standard (NASA-STD 7009A) that includes requirements for the reporting of the results from M&S to those making “critical decisions” (section 4.8). (The standard defines a critical decision as: Those technical decisions related to design, development, manufacturing, ground, or flight operations that may impact human safety or mission success, as measured by program/project-defined criteria.) The reporting requirements of this new standard foster the consistent presentation—across NASA Centers and across programs and projects—of the rigor behind particular M&S results, including the associated uncertainty estimates. Per section 4.7 and its accompanying appendix in this standard, the M&S rigor is reported on the Credibility Assessment Scale. This is a five-level, eight-factor scale. The standard also requires the reporting of the overall score determined from a roll-up of the eight individual factors. The differences between this approach and the specific recommendation of the ASAP are two-fold. First, there are five levels, not three. More fundamentally, the decision maker makes his or her own determination of the confidence to be placed in the M&S results based not only on the results on the scale, but also upon the size of the uncertainty in the results.

NASA-STD 7009 “Standard for Models and Simulations” can be found at [http://standards.nasa.gov/public/public\\_detail.taf?Documents\\_uid1=6365&doc\\_name=NASA-STD-7009](http://standards.nasa.gov/public/public_detail.taf?Documents_uid1=6365&doc_name=NASA-STD-7009).



## 2008-02-04, NASA DECISION TREE FOR OPTIMIZING THE USE OF ROBOTICS IN EXPLORATION

The ASAP recommended that NASA formulate a decision tree for optimizing the use of robotics in exploration, so as to diminish the risks to humans, including all criteria relevant to the decision.

### Status

Open

### NASA Response

NASA concurs with the ASAP recommendation to formulate a decision tree for optimizing the use of robotics in exploration to diminish the risks to humans. The decision tree will take into account the following discussion to enhance exploration rather than making a “cut and dry” if/then process.

Given the end goal of safe and efficient human exploration on Mars and other destinations, systems engineering trades will be performed at the campaign, architecture, and program levels to determine the optimum mix of human and robotic functions to minimize the risks of human exploration. These trades will take into account the understanding that human exploration is necessary for the purpose of the following goals:

- Discovery and science in ways that are only possible through firsthand investigation and observation.
- Extending human presence off-planet and on to other planetary bodies.
- Gaining the experience and knowledge to travel and explore in ever-expanding dimensions within the solar system.
- Gaining operational experience on the Moon to prepare for exploration of Mars.
- Extending our economic sphere of influence beyond Earth and low-Earth orbit.
- Bringing the excitement and experience of exploration back to the people on Earth.
- Sharing these goals and the exploration experience with other nations of the world, building on current partnerships and building new ones.

These goals are based on concepts of operations developed to address these goals. The result is a campaign of missions with and without the crew. Lunar architecture studies are conducted to develop effective and efficient operational approaches for these missions and lunar operations. In evaluating specific objectives on the lunar surface, we will take the approach that people will be utilized to the maximum extent to achieve objectives for which they are uniquely needed.

These trades will be risk-informed, using state-of-the-art tools and methods comparing the relative safety risks, as well as other safety/reliability and mission success criteria. Our systems engineering teams will present well-documented campaign analysis, trade study results, and propose options to our decision makers at appropriate requirements reviews, change boards, and design reviews. We will engage appropriate technical and medical technical authorities as well as flight crew concurrence in the final decisions involving human (vs. robotic) tasks. The NPR 7120.5D dissent process will be available at each level as necessary. This approach is consistent with our existing systems engineering processes and decision forums and requires no new unique procedures or tools.

In addition to architectural studies, NASA will incorporate data collected by its lunar robotic precursor missions and those of partner nations. Our Lunar Reconnaissance Orbiter will provide detailed topographic maps of the Moon and environmental data on the temperature, radiation, and lighting environment of the areas of highest interest for human lunar missions. That data will be incorporated into planning models to develop more detailed design requirements for the lunar lander, Extra Vehicular Activity (EVA), and surface systems, and to inform the development of operational scenarios.

NASA is also conducting a series of human lunar analog missions at selected sites in the United States and Canada, with the goal of understanding the capabilities needed by human lunar explorers of the future. These capabilities will inform the development of requirements for these systems. Systems include surface mobility, robotic assistants, and EVA suits.

In addition, systems engineers for EVA and lunar surface systems have deployed with planetary geologists to areas with geography similar to that on the lunar surface to better understand the demands of the terrain and the needs of the science community, again with the idea to develop requirements for future exploration systems.

Once detailed mission planning is undertaken, actual system capabilities will be compared to environmental conditions at the landing site and its environs to determine specific flight rules and operational constraints to the mission. This planning will be similar to the planning that is currently performed for International Space Station (ISS) and Space Shuttle missions, where Shuttle and ISS flight parameters are adjusted to minimize risk to the crew and the mission.

#### **2008-02-05, ADDITION OF TRAFFIC COLLISION AVOIDANCE SYSTEM (TCAS) TO NASA AIRCRAFT**

The ASAP urged that NASA review the applicability of developing a policy that would formally add to appropriate NASA aircraft Traffic Collision Avoidance System (TCAS), advanced ground warning systems, and other advanced avionics programs that have been embraced by the civilian and military worlds.

##### **Status**

Open

##### **NASA Response**

Two of the systems recommended by ASAP are used to aid in the prevention of midair collisions and controlled flight into terrain (CFIT), respectively. NASA takes these risks seriously and has, over the years, incorporated advanced avionics systems or put in place procedures to mitigate these risks. For example, NASA currently operates 75 aircraft in support of NASA missions with approximately two thirds either configured with, or planning to incorporate, traffic collision advisory systems. The installation of TCAS was in response to the NASA aircraft operations community's thorough risk management, identifying the risk associated with midair collision in the high-traffic areas in which NASA aircraft operate and formulating a risk migration plan. As this risk was identified, funding was established to perform the modifications needed to control this risk. NASA's aircraft operations community continues to review risks associated with aircraft operations and actively seeks safety enhancement for our fleet of aircraft to ensure that risks of flying are identified and controls are put in place.

As part of the effort to continually improve the safety of aircraft operations with the addition of modern avionics systems, NASA has recently required Crew Resource Management (CRM) training for all its pilots. CRM is an industry-recognized aviation safety tool which is used to aid flight crews in recognizing and managing situations like midair collisions and CFIT. NASA will continue to look at employing systems like TCAS and procedures like CRM as appropriate for NASA's aircraft operations. As part of this effort, the Aircraft Management Division (AMD) plans to incorporate policy in NASA Policy Directive 7900.4, NASA Aircraft Operations Management, to require that Centers regularly review both system and procedural enhancements based on risk management. The AMD with the assistance of the Intercenter Aircraft Operations Panel (IAOP) will oversee this implementation during biennial aircraft functional reviews through the IAOP Review Program.

#### **2008-02-06, INDEPENDENT AUDITS OF PRIVATE CHARTER OPERATORS**

The ASAP recommended that, prior to contracting with a private charter operator, NASA consider requiring that all contractors be subject to an independent audit.

##### **Status**

Closed

##### **NASA Response**

NASA reviewed its current documentation for any requirements that would be related to this recommendation. The review identified the following:

##### **1. NASA Federal Acquisition Regulation (FAR) Supplement (NFS) 1847.200-71, Charter or Lease of Aircraft:**

“Before releasing any solicitation or awarding any contract for the lease or charter of aircraft, manned aerial system or unmanned aerial system (UAS), contracting officers shall obtain concurrence from the Center Flight Operations office that the contemplated award complies with NASA aviation safety program requirements, particularly NASA Policy Directive (NPD) 7900.4, NASA Aircraft Operations Management, and NPR 7900.3, Aircraft Operations Management.” (revised June 2008)



## 2. NPD 7900.4B Aircraft Operations Management:

a) Paragraph 1.e: “All aviation-related NASA contracts and agreements must require compliance with NASA aviation safety program requirements and aircraft management policies.”

b) In section 5 of Attachment A (Policy on the Use of Aircraft to Support NASA Requirements) requirements for independent reviews are provided for “Contractor-owned and contractor-operated aircraft.” The NPD states that “Prior to contract award, a risk analysis of the final candidates shall be conducted by the flight operations office at the NASA Center that manages the contract. The risk analysis shall include a review of the terms of the contract, the risks to NASA, the hazards associated with the proposed flight operation, the airworthiness of the aircraft, and the capabilities of the contractor.”

## 3. NPD 8730.5 NASA Quality Assurance Program Policy:

a) Paragraph 1.b (1) states that NASA quality assurance programs shall “be designed and implemented in a manner that mitigates risks associated with noncompliance. Determination of risk considers the likelihood of noncompliance and the consequences associated with noncompliance, including the maturity, complexity, criticality, and value of work performed, as well as demonstrated experience with past quality system or program performance.

b) Paragraph 1.b (4) states that NASA quality assurance programs shall “include prework assurance measures that provide increased confidence for meeting prescribed requirements (e.g., preaward surveys, qualified source selection...”)

NASA concurs with adding an explicit requirement for the performance and analysis of the results of pre-award surveys as an integral component of the risk analysis for contractor-owned and operated aircraft (precontract award). Pre-award surveys would be required under circumstances where it is deemed that there is excessive risk or insufficient information concerning contractor past performance to perform a comprehensive/adequate risk analysis.

NPD 7900.4B expires on April 27, 2009, and is currently being updated by NASA’s Aircraft Management Office. The NPD revision will incorporate specific language as discussed above. The revision is expected to be submitted to the NASA Online Directives Information System (NODIS) within the next four months proposing the incorporation of this change.

In addition to the above existing requirements, NASA will update its Aircraft Operations Requirements Document within the next six months to specifically require pre-award surveys for lease or charter of aircraft where it is deemed that there is excessive risk or insufficient information on contractor past performance to perform an adequate risk analysis.

## 2008-02-07, ACCIDENT REVIEW TIMELINESS

The ASAP urged that greater timeliness be achieved in completing accident reviews. The Panel also recommended that an organized and rigorous mishap trend analysis effort be undertaken Agency-wide to identify causal trends at an Agency level as well as by Center. The results of this analysis should be briefed on a regular basis to senior Agency leadership. The Panel would like to see the Center analyses during their visits to field operations. The Panel recommended that a policy be implemented to brief senior leadership of initial causal analysis in a timely fashion after major mishaps. Finally, the Panel recommended that a closed loop, management tracking system, similar to that used for ground mishaps, be developed to ensure implementation of lessons learned from flight failure investigations.

### **Status**

Open

### **NASA Response**

NASA acknowledges and accepts the ASAP recommendations. In response to the ASAP recommendations, NASA has initiated the following actions:

*Action 1:* NASA has initiated mishap and close call trending at the Agency level as well as the Center level. Since July 2008, the NASA Safety Center (NSC) has completed trending on the number and type of mishaps and close calls and presented these trends to NASA’s senior management at the monthly Baseline Performance Reviews

(BPRs) which are chaired by the Associate Deputy Administrator.  
(Action 1: Completed.)

*Action 2:* NASA will complete the development of the NASA Root Cause Analysis Tool to provide the Agency with the capability to systematically evaluate and electronically document proximate, intermediate, and root causes for all mishaps and close calls rather than doing the analysis manually. Once completed, NASA will take all Type A and Type B mishap reports from the last three years, and all those in the future, and use the tool to document, analyze, and electronically trend the causes of mishaps. Mishap-cause trending will be presented at monthly BPRs.  
(Action 2: Projected completion and initial presentation to the BPRs - August 2009.)

*Action 3:* Currently, for each Type A mishap, Type B mishap, and high-visibility mishap, the NASA mishap investigation board provides an out brief to all endorsing officials (Chief, Safety and Mission Assurance, Chief Engineer, Chief Health and Medical Officer (when the mishap involves injuries, illnesses, or fatalities) and the responsible Center Director or Associate Administrator). The out brief includes a summary of the events that led up to the mishap; proximate, intermediate, and root causes; and recommendations. Additionally, the NSC also has created a comprehensive Web site for Agency personnel to access and view the latest safety data for the Agency. To expand the dissemination of information, after each out brief, the NSC will create a two-page summary (including findings and causes) and include that summary in the briefing to NASA senior management at the monthly BPR.  
(Action 3: Out briefs are an established part of the process; Web site is completed. Projected start of monthly BPR briefings - December 2008).

*Action 4:* Agency personnel are working to complete a closed loop tracking system to ensure that lessons learned from mishaps are input to the Lessons Learned Information System. Additionally, the NSC hired an employee to monitor and track mishap and close call recommendations to ensure that 1) the corrective action plans have been developed by the responsible organization, 2) the recommendations have been implemented, and 3) the lessons learned have been shared across the Agency. The NSC will generate trending of NASA's success on implementing mishap and close call recommendations.  
(Action 4: Projected completion - May 2009).

*Action 5:* The Agency is working hard to ensure a greater timeliness in the review of Type A and Type B mishap reports. Currently, the NSC is developing information for all endorsing officials indicating which reports are waiting for a review and endorsement. The NSC is also providing support in the Office of Safety and Mission Assurance's (OSMA) analysis and critique of all Type A and Type B mishap reports. Starting in January 2009, the NSC will complete all Type A and Type B mishap report critiques for the OSMA and forward the signed critique to OSMA and the mishap investigation board within two weeks of the mishap. OSMA will use the critique to generate OSMA's endorsement letter. The NSC's newly expanded role in the detailed review and analysis of the reports will begin to shorten OSMA's response time for these reviews.  
(Action 5: Projected completion - January 2009.)

#### **2008-02-08, NASA FALL PROTECTION STANDARD**

The ASAP recommended that the new NASA Fall Protection Standard resulting from a 2006 fatal accident be accelerated to take effect well before the 2010-2011 currently projected and that the key elements of this standard be mandatory (with waiver capability) NASA-wide rather than advisory.

#### **Status**

Open

#### **NASA Response**

NASA agrees with the ASAP recommendation that an upgrade is needed in NASA-wide policy to ensure full implementation of Federal regulations on fall protection. The Office of Safety and Mission Assurance (OSMA) is currently establishing a NASA-wide fall protection policy in NASA Procedural Requirements (NPR) 8715.3 that will be based on requirements being worked by the Kennedy Space Center (KSC) for inclusion in KSC Procedural Requirements (KNPR) 8715.3. The proposed policy in NPR 8715.3 will mandate that NASA Centers become compliant with 29 Code of Federal Regulations (CFR) 1910 (General Industry), 29 CFR 1926 (Construction Industry), and the American National Standards Institute (ANSI) Z359.1 (Safety Requirements for Personal Fall Arrest Systems). The goal is for the NPR 8715.3 change to be submitted to NASA Online Directives Information System (NODIS) in December 2008 for official review. The NODIS review schedule for a December 2008

submission projects approval in March 2009. A one-year period for implementation will be posed for compliance. If all goes as stated, the NASA Centers would attain compliance by sometime in the spring 2010 timeframe.

#### **2008-03-01, ASSESSMENT OF THE MARSHALL SPACE FLIGHT CENTER INDUSTRIAL SAFETY PROGRAM**

The ASAP recommends that the staff of the NASA Chief of Safety and Mission Assurance should assess the Agency-wide applicability of the MSFC approaches for implementing a successful industrial safety program.

##### **Status**

Closed

##### **NASA Response**

The MSFC presentation provided to the ASAP in July 2008 (Reference: Presentation to ASAP by Mr. Ed Kiessling entitled “MSFC Industrial Safety Program” July 2008) explains the MSFC approach for implementing the safety requirements of NPR 8715.1, NASA Occupational Safety and Health Programs (NASA’s implementation of 29 CFR 1960, Basic Program Elements for Federal Employees, Occupational Safety and Health Programs and Related Matters) and NPR 8715.3, NASA General Safety Program Requirements. These requirements have Agency-wide applicability—they are the fundamental requirements of NASA’s safety program that all Centers are expected to follow. MSFC’s approach is a very good implementation of NASA’s safety program, and it has been shared across the Agency. It is very similar to a longstanding Ames Research Center Safety Accountability Program that was also shared and adapted by several Centers for their use.

All Center safety offices are encouraged to share their approaches across the Agency, and all have done so. In addition to general information dissemination techniques, such as e-mail and Web sites, NASA convenes its safety and health managers annually to discuss problems, solutions, and best practices. These detailed briefings are captured and posted online for all to use.

#### **2008-03-02, INDUSTRIAL SAFETY PERFORMANCE METRICS**

To expedite future ASAP site visits, the Panel recommends that other Centers present leading and lagging industrial safety performance metrics similar to those tracked by the Marshall Space Flight Center (MSFC), establishing a basis for discussions with the ASAP. This approach would give the Panel opportunities for gaining a better, more consistent understanding of safety processes; improving the bases for comparing and contrasting programs; and perhaps also supporting NASA cross-pollination of good ideas.

##### **Status**

Open

##### **NASA Response**

NASA agrees that the MSFC safety performance metrics presentation to the ASAP provided a solid framework for discussion. The Office of Safety and Mission Assurance provided a copy of the material that MSFC presented to the recent ASAP meeting to all Centers, indicating that the use of this format was an ASAP-preferred practice.

Agency safety metrics are also posted on the NASA Safety Center Web site at: <http://nsc.nasa.gov/>. There are summary charts posted that compare Center performance in lost time cases, mishaps, close calls, and property damage; provide Agency aggregate data on the Occupational Safety and Health Administration recordable accident sources (both civil service and contractor); and provide individual Center reports on lost time injury rates. The ASAP is welcome to observe these metrics to evaluate whether the information might provide the insight and comparison they are seeking. It is Agency practice not to use these data to compare and contrast Center progress as this is counterproductive for a mishap prevention program, and promotes the wrong kind of competition, and drives down the necessary reporting of mishaps. Our expectations are for the Centers to achieve a continuous improvement in their mishap experiences based on their past records.

#### **2008-03-03, CONSTELLATION APPROACH TO INTEGRATION**

The ASAP agrees with the new Constellation Program approach to integration, which places NASA in the position of prime systems integrator, but the Panel notes that it is a high-risk proposition. Although NASA and the Marshall

Space Flight Center deserve high marks for a good start, the ASAP recommends that this Panel and others should continue to closely monitor the progress of Constellation Program operations for years to come.

**Status**

Closed

**NASA Response**

Concur with recommendation..

NASA will work with ASAP to identify critical areas of importance.

**2008-03-04, BASE REALIGNMENT AND CLOSURE IMPACT ON MARSHALL SPACE FLIGHT CENTER**

The ASAP concluded that planning for BRAC moves to the Huntsville area is lifecritical at Marshal Space Flight Center (MSFC), so (1) the Center should review Constellation and other core ongoing programs to identify key and critical personnel whom the Center absolutely must retain to deliver required Constellation Program services; and (2) to protect the integrity of the Constellation Program and level the employment playing field with the Department of Defense, MSFC should immediately request Government waivers from term appointment constraints and from retirement salary reduction offsets.

**Status**

Open

**NASA Response**

(1) the Center should review Constellation and other core ongoing programs to identify key and critical personnel whom the Center absolutely must retain to deliver required Constellation Program services;

The BRAC presents NASA/MSFC with critical workforce challenges. As a part of the MSFC workforce planning process, the Center identified Constellation and other core ongoing programs listed below:

<b>Constellation Systems Program</b>	<ul style="list-style-type: none"> <li>Program Integration</li> <li>Ground Operations</li> <li>Orion Crew Exploration Vehicle</li> <li>Ares I Crew Launch Vehicle</li> <li>Altair Lunar Lander</li> <li>Ares V Cargo Launch Vehicle</li> <li>Lunar Surface Systems</li> <li>Constellation Systems Program Support</li> </ul>
<b>Science</b>	
Lunar Science Program	<ul style="list-style-type: none"> <li>Lunar Management</li> <li>International Lunar Network</li> </ul>
Discovery Program	<ul style="list-style-type: none"> <li>Discovery Management</li> </ul>
New Frontiers Program	<ul style="list-style-type: none"> <li>New Frontiers Management</li> </ul>
<b>Space Operations</b>	
	<ul style="list-style-type: none"> <li>Space Shuttle Program</li> <li>International Space Station Program</li> <li>Michoud Assembly Facility Operations</li> </ul>

Attachment 1 includes a listing of critical competencies the Center believes it must retain to deliver mission requirements. The document includes a listing of core and unique competencies required to deliver on the MSFC mission and goals, the positions that currently maintain the core and unique competencies, the MSFC directorate, and the number of employees that are needed to maintain those core and unique competencies. In order to maintain key and critical personnel, MSFC is implementing a mitigation strategy that includes the following activities:

- Strategic hiring initiative. MSFC implemented a strategic hiring initiative for FY08 to help compensate for BRAC-related challenges. Maintaining a high fill rate and a pipeline of core competencies will be necessary for the next couple of years to help the Center withstand the pressures of BRAC and to ensure the optimum number of critical skills available in the workforce to meet current and future mission requirements. MSFC's hiring strategy focuses on building the core competencies needed today and in the future. The Center is closely monitoring that strategy during this time to ensure that a viable plan is in place to manage the supply and demand environment.
- Managing critical positions and key personnel strategically by:
  - Converting existing term employees to permanent positions as feasible in critical competency areas.
  - Initially filling some critical competency positions as permanent appointments rather than filling as term and then converting at a later date.
  - Effective use of pipeline programs (e.g., increasing potential pool of entry-level candidates for future position vacancies by increasing co-op allocations from 48 to 60 for FY09.)
  - Hiring in critical competencies to compensate for projected BRAC-related attrition.
  - Using Flexibility Act incentives where feasible to acquire and retain critical competencies.
  - Developing employees in critical competencies so the Center does not have single point failures in its workforce.

While BRAC presents definite workforce challenges to MSFC, the Center is continually reviewing options to mitigate these challenges to ensure capability to meet mission requirements in a very dynamic workforce environment.

(2) to protect the integrity of the Constellation Program and level the employment playing field with DoD, MSFC should immediately request Government waivers from term appointment constraints and from retirement salary reduction offsets

In an effort to create greater flexibility in the Agency's workforce to respond to evolving program needs, NASA has implemented term appointment goals for the Centers. The Agency is monitoring the BRAC effect closely at MSFC and will revise those goals if necessary.

NASA currently has the authority to waive the salary offset for reemployed annuitants for acquisition positions. All other requests for waivers of salary offset in other positions require Office of Personnel Management (OPM) approval. NASA has previously proposed legislation that would give the Agency broader authority to waive the salary offset for nonacquisition positions. Historically, OPM has objected to granting individual agencies such broad-reaching authority, and the legislation did not go forward. The Office of Human Capital Management has resubmitted the proposed legislation in FY09.

#### **2008-03-05, OPEN CAIB RECOMMENDATIONS**

In accordance with its mandate, the ASAP will continue to monitor new developments relevant to the three CAIB recommendations that have not been closed out, but the Panel does not have the resources necessary to conduct the extensive review and analysis necessary to recommend closeout. NASA must decide whether to accept the risks associated with the remaining three CAIB recommendations before the Panel can decide whether to concur.

#### **Status**

Open

#### **NASA Response**

NASA has made significant progress on the three open CAIB recommendations since the STS-114 Return to Flight (RTF) mission in July 2005. NASA accepts the risk associated with the three remaining CAIB recommendations. Even though NASA accepts these risks, we are not done and will continue to investigate, learn, and improve our risk posture.

#### ***External Tank (ET) Thermal Protection System (TPS) Modifications***

Prior to RTF, the External Tank Project made significant redesigns to the ET: Longerons closeouts were removed and replaced, intertank/LH2 tank flange closeouts were enhanced, the LH2 Protuberance Air Load (PAL) Ramp

(forward 10 feet) was removed, LO2 feedline fairing cameras were added, venting on the intertank foam was increased, bipod fitting and TPS closeouts were redesigned, and LO2 feedline bellows TPS drip lip (3 stations) and heaters were added. Improvements—standardization and demonstration pours—were also made to many foam application processes. Following STS-114, foam loss events indicated additional improvements were required to reduce flight risk.

This led to a second phase of redesigns: LH2 and LO2 PAL ramp removal (for debris mitigation), increased venting in the intertank foam and bipod harness modifications (also for debris mitigation). These redesigns were implemented on the STS-121 flight, the flight after STS-114. The results of these changes have significantly mitigated critical debris shedding. Hardware and process changes implemented since RTF have performed nominally, and no releases of critical debris have occurred since STS-114. Since removal of the PAL ramps for STS-121, the largest piece of foam released since RTF is more than 25 times smaller than the 1.67 pounds of foam that liberated and struck Columbia in February 2003. The effort does not stop here.

Since the first two RTF flights, the Shuttle Program has continued its efforts to understand foam shedding and eliminate the primary causes and improve ET designs. Following STS-114, an ET Tiger Team was established to determine the cause of unexpected debris from the STS-114 LH2 ice/frost ramps (IFR) and surrounding acreage. The Tiger Team used the ET-120 tank, originally slated for STS-114, as a test bed for dissecting foam from the IFR area. The dissections revealed delaminations and voids in the acreage foam. The ET Project developed IFR assessment/ decision logic (roadmap) to guide decisions and solidify potential mitigations. Testing included: producibility demonstrations, use of cryo panels to determine design effectiveness, wind tunnel testing to assess aerodynamic performance, and thermal vacuum testing to determine acceptability of testing in ascent environment. The testing resulted in a better understanding of the cause of debris shedding, improved TPS divot modeling, and subsequent repairs made to eliminate voids in the foam.

Although the ice-frost ramp redesign was clearly demonstrated to be a success when flown on STS-120/ET-120, the ET-128 (STS-124) was the first “in-line” production tank incorporating all the debris mitigation redesigns implemented since RTF. ET-128 final assembly utilized improved process controls including the use of mats to help eliminate foam crushing. Major debris mitigation changes included the redesign of the LO2 feedline bracket (titanium) and TPS (four locations) and the redesign of the LH2 pressline hardware and IFRs (17 locations). (The IFR redesign was intended to reduce IFR adjacent acreage and IFR body TPS debris as well as aid in further understanding critical foam loss failure mechanisms.) Major productivity changes included the resizing of the +Z LH2 barrel panels (10 of 32 panels) and substitution of Aluminum (Al) 2195 with Al 2219 on 12 LO2 aft dome gore panels (12) and the LO2 aft dome cap (which was also resized). The post-flight performance assessment verified that all systems performed nominally and resulted in no Launch Commit Criteria (LCC) or Operational Maintenance Requirements and Specification (OMRS) violations and no In-Flight Anomalies (IFA).

The changes and improvements indicated above will continue to be evaluated against flight performance through the remainder of the Shuttle Program. Design changes will be made to keep risk at a minimum acceptable level to ensure safe flight.

### ***Orbiter Hardening and TPS Impact Tolerance***

The Space Shuttle Program has initiated a program appropriate for the remaining service life of the Shuttle and has hardened critical areas of the TPS. The areas initially identified for improvement (and all are now complete) were: Main Landing Gear Door (MLGD) corner void elimination, Forward Reaction Control System (FRCS) bonded stud elimination, wing spar protection, and thicker window modifications. The introduction of a hardened tile, BRI-18, to replace tile in the top five priority areas (MLGD, ET door and Leading Edge Support Structure (LESS)) is now complete for OV-103 and OV-104, and continues in work on OV-105. Additionally, the use of BRI-18 in lower-priority areas is being aggressively implemented. In addition to hardware modifications, the Shuttle Program has and continues to develop models for damage assessment purposes and maintains a database of damage allowable maps and site specific assessments. The damage assessment tools are configuration controlled and updated based on flight experience. During Shuttle missions, a Damage Assessment Team (DAT) provides real-time assessment of any TPS damage noted on ascent or on-orbit, including assessment uncertainties to the Mission Management Team.

NASA has taken a very proactive stance in determining the cause of RCC Silicon Carbide (SiC) liberation. In November 2007, NASA formed a Tiger Team to determine, to the extent possible: the mechanism and root cause of RCC SiC coating liberation at the slip side joggle area; through inspection, test, and analysis, establish pass/fail criteria for suspect coating areas that allow removal and replacement of Orbiter RCC before flight; and identify



threats to spares and recommend a replenishment strategy to the United Space Alliance logistics based on the root cause identification and inspection strategy.

While the investigation is still ongoing, the Space Shuttle Program (SSP) has taken several steps to ensure that risk is mitigated: The SSP inspects, removes, and replaces panels with indications greater than 0.2 line scan magnitude (Wf) from the vehicle (10 panels have been removed from the fleet to date); and six new panels have been procured to maintain a fleet-wide spare inventory of at least one panel per location.

#### ***TPS On-Orbit Inspection and Repair (repair portion only; inspection portion met)***

The SSP has continued to improve its repair capabilities. We currently have an operational capability to repair the most likely damage using one of the following:

For Tile Repair: Emittance Primer Coating for minor tile coating and shallow tile damage; Tile Repair Ablator Dispenser (T-RAD)/STA-54 for limited volume tile damage and door seal penetration; and Government Furnished Equipment (GFE) Tile Overlay Repair (GTOR) for large tile damage or missing tiles.

For RCC Repair: Non-Oxide Adhesive Experimental (NOAX) for coating loss, cracks, gouges, and small holes less than 0.5 inches; and plugs for intermediate size holes of approximately one to four inches.

NASA has successfully developed three on-orbit tile repair systems and two on-orbit RCC repair systems. TPS repair hardware has flown on all flights post STS-114. Successful ground tests and on-orbit tests provide the additional confidence that each of the repairs can be implemented on-orbit and serve its repair function for the intended design requirement.

The SSP began working tile repair options as part of return to flight. It proved to be a difficult task, particularly in being able to “certify” a repair capability. In spite of this, the SSP continued to develop a suitable dispensing tool for the STA-54 tile repair material. The dispenser, known as T-RAD (Tile Repair Ablator Dispenser) was manifested on STS-120 as a Detailed Test Objective (DTO-848) but was postponed due to ISS solar array repair. The DTO-848 was successfully conducted on STS-123. The DTO had six test objectives designed to evaluate multi-depth damage, characterize adhesion properties, and demonstrate that EVA techniques are adequate. The samples repaired during the STS-123 DTO were subjected to arc-jet testing, and the results recently presented. The samples dispensed on orbit and those dispensed on the ground were both subjected to arc jet testing and both ground and space-based repairs passed thermal testing, showing similar thermal and swell properties. This was an important finding as it allows test results from real-time ground prepared samples to be used to evaluate and assess the effectiveness of an on-orbit STA-54 repair. T-RAD/STA-54 will be manifest on each of the remaining Shuttle flights.

The Space Shuttle Program is a learning organization and continues to work to improve our risk posture in all areas of accepted risk, including the three areas above. Through every flight, we better understand our systems and the risks associated with operating in the integrated environment in addition to testing and analysis of every anomaly. NASA accepts the risks associated with the three CAIB recommendations that were not closed by the Return to Flight Task Group.

#### **2008-03-06, HUMAN-RATING REQUIREMENTS BRIEFING**

When the timing is appropriate, the ASAP requests a briefing from NASA on the new, recently published NASA Human-Rating Requirements NASA Procedural Requirement (NPR) 8705.2.

#### **Status**

Closed

#### **NASA Response**

The Human Rating Requirements for Space Systems, NPR 8705.2, became effective on May 6, 2008. The Office of Safety and Mission Assurance, as the Office of Primary Responsibility for the NPR, provided a briefing to the ASAP during the ASAP’s October meeting at the Ames Research Center. Mr. O’Connor, Chief Safety and Mission Assurance, and Mr. Jett from the Flight Crew Operations Directorate at the Johnson Space Center provided answers to additional questions concerning the Human-Rating NPR during the ASAP’s December meeting at NASA Headquarters.

NASA understands that the ASAP has additional questions concerning implementation of the Human-Rating NPR and will provide a follow-up briefing at a mutually convenient time.

### **2008-03-07, ARES I THRUST OSCILLATION RISK-BASED ANALYSIS**

The ASAP recommends that NASA perform an updated risk-based analysis in the near future to assess the crew-performance impacts of thrust oscillations generated within the Ares I Solid Rocket Motors. This timely analysis will enable NASA to quantify, manage, and if necessary mitigate operational risks associated with such oscillations.

#### **Status**

Open

#### **NASA Response**

NASA concurs with the recommendation. Based on the probabilistic analysis of 42 four-segment and one five-segment solid rocket motor ground tests, unmitigated oscillations on the crew are predicted to exceed the current Human System Interface Requirements (HSIR) crew health limit. In the 99.865 probability case, crew accelerations are predicted to be above 5 gs in the worst seat location. The equivalent HSIR crew health limit is 3.7 gs. As a guideline for the analysis of thrust oscillation mitigation options, the Constellation Thrust Oscillation Focus Team used the crew performance limit, set by Gemini, of 0.25 gs in the X or chest in/out direction. Even though crew accelerations above 0.25 gs do not necessarily pose a crew health concern, past data has shown that the crew's ability to perform visual and manual tasks, as well as speech, is degraded. An additional concern is that there could be residual effects due to the short-duration oscillations, just before booster staging, that would affect crew performance during second-stage flight when crew intervention is possible. Because these effects are not well defined, it has been determined that additional data is required to provide input to the crew risk assessment.

Tests have been performed at the Ames Research Center centrifuge facility to provide quantitative data to support crew performance effects. These tests include the effects of both steady-state accelerations and oscillatory accelerations due to thrust oscillation, eliminating the variable of body impedance created by the steady-state acceleration. The findings were presented at the Ares PDR +90 day review and serve as a key parameter in determining risk to crew performance.

During the test, subjects were accelerated to a steady state of 3.8 gs and simultaneously vibrated for 145 seconds at 0, 0.15, 0.3, 0.5, and 0.7 gs. Test subjects were asked to perform a number reading tasks with 10 point and 14 point font sizes. The study indicated that for the 10 point fonts, the error rate (ER) and response time (RT) at 0.15 and 0.3 gs were not significantly different than 0 g. For the 14 point fonts, the ER and RT at 0.15, 0.3, and 0.5 gs were not significantly different than 0 g. Also, the study indicated that ER and RT return to zero-vibration levels as soon as the 145-second vibration stops indicating no evidence of statistically significant reading task performance (ER or RT) aftereffects after vibration is stopped.

A thrust oscillation risk mitigation analysis was conducted by the Constellation program wherein they analyzed two Ares thrust oscillation mitigation options: (1) passive aft skirt Tuned Mass Absorbers (TMAs), coupled with passive interstage/frustum Isolators; and (2) active aft skirt Reaction Mass Absorbers (RMAs) coupled with passive interstage/frustum Isolator. The focus of the analysis was on the situational awareness of crew and their ability to perform abort during a thrust oscillation event. All design solutions under consideration meet or exceed the crew safety risk requirements. The analysis concluded that thrust oscillation would occur on every flight. However, getting thrust oscillations at the critical levels greater than 3.7 gs are a noncredible event with either passive or active mitigation. Additionally, having an event that the crew has time to respond to (greater than a 2.0-second RT) and having it occur within the time window (even when conservatively expanded to 50 seconds to include crew aftereffects) is a very low probability occurrence of 1/150,000 for passive mitigation options.

In parallel, the Ares project is proceeding toward a System Definition Review of a mitigation strategy that will reduce crew accelerations due to the thrust oscillation being down to 0.25 gs using passively controlled absorber designs. Designs include a passively tuned vibration absorber designed to counter the force generated by pressure oscillations in the motor. Additionally, an isolation system between the Ares first stage and upper stage is designed to reduce the coupling between the solid motor frequency and the natural dynamic frequency of the integrated Ares and Orion vehicle. By moving the natural frequency of the vehicle by reducing the structural stiffness, the response to the solid motor frequency is greatly reduced.



The Orion project is defining follow-on human testing designed to understand the impacts of the launch acceleration and vibration profile on crew performance. Additionally, they are developing an integrated cockpit design that maximizes crew performance throughout all mission phases, including the five to ten seconds where thrust oscillations peak.

The Constellation program and projects recognize that better understanding the impacts of thrust oscillation on crew, as well as maturing passive mitigation designs, decreases the risk to the program as it progresses toward the first human mission, planned for March 2015.

#### **2008-04-01, NASA-WIDE UNDERSTANDING OF THRUST OSCILLATION CONCERNS**

The ASAP notes that there is not a consistent Agency-wide understanding of the technical concerns associated with thrust oscillation for the Ares vehicle, especially with respect to the impact on crew performance due to the immediate and residual effects of launch vibration and acceleration. The ASAP therefore recommends that NASA ensure that all concerns are appropriately evaluated and communicated to stakeholders and that a consensus exists on the rationale for the solutions ultimately adopted.

##### **Status**

Open

#### **2008-04-02, HUMAN-RATING REQUIREMENTS GRAYBEARD REVIEW**

The ASAP recommends that NASA obtain greater validation that the new Human-Rating Requirements Standard meets the safety requirements of a broad range of future human spaceflight programs by scheduling an external review by an independent “gray-beard” assessment panel.

##### **Status**

Open

#### **2008-04-03, HUMAN-RATING REQUIREMENTS GUIDELINES AND TRAINING**

After the Human-Rating Requirements Standard is reviewed and validated, the ASAP recommends that NASA develop specific guidelines and tools, widely available training courses, and implementation evaluation criteria that enable system safety and reliability personnel to effectively define and apply the new integrated design and safety analysis approach specified by the standard.

##### **Status**

Open

#### **2008-04-04, CHAMPION FOR HUMAN-RATING REQUIREMENTS IMPLEMENTATION**

The ASAP recommends that NASA designate an office of prime responsibility that will serve as the champion of the Human-Rating Requirements Standard process to ensure that every program and relevant subject-matter expert uniformly, objectively, and aggressively implements the new NPR 8705.2B standard.

##### **Status**

Open

#### **2008-04-05, COMMUNICATIONS ON EXECUTIVE SAFETY COMMITTEE ACTIVITIES**

The ASAP recommends that the Executive Safety Committee (ESC) at each NASA Center ensure that the Center Director is fully informed about ESC activities and conclusions.

##### **Status**

Open

**2008 ACTIVITIES OF THE  
AEROSPACE SAFETY ADVISORY PANEL**

**First Quarter Meeting**

Kennedy Space Center  
Merritt Island, FL  
February 12-13, 2008

**Second Quarter Meeting**

NASA Headquarters  
Washington, DC  
May 21-22, 2008

**Third Quarter Meeting**

Marshall Space Flight Center  
Huntsville, AL  
July 16-17, 2008

**Fourth Quarter Meeting**

Ames Research Center  
Moffett Field, CA  
October 22-23, 2008

**Insight Meetings (Site Visits)**

Langley Research Center  
Wallops Island, VA  
March 11, 2008

Johnson Space Center  
Houston, TX  
June 16, 2008

Goddard Space Flight Center  
Greenbelt, MD  
September 24, 2008

NASA AEROSPACE SAFETY ADVISORY PANEL  
National Aeronautics and Space Administration  
Washington, DC 20546  
VADM Joseph W. Dyer USN, (Ret.), Chair

July 3, 2008

The Honorable Michael D. Griffin  
Administrator  
National Aeronautics and Space Administration  
Washington, DC 20546

Dear Dr. Griffin:

The Aerospace Safety Advisory Panel held its 2008 First Quarterly Meeting at the NASA Kennedy Space Center on February 12-13, 2008. While at KSC, the Panel heard updates on the Orion project configuration; the NASA Safety Reporting System; and the status of KSC's Human Capital, Safety, and Constellation programs.

The Panel submits the enclosed Minutes with Recommendations resulting from this meeting for your consideration.

Sincerely,

A handwritten signature in black ink, appearing to read "J. W. Dyer". The signature is fluid and cursive, with a large initial "J" and "W".

Joseph W. Dyer, VADM, USN (Ret.)  
Chair

Enclosure

**Aerospace Safety Advisory Panel  
2008 First Quarterly Meeting  
Minutes and Recommendations**

**Aerospace Safety Advisory Panel Public Meeting  
February 13, 2008  
Kennedy Space Center  
Florida Space Port Authority**

**Aerospace Safety Advisory Panel Members Present:**

VADM Joseph W. Dyer, USN (Ret.), Chair  
Ms. Joyce McDevitt  
Dr. James Bagian  
Mr. Randy Stone  
Ms. Deborah Grubbe

**ASAP Staff and Support Members Present:**

Ms. Kathy Dakon, ASAP Executive Director  
Ms. Susan Burch, ASAP Administrative Officer  
Mr. Lester Reingold, Reports Editor

**Public Session Attendees:**

Ms. Launa Maier, Kennedy Space Center  
Mr. Todd Halvorson, Florida Today

**Opening Remarks**

The public session of the ASAP 2008 First Quarterly Meeting was held on February 13, 2008. Topics included a discussion of accident or incident investigation processes and the contrast between the Department of Defense process and the process at NASA. ASAP addressed safety reporting in a general sense, as well.

Adm. Dyer noted that the key to this visit was a review of recent changes to the Orion vehicle design, pursuant to finding the 10 percent weight reductions deemed necessary to its function. The Panel also addressed issues and resource constraints, the transparency of NASA communications to those outside the agency, and policy clarity.

The KSC Center Director, Bill Parsons, briefed the Panel on the STS-124 flight. Mr. Parsons noted that the STS-124 is the first to have an external fuel tank from the new production line, with all known fixes aboard. Tanks flown on recent missions have had fixes incrementally incorporated; however all the modifications developed to date were incorporated in the production for STS-124. The Panel viewed this as significant progress.

Mr. Parsons noted that work continued on the Ares experimental vehicle and that progress on workforce management is still very much a challenge. The transition between Shuttle phase-out and the stand-up of the new programs represents an opportunity for great analysis and great management, still to be encountered. Viewed in this context, the Panel and NASA management strongly believe that the 2010 shut-down of the Shuttle program needs to stand firm. If one looks at the tiering of suppliers, skill mixes, and personnel retention, the safety implications in extending Shuttle beyond 2010 would represent significant risk.

## **Orion Project Configuration**

### **Mass-Scrub or Zero-Based Process Associated with Vehicle Design**

Mr. Stone observed that in 2007, the weight of the Orion spacecraft became a critical issue. The vehicle was over the design maximums and gave the program no growth margin for surprises. Thus, a methodology was developed to reduce the vehicle weight. The ASAP became interested in the design process as it had originally been presented as a zero-based vehicle; i.e. minimally functional. The new design supported life, and had communications and attitude control systems, but it became clear to NASA that such a vehicle would be unacceptable from a safety perspective in any space mission. The program realized that this minimum zero-based vehicle was not the answer, but the bare-bones design did present a basis for a new design process, allowing the program to add features back to the vehicle to achieve the desired functionality in a very rigorous manner, and within acceptable weight margins.

Associated with weight margin and redundancy is the evolution of the human-rating requirements that NASA has upheld for several years. This evolved human-rating requirement states that one will have no less than one fault tolerant for the prevention of a catastrophic hazard that would result in loss of vehicle or the crew; this philosophy is somewhat of a departure in thinking from the way that the Shuttle was designed from a systems perspective. Clearly the Shuttle had items that were not greater than single-fault tolerant -- in structure as an example -- but in systems, the Shuttle had a set of redundancy requirements based on safety criticality. The new human-rating requirement approaches redundancy in a different fashion. One may end up with redundancy similar to that of the Shuttle, but this is not required.

For Orion, the program developed a series of analysis gates that the design team used to put hardware back onto the vehicle to achieve acceptable safety requirements for the crew and the vehicle, and mission success. The Panel believes that the new design has considerable engineering rigor and the Panel conceptually agrees that project will be able to produce a vehicle that is acceptable within the human-rating requirements. The Panel shall continue to work with the program to gain insight into the interplay between design, human rating requirements and system weight. The Panel believes it is going to be a maturing process and that it will be important for the Panel to understand the implications of reduced fault tolerance on the Orion vehicle.

Adm. Dyer noted that while the Panel is encouraged by these developments, there are still concerns. For example, weight growth in the early design phase is driving a set of engineering trades on the vehicle. Adm. Dyer provided by way of analogy the spotty safety history of vertical-take off aircraft such as the AV-8B Harrier jump jet. He noted that one inherent problem with such vehicles is that their design is strongly driven by weight considerations due to the limitations of thrust, and the requirement to take off and land vertically. As a result, vertical take-off vehicles are always faced with a requirement to reduce weight. The zero-based approach, or "mass-scrub" as NASA now calls it, is a very cogent way to approach the design. But success assumes good knowledge of the future. One has to add back weight where it is required in order to increase safety. This case is in contrast to the more classic approach where the design team has more redundancy and where weight is not as much of an issue. In the classic case, embedded safety factors can often address challenges the design team did not anticipate. However, when one does a zero-based build-up, there is more risk because one uses judgment to make an assessment as to where to put the weight. This does not mean a zero-based approach cannot be successful; it certainly does not mean that it is not cogent, but given the restrictions on weight, it does make one a little more nervous with regard to the future. Ideally, one would like to have more weight margin. However, the Panel and the world's best engineers are working the problem, and Adm. Dyer expressed confidence in the outcome.

### **Risk Leveling Strategy**

Ms. Grubbe addressed how NASA is approaching reducing Orion vehicle-risk both at a macro- and micro-level. From a general perspective, Ms. Grubbe believed NASA was thinking about the subject in

the absolutely correct way. NASA is looking at fault tolerance very systemically and ruggedly versus merely building in redundancy, the latter of which does not necessarily yield the most elegant and appropriate design. At the micro-level, Ms. Grubbe praised the integrated nature of the design process, especially the in the development of workforce skill sets and the inclusive nature of the teams. Ms. Grubbe was pleased to note that NASA has chosen the right set of brains around the table to address the design process.

Ms. Grubbe made two additional comments in this area: the Panel really does need to ensure that as NASA goes through these decision processes and discussions, that it must adequately document and keep track of the decisions and the documents. NASA must go beyond simple documentation and keep actual track of both how and why risk decisions were made and why the decisions were made the way they were. In the event of an incident, one wants to be able to look back and analyze it in a very complete way so that one may better repair the problem. Ms. Grubbe also asked that NASA consider a proactive communications plan regarding risk, including the risk assessments conducted and the resultant failure tolerances. Ms. Grubbe emphasized the importance for both the Panel and for NASA to outline this process to its major stakeholders so that all the major stakeholders have appropriate expectations.

### **Loss of Crew and Loss of Mission Analysis**

Dr. Bagian praised NASA's new systems-based approach to developing human-rating requirements, adding that overall system robustness and reliability is more important than simply adding layers of redundancy. In the past, NASA "stovepiping" would provide multiple redundant solutions without an overall systems view. Dr. Bagian likened the process to flying 10 redundant batteries or one redundant battery for a device with a ten percent risk of failure. In this case, one would carry not 10 batteries, but only one redundant battery. He also agreed with Ms. Grubbe's comment about NASA needing to be more explicit in communicating the determination of acceptable performance standards, both in terms of risk for crew or mission loss: the targets for each of these scenarios are different from what is minimally acceptable. While Dr. Bagian recognized that it is still too early to have that total definition, NASA must be sure that as it advances the design, the process must be predicated on both realistic targets of achievement versus minimally acceptable designs, so as not to run the risk of confusing the two. This becomes a communication risk both externally for credibility, but also internally. Pointing out the need to establish targets and minimal levels would encourage free discussion among the various design participants at both the program level and the safety requirement level. Program targets and minimal acceptable thresholds are very different: Safety is going to be concerned about minimal thresholds and the program is concerned with the achievements possible. The end result should be more than the minimum, of course, thus the Panel felt that as the program moves forward, it should not wait too long to explicitly define what these various levels are. The design process must be very clear to enable program designers to harness their efforts to support this new, proactive sort of risk assessment approach.

Ms. McDevitt noted at this point that the Panel is concerned that NASA has not yet quantified its risk assessment approach with respect to human-rating policy. This numerical goal and quantification of unacceptable risk levels will eventually need to be addressed. The Panel has been told that the requirement of such quantitative analysis is currently not in NASA policy, but has been imposed by the management of the Constellation program.

Dr. Bagian referenced his participation on a 2002 National Research Council panel on the International Space Station. One of the questions addressed by this panel was the three-person versus six-person crew. The ISS does not have a six-person crew because of the inability to evacuate the entire crew in the case of an adverse event. However, there is no actual requirement in the ISS program stating this reasoning; there is no decision tree explicitly stating intelligent trades, specific risk assessments and particular mission standards. How do we accomplish these proactive risk assessments if we do not know what the standard is? This is a current theme that needs to be addressed.

Ms. Grubbe noted that this leads to a discussion with respect to precision and accuracy: One can set numerical targets. When does one need to be accurate or when does one need to be precise? That is a difficult conversation to have and sometimes we do not get it right on the first pass either.

Dr. Bagian noted that introducing redundancy resulted from the desire to address “unknown unknowns”, and that policy had been weighted more to specifying a particular level of redundancy, which NASA felt to be an appropriate approach.

Adm. Dyer commented that NASA must develop a crisp answer to the survivability requirement for Constellation. That number will be key to an understanding of risk and a key to communicating with the public on the issue of risk tolerance.

### **Safety Reporting System**

Ms. McDevitt noted that the Panel reviewed the NASA Safety Reporting System (NSRS), an anonymous and voluntary reporting channel to NASA’s upper management regarding concerns about hazards. The NSRS was patterned after the NASA/ Federal Aviation Administration (FAA) Aerospace Safety Reporting System that was established in 1987 after the Challenger accident. It is promoted throughout NASA and NASA contractors with posters and brochures in every building. The brochure promises a protection of anonymity, but it is important to know that no statutory requirement exists that guarantees this anonymity. Ms. McDevitt expressed concern that in the analysis and investigation of NSRS reporting, it is nearly impossible to maintain anonymity in some cases. This raises credibility and trust issues.

The Panel suggested that the wording of the NSRS policy should be stated differently, suggesting that NASA “would do its best” to maintain anonymity. The Panel also suggested NASA take a look at how the NASA/FAA Aerospace Safety Report System currently handles anonymity issues. The Panel is also concerned that privacy matters may be promoting an unnecessary cloak of secrecy around the safety information that is being provided. This is a supplemental report that one can resort to outside of the local hazard reporting channels. It was intended to solicit input of those people who were afraid to speak up for fear of reprisal. There may be value in the report that is being submitted as part of the overall safety management system. The Panel would like to get more information to see if the information that is being provided might have such a value.

The overall safety management information system consists of mishap reports and close calls, along with other types of safety reporting such as project and staff weekly and monthly reports and audit results. There might be some coordination of NSRS reports with the reports that are being done locally to see if NSRS is truly serving its purpose as a safety valve. There might be audit inputs when you look at all the different clues that you have out there from the safety efforts that are ongoing. This auxiliary information might point one toward eliminating some hazard causes or a better sharing of lessons learned. In its current form, the information just stifles any possible sharing of useful safety information.

The Panel suggested that in conjunction with the Office of Safety and Mission Assurance at Headquarters, that the Panel pursue a review of the closed NSRS reports to see if they have potential value in NASA’s wider safety management information system in improving information dissemination to those folks that are involved in the business. Ms. Grubbe added that private industry has hot-lines and it might be helpful to do a little benchmarking with respect to these. Ms. McDevitt agreed that Ms. Grubbe’s suggestion would be added to the Panel’s recommendation. In discussing benchmarking, clarification will be needed on policy as to what the purpose of the NSRS really is. Is it simply a safety valve or does it have meaningful information as a vulnerability tool? Ms. Grubbe agreed; information can be used to reflect

safety concerns, thus it should flow up in multiple places. She added that she did not get the sense that all the available data is truly being collected and examined for trends.

Dr. Bagian emphasized that NSRS must be defined more clearly as to its guarantee of anonymity or lack thereof. Currently, it is easy to read the tea leaves to know who reported what. The point is to be clear about the policy to help guide how to use that information. Right now it is neither fish nor fowl.

### **Kennedy Space Center (KSC) Safety Program**

Mr. Stone noted that KSC's safety organization has had a number of changes in leadership in a short time period, making for a rather unstable organization driven by the workforce concerns about job stability during the transition from Shuttle to Constellation. In response to this situation, KSC's senior management has put in place a very strong methodology for stabilizing the organization, and moreover has a keen recognition that workforce planning over the next three or four years will be key to making this transition safely, while retaining a skill base for the support of the Constellation program. From that perspective, Mr. Stone believed KSC has made significant progress and with their aggressive planning cycle, they are winning in the arena of having people trained/cross-trained, ready to do the next job that is required.

However, Mr. Stone expressed concern with recent mishap investigations that have sensitized the organization, referring to an incident in which an employee fell and was killed. The observation of the local organization is that the mishap policy requires an independent review team, which is typically assigned out of NASA Headquarters. The center is allowed to participate, but typically Headquarters forms the Chair and membership of the team. This results in a trade of independence versus local technical expertise. Sometimes independence is great but sometimes local expertise is required to delve into a mishap. The fact that it is an independent team is really not a problem if they report and have an ensuing dialogue in a very timely manner with the organization that it affected. When contractors are involved in a mishap, however, they are on the outside looking in and cannot perform corrective actions until they get the output of the report. Because interviewees are protected by privacy rules, the system is closed and there is no sharing of information until the end of the investigation process. The real problem lies in the long time period between the investigation and the final report, leaving the vulnerability that caused the accident to remain. The Panel has therefore concluded that this mishap investigation process is too long and restrictive. Because of the way it is organized and the policy that is in place, the investigation is very difficult to execute in a timely manner. The Panel has a recommendation that NASA reassess the mishap investigation policy to enable a more rapid, expert, and thorough determination of the root cause.

Mr. Stone agreed with the Panel's recommendation to revisit its mishap investigation process, and described the Department of Defense's (DOD) approach to a major hardware loss, or loss of life. Regardless of the complexity of the situation, the DOD requires a 30-day turnaround to start working the corrective action. The Panel should recommend that NASA consider this 30-day hard number for delivering at least a preliminary report, so that dialogue can quickly take place within the affected organizations. Notwithstanding, the KSC safety organization does believe that the mishap investigation process is improving. Type A and B mishaps do not happen very often, but when they do, they should be treated such that the organizations can respond to it with a corrective action plan, the corrective action plan can be monitored, and NASA Management can be assured that the problem is fixed. In summary, the Panel feels these investigations can certainly be more timely, and that more timely determinations are a positive contribution to safety. In addition, NASA could better avail itself of expert knowledge. A step in the direction of transparency would also be positive. Dr. Bagian noted it is important to ensure that the processes and the outcomes are what one intended, which will require constant feedback during the modification of the investigation process.



## **Human Capital**

Ms. Grubbe addressed what has been referred to as “the great crew change” at KSC, which is well in progress. It is very comprehensive at least in intent and vector, and the vector is in the right direction. The workforce planning process appears to be very robust. The plan is in good shape and also mirrors the broader NASA plan, a positive sign that it is not isolated from the rest of the Agency. The fact that there is an overall view that the right kind of thinking is being applied, is very encouraging, and mirrors Ms. Grubbe’s private sector observations. To the credit of the Human Resources (HR) organization at KSC, she noted that there is very good collaboration between NASA and its contractors, which must continue as one looks at the number and timing of required skill sets. If one looks at the labor pool, in a broader sense, one ends up in a better spot to having the needs of all the stakeholders served. Ms. Grubbe further encouraged KSC and the HR organization to be much more aggressive in detailing human capital requirements. The timing of this particular ASAP meeting has not been conducive to uncovering the desired level of detail, therefore the Panel should request follow-up to allow assessment of the different specialties and the differences in availability of the specialties, and the differences in age and sophistication of the specialties. Someone with 20 years of experience obviously has a different level of understanding than someone with three years of experience when it comes to the work itself, risks and hazard awareness. The Panel wants to ensure that KSC is staffed not only with the right specialties but also the right skills that come from being in the saddle for some portion of time, as well as development plans, head counts, and the numerous details involved. Ms. Grubbe felt that KSC was well along in their overall map and thinking and she looked forward to seeing more as time goes on.

## **Status of the Constellation Program with Regard to Infrastructure at Kennedy Space Center**

Adm. Dyer noted that there was a \$1.2 billion dollar infrastructure investment at KSC associated with Constellation, and an impressive approach of using existing facilities and new, specifically program-tailored facilities that will extract the best value for taxpayer dollars. The Panel deemed the program a good plan that was being well managed, and a great example of both systems engineering and stewardship.

## **Budget Issues**

The Panel examined the budget across NASA and the 10 NASA Centers. The Panel indicated a growing concern that fiduciary anxieties are growing in the workforce and leadership earlier in this program than one would typically see. This perhaps does not speak positively to an environment of the very best safety. There will be a follow-up meeting at Headquarters later this year and the Panel will bring up the topic of potential budget shortfall at that time. The Panel has brought this matter up in the past and the Panel noted this as a concern again.

## **Policy Communication and Clarity**

Ms. Grubbe noted that clarity in policy communication is a follow-up item from prior discussions. The Panel would like NASA to provide further details on how it communicates policy, especially on legal and illegal substances, or potential substance abuse. A few years ago there was an incident at KSC involving substance abuse. Has NASA adequately followed up on this incident and communicated lessons learned? Ms. Grubbe stated she firmly believed that policies exist somewhere in the NASA system to address the prohibition of drinking and drugs, for example, on NASA property. The Panel is concerned that there seems to be some confusion as to where definitive statements reside in NASA policy documents on substance use, *per se*. Ms. Grubbe additionally noted that there are still some outstanding actions to be taken with respect to the use of drugs and alcohol, not only on NASA property, but on meals and breaks while one is on duty.

## **PUBLIC PARTICIPATION:**

Ms. Launa Maier, KSC, acknowledged that KSC did indeed have a policy regarding alcohol use on KSC property.

Mr. Todd Halvorson of Florida Today asked, “What does the ASAP think of the current status of the Ares I development, especially in terms of technical challenges of weight margins with the Orion spacecraft and press isolation with the Ares I segment solid rocket boosters and impact on the whole stack?”

Adm. Dyer responded that the Panel is not in line management and would not pretend to be experts in that arena, and expressed confidence that NASA has the best minds available and that they are being applied to the development of Ares I. Mr. Stone added that while he agreed weight margins were a challenge, thrust, Constellation has always had a challenge with respect to thrust. When dealing with large solid rockets, one gets these thrust pulses and typically it can be the design worked with the shape of the propellant to reduce these isolations to a level that is not damaging to the structure. Mr. Stone did not profess expertise but felt that NASA was conducting a very healthy conversation and in-depth analysis to assure they have a good handle on this phenomenon with this large solid stack, and believed it is a engineering challenge that will be solved, and expected it to be a “non-issue” on launch day.

Mr. Halvorson of Florida Today then asked, “What do you think about the importance of stability in the goals that NASA has set out right now? We are in an election year and there is a lot of call for the reshaping of the Vision or a reshaping of the Vision for Space Exploration by different folks across the country or even employing different means for launching the Orion spacecraft. I just want your general thoughts on the importance of stability in NASA programs, particularly in the Constellation program, as a new Administration comes in on January 20, 2009.”

Adm. Dyer responded that stability in design of programs is normally a good thing, while Mr. Stone added that loss of stability costs lots of money. Ms. Grubbe asked if the American people were ready to be second place to the Chinese.

## ASAP Recommendations, First Quarter 2008

1. *Mass Scrub process associated with the Orion vehicle design.* The design team used a set of analysis gates to equip Orion with sufficient hardware to achieve an acceptable safety requirement for the crew, vehicle and mission success. The ASAP believes that this set of analysis gates has considerable engineering rigor and the Panel conceptually agrees with the process the project is using to arrive at a vehicle that is acceptable to the human rating requirements. The ASAP would recommend to the project that the Panel once again snapshot this process.
2. *Orion: NASA's approach to risk both at a macro and a more detailed level.* The Panel must ensure that as NASA goes through the decision processes and discussions in the Orion design process, that they adequately document and keep track of decisions, as well as track the documents used in the process of doing design.
3. *Communication of risk.* The Panel recommends NASA consider a proactive communications plan for the Constellation Program around risks, risk assessments and failure tolerances. The Panel believes that it's important for NASA to outline this process to its major stakeholders so that people and all the major stakeholders have appropriate expectations. As the design advances, the risk process must be predicated on both realistic targets of achievement and minimally acceptable risk levels so as to maintain credibility in communicating risks internally and externally.
4. *NASA Safety Reporting System.* The ASAP reviewed the NASA Safety Reporting System (NSRS). The Panel would like to obtain more information about the system to see if the information that's being provided might have value as part of the overall safety management information system.
5. *NSRS Benchmarking.* The Panel recommends NASA to do a benchmarking of the NSRS. In discussing benchmarking, clarification will be needed on policy as to what the purpose of the NSRS really is. Is it simply a safety valve or does it have meaningful information as a vulnerability tool? Also, in benchmarking, the ASAP recommends that the NSRS review how to define more clearly its guarantee of anonymity.
6. *NASA Headquarters Mishap Investigation.* The ASAP has recommended that NASA re-evaluate its mishap investigation process with an eye to producing report results in a timely manner, and utilizing the appropriate experts for determining root cause. NASA should consider a 30-day hard number for delivering at least a preliminary mishap report, to enable dialogue to begin within the affected organizations.

NASA AEROSPACE SAFETY ADVISORY PANEL  
National Aeronautics and Space Administration  
Washington, DC 20546  
VADM Joseph W. Dyer USN, (Ret.), Chair

July 31, 2008

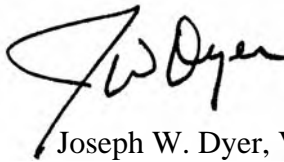
The Honorable Michael D. Griffin  
Administrator  
National Aeronautics and Space Administration  
Washington, DC 20546

Dear Dr. Griffin:

The Aerospace Safety Advisory Panel held its 2008 Second Quarterly Meeting at NASA Headquarters on May 21-22, 2008. We greatly appreciate the support received from NASA subject matter experts, as well as the time you spent with us and your willingness to discuss our concerns open and candidly.

The Panel submits the enclosed Minutes with Recommendations resulting from this meeting for your consideration.

Sincerely,

A handwritten signature in black ink, appearing to read 'J. W. Dyer', is written over a light grey rectangular background.

Joseph W. Dyer, VADM, USN (Ret.)  
Chair

Enclosure

# **Aerospace Safety Advisory Panel 2008 Second Quarterly Report Minutes and Recommendations**

ASAP Public Meeting  
May 22, 2008, 1-3 p.m.  
NASA Headquarters  
300 E Street SW  
Room 9H40  
Washington D.C.

## **Aerospace Safety Advisory Panel Members Present**

Vice Admiral Joseph Dyer, USN (Retired), Chairman  
Dr. James Bagian  
Major General Charles F. Bolden, Jr., USMC (Ret)  
Mr. John Frost  
Mr. John Marshall  
Ms. Joyce McDevitt  
Dr. Don McErlean

## **ASAP Staff and Support Members Present**

Ms. Katherine Dakon, ASAP Executive Director  
Ms. Susan Burch, ASAP Administrative Officer  
Mr. Mark Bernstein, Meeting Reporter

## **Public**

Ms. P. Diane Rausch, NASA  
Mr. Garvey McIntosh, NASA

## **Opening Remarks**

The public session of the 2008 second quarterly meeting of the Aerospace Safety Advisory Panel [ASAP] was held at NASA headquarters in Washington D.C., following two days of meetings on a range of topics. Adm. Dyer expressed appreciation for the support received from NASA subject matter experts, as well as the opportunity to spend significant time with NASA Administrator Dr. Michael Griffin and senior agency leadership.

## **Chief Engineer Introduction**

The ASAP met with Dr. Michael Ryschkewitsch, appointed NASA Chief Engineer in August 2007. The discussion touched on various points, particularly Technical Standards and Technical Authority, with the Panel welcoming Dr. Ryschkewitsch's statement that NASA engineering was increasingly developing an agency-wide perspective. On Technical Standards, the Panel noted Dr. Ryschkewitsch's intention to

adopt established consensus standards [e.g. AIA or SAE] where appropriate, but to use NASA standards where no others existed. The Panel endorsed the Chief Engineer's stated policy to develop interim standards, and then beta test them for one year to gather information prior to their adoption. The Panel expressed satisfaction with the release of Document 7009 on Modeling and Simulation standards, the first mandatory NASA standard applicable to all simulations; that standard is now in beta testing. The Panel agreed the approach being taken would give program managers and chief engineers a consistent basis on which to compare and assess the risk of adopting results from simulations.

The ASAP, in previous meetings, has been attentive to the question of integration and alignment between centers. The Panel noted with approval the attention Dr. Ryschkewitsch has been paying to promoting overall program integration between centers, including the integration agreements that exist between centers to lessen the potential that various parts and components will fail to work as planned. Adm. Dyer said the movement to NASA headquarters of respected technical leaders from the centers, such as Dr. Ryschkewitsch, was a positive step.

Mr. Frost commented on the possible role that could be played by the NASA Safety Center [NSC] in standards development and suggested that they be added for coordination of standards when appropriate. He noted the ASAP discussion relative to how the lessons learned from both successes and failures were placed into 'golden rules': Goddard Space Flight Center [GSFC] had such a set; the Jet Propulsion Laboratory [JPL] had such a set. While he acknowledged that each NASA center at times dealt with matters unique to it, he believed it would be useful to create a mechanism for establishing 'NASA Golden Rules' to be shared agency-wide. Mr. Frost praised the work done on modeling and simulation, saying it was among the best he had seen: if one were to make 'life and death' decisions based on models, it was well to know what level of confidence could be assigned to them. The modeling and simulation proposal called for the creation of a matrix that would classify models as 'green,' 'yellow' and 'red.' Dr. McErlean said it 'extremely important' that common and universally accepted definitions be established as to what each matrix block meant; if an engineer at one center described a risk level as a '3,' this should conjure a shared image with engineers elsewhere.

In closing comments, Mr. Frost noted that the Panel had earlier selected two random examples of issues that had occurred in space flight to determine how these were turned into standards. That process, he said, was still in development; he urged the Panel to continue to monitor the matter to see how lessons learned are documented and applied to current programs in the form of new standards. Ms. McDevitt noted that the agency website on standards presented the consensus standards thus far completed by NASA. The Panel, she added, has been interested that linkage be established with the lessons learned, with those lesson tagged to the appropriate standards. She noted that connecting such things as the JPL work practices to the standards would bring them to a wider audience.

### **Technical Authority Update/Technical Standards Update**

The ASAP was additionally briefed by Mr. Gregory Robinson, NASA Chief Deputy Engineers, on the promulgation of the Technical Authority policy. The Panel expressed satisfaction that NASA's Strategic Management and Governance Handbook [NPD 1000] had been changed: the Technical Authority roles regarding risk have been laid out such that decisions related to technical and operational matters that pertain to safety and mission success risk require the formal concurrence by the cognizant Technical Authority of engineering, safety and mission assurance, health and medical. The Panel believed the Technical Authority program was being promulgated from headquarters and appropriately documented in management documents.

The Panel believed the adoption of the Technical Fellows program had been excellent; these Fellows are discipline experts, tasked with maintaining the competence of work done in their field and with serving as arbiters of technical issues. The Fellows work related to, but was different from, that of the Technical Authority, which was itself a decision node for determining the adequacy of the process followed and the appropriateness of the conclusions reached.

The Panel, however, expressed concern that wide variances existed in how the Technical Authority was being interpreted, both center-to-center and at varying levels within the organization. While the Panel believed there was high acceptance of the concept at the senior levels of the centers, engineers on the floor still required considerable learning. Concern was expressed that when the Panel visited various centers, the engineers at the working level appeared to have widely varying interpretations of what the program meant and to be uncertain how the Technical Authority related to their own daily practice. Further, it appeared that those in individual centers tended to call upon the most geographically accessible expert, as opposed to NASA's best expert.

Adm. Dyer identified the Technical Authority concept as critical, stating that it was the most important of the recommendations that had been made. Dr. McErlean stressed the importance of the Technical Authority program, noted that it had been supported and promoted by Administrator Griffin, and said the concept needed to be firmly in place to ensure its continuation in a new administration. Mr. Frost noted that a direct line of authority from a center's chief engineering and chief safety officer to their Headquarters counterpart might, or might not, be shown properly on various Center implementation charts. He stressed that this relationship of Technical Authority to headquarters needed to be clarified in such charts.

### **Ethics Briefing**

Adm. Dyer noted the Panel had received its annual ethics briefing during the May 21 session.

### **Fall Protection Standards**

The ASAP was briefed by Mr. Jonathan Mullin, Manager, Operational Safety, on steps and actions that followed from an accident that had occurred at Kennedy Space Center [KSC] in 2006, when a contractor fell from a roof and subsequently died from injuries received. Following the accident, NASA had aggressively convened an accident board, which undertook what the ASAP regarded as 'an excellent and timely' evaluation of the factors involved and then issued what the Panel regarded as a series of good recommendations. Subsequently, the KSC Director convened an inquiry into how similar accidents could be prevented in the future. The Panel had earlier recommended that all other NASA centers review the KSC actions. On May 21, the Panel reviewed the question of whether this activity should be undertaken agency-wide. No answer was as yet available, as questions of the needed capital investment and training remained. A decision on the question of agency-wide action is expected by January 2009. Panel members praised KSC for its efforts and NASA for looking to apply a center's action agency-wide. The Panel noted that the creation of agency-wide standards was valuable, as they would simplify the commonly occurring movement of personnel from center to center. Ms. McDevitt reported that, when the KSC recommendations were made, concern had been expressed that KSC contractors might regard the safety recommendations as prohibitively costly. In practice, she said, they had not done so; this spoke well for the undertaking. The ASAP expressed regret that the policy decision would not come until 2009, and, further, that final implementation might not occur before 2011: the Panel believed a greater sense of urgency on implementation was merited.

## **Exploration: Review Update Of Optimization of Robotics Use To Support Human Exploration**

The Panel discussed with Mr. William Gerstenmaier, Associate Administrator for Space Operations Mission Directorate [SOMD]; Mr. Douglas Cooke, Deputy Assistant Administrator, SOMD; and Mr. Geoffrey Yoder, Division Director, Directorate Integration Office, the status of robotic activities in support of human exploration. Specifically, the Panel sought to determine if a current policy existed on the best mix of human vs. robotic assets for a given mission. The Panel was informed that while no formal policy existed, the general policy was to undertake 'blue collar' tasks robotically with 'science' tasks done by humans. The three presenters agreed that a formal decision tree on the subject might be useful. Mr. Gerstenmaier commented that undertaking tasks robotically often took more time; the Panel recognized that in some cases this meant tradeoffs were made between safety and time. The Panel welcomed the statement that robotic missions would have as a primary objective the gaining of the data most needed to support human exploration; thus, such missions would be part of the risk reduction effort for subsequent human activity.

## **Safe Use of Limited Life Components On The Space Shuttle**

The Panel had previously received a concern that certain safety critical limited life components might be in use on the Space Shuttle beyond their safe life limits. Mr. Gerstenmaier described to the Panel how such components are tracked and monitored and assured the Panel that a positive program was in place to prevent such an occurrence. He further explained that all such components are either within safe life limits at launch, or the risk of their use is evaluated and the risk is formally accepted as part of the FRR process. Based on this information, the Panel considers this issue closed.

## **Random Drug and Alcohol Testing Update**

The ASAP held a discussion with, Ms. Faith Chandler, Manager, Mishap Investigation Program, on the status of work being done on testing for alcohol and illegal drugs. This data followed a 2006 ASAP recommendation made in the aftermath of an accident. That recommendation was that random pre-incident and post-incident testing for alcohol should be expanded to include both contractors and NASA civil service employees. In 2007, the Panel received a report on post-incident testing for illegal drugs; however, that report had made no reference to alcohol.

At the present meeting, the Panel learned that while NASA had a policy for the post-incident testing for illegal drugs, it had not had a policy for testing with regard to alcohol. The Panel learned that the initial effort put forth by the Office of Safety and Mission Assurance [OSMA] was to clarify and expand the policy on post-incident testing. That office had developed a draft NASA policy for a drug-free workforce and, further, had reviewed the requirements for contractors stated in the pertinent federal acquisitions regulation, strengthening these as well. The cost implications and effectiveness of this draft policy are currently being assessed through a pilot program at KSC; the policy itself has been tabled until the results of that pilot project are known. In the interim, OSMA published in August 2007 a NASA policy letter clarifying post-mishap actions for NASA civil servants. The ASAP was informed of other steps being taken, including training for supervisory personnel to reemphasize the requirements in this area; testing undertaken in connection with Type A and Type B mishaps; and efforts to develop a NASA policy on alcohol use.

The ASAP noted the complexity of the task at hand. For example, NASA civil servants and outside contractors have different applicable authority documents, a circumstance that considerably affects the scope of NASA's ability to implement changes in this area. For civil servants, the authoritative



documents are under the control of the Department of Justice; for contractors, the Federal Acquisition Regulations [FAR] apply: these require public review and comment.

The ASAP learned that, given these issues, NASA deemed it necessary to assemble an implementation plan to address these tasks; meetings have been held with the NASA Administrator, who approved the applicable parameters for policy development. OSMA is being supported in this activity by various NASA headquarter organizations, including health and medical, general counsel, capital management, procurement, security and program protection.

The ASAP said the presentation provided important clarification on the effort. Previously, the Panel had not understood why the effort was addressing illegal drugs, but not alcohol. The Panel now believed that considerable progress was being made, including the pilot program at KSC. While it had, the Panel noted, taken two years to reach this point, a plan had now been created, and the action team associated with that plan had the necessary momentum to create a standard that would apply across the agency.

Mr. Marshall praised the activity, saying he believed a superb job had been done on a process that was broadly applicable, standardized across the agency, and cost effective. Mr. Frost commended the process for involving both the 'brain trust' from headquarters and working groups from the centers. He noted that the ASAP was often told that, given the differences between centers, agency-wide policies were impractical. He believed a successful policy was being achieved in this instance, even with such complicating circumstances as the fact that first responders were civil servants at some centers and contractors at others.

### **Mishaps Report Update**

The ASAP discussed the status of mishap reports with Ms. Faith Chandler, Manager, Mishap Investigation Program. The ASAP has expressed concern that if an investigation at an individual center uncovered a potential hazard, that this information be rapidly shared agency-wide. The Panel was informed that the former safety alert system had been revamped into a warning action response; the Panel regarded the new practice as appearing to be timely and distributed to the right people. The Panel described the process as very methodical: lessons learned were documented and implemented, with an action plan developed to track activities through completion. The Panel praised the fact that emphasis went beyond identifying the direct cause of the accident to investigating the underlying circumstances that made the accident possible. The Panel identified two concerns. First, thoroughness appeared to be being achieved at the expense of timeliness; for the years 2004 through 2008, only about one-fifth of Type A and Type B accidents had been through the entire process, with action plans distributed to all centers. The time delays, the Panel believed, were simply too long for the information they supplied to be of high use to management. Second, the data gathered was being insufficiently analyzed; consequently, trends and underlying causes were not being identified in ways that would support focused safety efforts across the agency. Dr. McErlean urged that a strengthened effort be made to analyze data in ways that would help determine trends and systematic weaknesses.

Mr. Frost commented that, in most organizations, the highest level of an organization was briefed any time a serious accident occurred; NASA, he noted, is not currently doing this. He believed the expectation that such a review would occur would lead to a greater emphasis being placed on gathering the requisite data. Additionally, he noted that the findings of the very comprehensive investigations of orbital failures and deep space probes were not as yet being methodically turned into 'lessons learned' and corrective action plans. He believed this activity should be linked with the existing ground accident process so that lessons learned and action plans were automatically created and tracked. Dr. McErlean

said the ‘missing piece’ was that corrective action plans were not being evaluated subsequent to their implementation to see if the recommended actions indeed corrected the problem.

The ASAP discussed the need for metrics in measuring safety. Adm. Dyer suggested creating an inclusive ‘Uber’ metric that would permit a ready answer to the question: was 2007 safer than 2006? No such metric currently existed. Mr. Frost said accident trend tracking was sufficiently important that the ASAP should request such information as a standard feature of its center visits. Mr. Marshall noted that for data to be meaningful, it must reflect a standard taxonomy and employ standard definitions. Mr. Frost commented that new software planned for installation this summer is said to include such definitions.

### **Meeting with Administrator Griffin**

The ASAP met for two hours during its May 22 session with Dr. Griffin, NASA Administrator. Space Shuttle and safety concerns were ‘front and center’ in that discussion, with Dr. Griffin strongly sharing the Panel’s view that the transition from the Shuttle program to the Constellation program presented a major opportunity to address safety concerns. The Panel believes that significant risk remained in the Shuttle program, which was now adding age to complexity. Given this and the resource requirements of the Constellation program, the ASAP was strongly of the view that the life of the Shuttle should not be extended: to do so would compound the safety implications and risks associated with that program.

Based on its conversations with Dr. Griffin, the ASAP concluded that the Constellation program safety related issues were on track, though it was experiencing signs of stress related to resource limitations at an earlier point than was common. The Panel reported that Dr. Griffin shared its view that the creation of a large program was a good opportunity to develop a culture; in the case of Constellation, safety was to be a central pillar of that culture. Further, the Panel noted, as an adverse trend, that due to financial constraints NASA aircraft were generally not equipped with the latest in life saving tools -- e.g. collision avoidance; ground proximity warning systems -- that are now common on military and civilian fleets.

The ASAP discussed with Dr. Griffin the question of resource constraints as they affected the agency, with Dr. Griffin reporting that the NASA appropriation was \$3 billion less than that needed to execute its assigned missions, a statement Dr. Griffin had communicated to Congress. Dr. Griffin said this shortfall had implications on safety; for example, with the NASA fleet. Panel members expressed concern with NASA’s budget constraints, particularly as they might affect safety. Adm. Dyer stated that, while organizations were generally inclined to claim they needed additional resources, NASA ‘has a strong and compelling story that that was indeed the case now.’ Mr. Marshall expressed concern that, where NASA funding was concerned, the ‘knee of the curve’ would be crossed, with consequences that would be of great concern. Mr. Frost expressed the view that the financial pressure stemmed from the overlap of the Shuttle program that was ramping down and the Lunar/Mars initiative which was simultaneously ramping up. Normally, he said, such overlaps were eased through additional temporary funding, but in this case NASA had received no increase in resources. Adm. Dyer said the topic would be addressed in the ASAP report to Congress, which he anticipated would be completed in June 2008. The Panel, he said, would go beyond the submission of the report and seek to discuss it directly with members of Congress.

### **Additional Matters**

The ASAP has been viewing the safety issues surrounding the Soyuz capsule and its associated recovery module with increasing concern. The Panel discussed the matter with

Mr. Gerstenmaier, who shared that concern and who said that SOMD was ‘focused like a laser beam’ on the issue. Adm. Dyer said the Panel emerged from this discussion with no less concern, but encouraged by how competently NASA was approaching the problem.

The ASAP restated its concern with enterprise alignment; ASAP has described NASA as being more of a confederation of ten centers than a strong and united union. When, for example, ASAP visited a center, discussion often began with the statement, ‘Yes, but we are different here.’ The Panel was of the view that while diversity is a strength, the agency would benefit generally if good ideas from one center were quickly and broadly shared. The Panel regarded the sense of difference between centers as adding to the challenge of implementing such things as Technical Authority. Adm. Dyer noted that the fact that different badges were required to gain access to different NASA locations suggested that work on integration remained to be done.

The ASAP called attention to the importance of leadership continuity at a time when a change in administrations was in the offing. The Panel noted that NASA currently has a great many projects in progress; care is needed so nothing is dropped in the transition to a new administration. The Panel observed that Dr. Griffin had placed outstanding people in senior positions, and expressed the hope that these individuals would be carried forward into the next administration.

## **ASAP Recommendations, 2nd Quarter 2008**

1. The ASAP recommended that the NSC be included in the NASA process for evaluating whether new standards are needed and the decision on whether to implement those standards.
2. The ASAP recommended that an agency-wide set of 'NASA Golden Rules' be established to assist in the sharing of knowledge between centers.
3. The ASAP recommended that on Modeling and Simulation, a NASA-wide matrix be created to classify models as 'green,' 'yellow' and 'red,' so that the statement 'high confidence' means the same thing from one center to another.
4. The ASAP recommended that NASA formulate a decision tree for optimizing the use of robotics in exploration, so as to diminish the risks to humans, with that decision tree including all criteria relevant to the decision.
5. The ASAP urged that NASA review the applicability of developing a policy that would formally add to appropriate NASA aircraft Traffic Collision Avoidance System [TCAS], advanced ground warning systems and other advanced avionics programs that have been embraced by the civilian and military worlds.
6. The ASAP recommended that, prior to contracting with a private charter operator, NASA consider requiring that all contractors be subject to an independent audit.
7. The ASAP urged that greater timeliness be achieved in completing accident reviews. The Panel also recommended that an organized and rigorous mishap trend analysis effort be undertaken agency-wide to identify causal trends at an Agency level as well as by Center. The results of this analysis should be briefed on a regular basis to senior Agency leadership. The Panel would like to see the Center analyses during their visits to field operations. The Panel recommended that a policy be implemented to brief senior leadership of initial causal analysis in a timely fashion after major mishaps. Finally, the Panel recommended that a closed loop management tracking system, similar to that used for ground mishaps, be developed to ensure implementation of lessons learned from flight failure investigations.
8. The ASAP recommended that the new NASA Fall Protection Standard resulting from a 2006 fatal accident be accelerated to take effect well before the 2010-2011 currently projected and that the key elements of this standard be mandatory ( with waiver capability) NASA wide rather than advisory.

NASA AEROSPACE SAFETY ADVISORY PANEL  
National Aeronautics and Space Administration  
Washington, DC 20546  
VADM Joseph W. Dyer USN, (Ret.), Chair

September 12, 2008

The Honorable Michael D. Griffin  
Administrator  
National Aeronautics and Space Administration  
Washington, DC 20546

Dear Dr. Griffin:

The Aerospace Safety Advisory Panel held its 2008 Third Quarterly Meeting at Marshall Space Flight Center (MSFC), Huntsville, AL, on July 16-17, 2008. We greatly appreciate the support received from MSFC subject matter experts and their willingness to discuss our concerns open and candidly.

The Panel submits the enclosed Minutes with Recommendations resulting from this meeting for your consideration.

Sincerely,

A handwritten signature in black ink, appearing to read "J. W. Dyer", written in a cursive style.

Joseph W. Dyer, VADM, USN (Ret.)  
Chair

Enclosure

**Aerospace Safety Advisory Panel  
2008 Third Quarterly Report  
Minutes and Recommendations**

Aerospace Safety Advisory Panel (ASAP)  
Public Meeting  
July 17, 2008  
Marshall Space Flight Center  
Huntsville, Alabama

**ASAP Members Present**

- Vice Admiral Joseph W. Dyer, USN (Retired), Chairman
- Dr. James P. Bagian
- Major General Charles F. Bolden, Jr., USMC (Retired)
- Mr. John C. Frost
- Mr. John C. Marshall
- Ms. Joyce A. McDevitt, P.E.

**ASAP Staff and Support Personnel Present**

- Ms. Katherine Dakon, ASAP Executive Director
- Ms. Sallie Birket Chafer, Reports Editor

**Attendees, Public Session**

- Roy W. Malone Jr., Director, MSFC Safety and Mission Assurance Directorate
- Pat Fuller, MSFC
- Vickie Rorex, MSFC
- Sandra Turner, MSFC

**OPENING REMARKS**

The Aerospace Safety Advisory Panel (ASAP) held the public session of the 2008 third quarterly meeting at the Marshall Space Flight Center (MSFC), located on the Redstone Arsenal in Huntsville, Alabama. Admiral Dyer opened the session by summarizing broad-brush ASAP observations.

First, the Panel is beginning to see the fruits of the decision to transfer knowledge from one generation of NASA scientists and engineers to the next as NASA assumes some of the prime contractor responsibilities for the Constellation Program. Program and technical leadership is complex and challenging, but also under way.

Second, it is especially evident to the ASAP that a number of MSFC safety programs are genuinely first-class efforts that deserve to be replicated at other NASA centers and improved upon as a basis for standardization. The MSFC safety tracking system and the staff's ability to identify trends and compare and document performance across years are perhaps best practices as well.

Third, the Base Realignment and Closure (BRAC) personnel moves will bring a tsunami of positions to Huntsville from Northern Virginia. Because the number of positions exceeds the

number of people making the move, the Panel is convinced that MSFC will face personnel management and workforce challenges that will negatively impact safety.

### **REUSABLE SOLID ROCKET MOTOR THRUST OSCILLATION ISSUES**

Thrust oscillation, also known as resonant burning, has several important effects, including the generation and transmission of the oscillation as well as the effects on humans at the top of the rocket. The topic has received a lot of press recently, so the Panel was interested in the ground truth. Mr. Frost observed that, to its credit, MSFC understands the issue and has identified it early in the development of the full Ares vehicle, giving MSFC a lot of trade space for its team of engineers, safety personnel, rocket motor experts, and human factors engineers to resolve the problem.

Garry Lyle, Associate Director for Technical Management at the MSFC Engineering Directorate, reported that thrust oscillation is a well-known characteristic of every solid rocket motor (SRM), so engineers anticipate and understand it and must design around it. The Ares problem is that the four-segment SRMs for the Shuttle resonate at about 15 Hz (or cycles per second); because this does not match any resonant frequency in the Shuttle, effects are minimal. However, when the motors are lengthened to five segments, resonance drops a bit to 12 Hz, which could match a resonant frequency in the overall Ares vehicle. As a phenomenon, resonance in any aerospace vehicle creates the potential for structural concerns and normally is designed out of the structure, either by changing the impulse or by redesigning the structure to change its response.

MSFC is attacking the issue on both engineering fronts. First, MSFC is trying to reduce the levels of thrust oscillation generated within the SRMs. Second, MSFC is considering adding attenuation or antiresonance features to the vehicle. Mr. Frost expressed great confidence that the problem is solvable and that MSFC is on the path to identifying the most effective solution while minimizing increased weight. The main limitation on vehicle vibration levels is the very stringent design limits allocated to vibration of the crew itself. The Panel notes the possibility that such limits could be raised, especially if the crew has few critical tasks at the time that the vibrations are most likely. On questioning, it was disclosed that a risk-based analysis had not been performed to assess the need to mitigate the oscillations based on the impact on crew performance. The presenters and the Panel members all agreed that such an analysis is needed to appropriately manage the associated risks.

Mr. Frost encouraged MSFC to expand human factors engineering involvement and to look for new ideas about human performance at those vibration levels, in particular by seeking input from experts who confront similar vibration limit issues (for instance, personnel who work on rotary wing vehicles such as those at the Army Aeromedical Research Laboratory at Fort Rucker).

### **UPDATE ON CAIB IMPLEMENTATION**

As mandated by Congress and the NASA Authorization Act of 2005, the ASAP is responsible for evaluating and reporting annually on NASA compliance with the return-to-flight (RTF) and continue-to-fly recommendations of the Columbia Accident Investigation Board (CAIB). John Casper, Associate Manager of the Space Shuttle Program, provided specifically requested updates on the three CAIB recommendations—external tank thermal protection system (TPS) modifications, orbiter hardening and TPS impact tolerance, and TPS on-orbit inspection and repair—that the RTF Task Group’s July 2005 final report categorized as needing more work. He also presented NASA’s recommendation that the ASAP close out these three recommendations.

Ms. McDevitt commented that this request is timely given the upcoming release of the ASAP *Annual Report for 2007*, which discusses this subject at some length, concluding:

While the ASAP is satisfied with...[NASA responses] to the three outstanding recommendations, the Panel continues to feel that it cannot make a final determination that would serve as the basis for closing those recommendations. As the Panel indicated in its *Annual Report for 2006*, the extensive review and analysis...necessary...are beyond the resources of the ASAP.

The ASAP noted that it was very pleased with NASA's overall response and continuing substantive progress. NASA has taken the CAIB recommendations very seriously, investing tremendous effort in closing them out by creating meaningful solutions. No member of the Panel doubts that the Shuttle is safer today than it has been at any time in the past and at any time since the CAIB issued its recommendations, but Admiral Dyer noted that risk absolutely still remains. Mr. Frost observed that, as a matter of vehicle physics, NASA cannot totally eliminate the hazard associated with the three CAIB recommendations, but should continue relevant work as long as a reasonable opportunity for further improvement exists. Mr. Marshall agreed that NASA has (and should use) opportunities other than closeout to manage these risks. This said, the Panel's consensus was that after all options are exhausted, it is NASA's responsibility, not the Panel's, ultimately to accept or reject the risks, as it does for each flight, by applying its very clear formal risk acceptance process, producing the accepted risk hazard report, and obtaining a final decision at the program level or from the NASA Administrator, depending on the level of risk.

The ASAP did confirm that it intends to continue monitoring the three remaining CAIB recommendations, using this status report (perhaps with an end-of-year update) as input for the 2008 annual report to the NASA Administrator and Congress. However, the Panel reaffirmed that it does not intend to take a position on closing out the three remaining CAIB recommendations.

### **MSFC—SPECIFIC SAFETY ISSUES, IDENTIFIED OPPORTUNITIES, AND NEAR MISSES**

Ed Kiessling of the Safety, Quality, and Management Systems Department, which is part of the Safety and Mission Assurance (S&MA) Directorate, described the MSFC Industrial Safety Program. The ASAP was extremely impressed, not only by the in-place processes that MSFC personnel are pursuing—a hard-core program backed by attention to detail and exceptionally good internal and external communications—but also by the results and their potential for Agency-wide application.

During FY 2008 (through June), MSFC had no fatalities or disabling injuries, only 3 lost-time mishaps, and 23 OSHA recordable mishaps (all world-class figures). The lost workdays equate to a .06 rate, compared to .1 percent for generally world-class organizations (for example, DuPont, Alcoa, and other companies that have focused for years on preventing, reducing, and eliminating workplace injuries).

The Panel expressed its sincere regret over the truly unfortunate onsite fatality. Although it was more the result of criminal action than an accident, the entire ASAP joins MSFC employees in grieving for the family. However, the Panel was impressed that MSFC already has taken action to prevent such an incident in the future, using an approach similar to the one for eliminating accidents.



Mr. Marshall noted that he was struck not only by the meaningful metrics generated by MSFC's world-class reporting procedures, but also by the associated leading-edge indicators (such as close calls, team metrics, and comparisons with other NASA centers or other organizations of like nature). MSFC is the first NASA organization that collectively gathers and analyzes data across all leading indicators at the same time, applying clear-cut visions and goals, key event timelines with milestones, and periodic assessments of Center failures and possible corrective actions. Mr. Marshall cited a few key recent successes, including ISO 14001 certification of a chemical management system institutionalized throughout MSFC; monthly Safety, Health, and Environmental (SHE) Program reports (submitted to the Integrated Management Systems Board) and SHE training assessment tools; the pressure systems improvement initiative; improved safety assessment processes; and, most important, a customer feedback assessment tool that solicits opinions on the effectiveness of safety programs from people working in the trenches.

Mr. Frost noted that although these tools currently are showing positive results, MSFC is continuing to observe and track its metrics and follow up on negative indicators. This continuous process improvement ensures that positive results are not a matter of luck, but rather intentional enhancements. He observed that MSFC safety procedures are world-class in no small part because of the level and quality of personnel. MSFC runs a modern management program with feedback channels and constant corrections to address the causes of problems, and the Panel concludes that other NASA centers should adopt similar or identical programs.

#### **OVERVIEW OF CONSTELLATION PROGRAM ACTIVITIES**

Jeff Hanley, the Constellation Program Manager, summarized the Constellation Program, which clearly is a huge, very complex undertaking and a serious focus of MSFC time and work, with expenditures totaling \$250 million a month even at this early stage. The Constellation Program implementation differs considerably from previous programs such as the Shuttle. Notably, MSFC is integrating all of the Constellation Program systems, and NASA is conducting Level 2 integration, previously a prime contractor task.

The ASAP unanimously agreed that NASA's prime integration role is a positive development that cultivates internal technical capabilities and thus the ability to own the program. MSFC is transferring knowledge, thereby building a new generation of rocket scientists and supporting the expanded management role of MSFC civil servants. Still, this approach entails risk that is exacerbated by factors such as the large number of moving parts, numerous vehicles, multiple producers, high burn rate, and program complexity. Mr. Marshall also cited the geographic dispersal of many of the involved organizations, the need for diverse programs to mature at the same time, exceptionally long Constellation Program lead times, and some new and unique problems (especially as the focus shifts beyond lunar exploration).

Dr. Bagian observed that a number of systems and structures are now in place to manage and integrate the Constellation Program, including communication channels at both Level 2 and MSFC. Ms. McDevitt added that people still have to understand and work effectively with the new systems to achieve the stated objectives. Furthermore, this approach requires a high level of vigilance and consistent monitoring of progress. Although ASAP conclusions are necessarily tentative at this early time, MSFC is making a good effort in the right direction, but must continue to learn as it proceeds.

The Panel also noted that the classic Department of Defense (DoD) or NASA management model paired a government program management office (responsible for cost, performance, and engineering oversight) with a total system integration contractor acting as prime. These two elements exerted a positive tension, but the Constellation Program does not include the same level of checks and balances. The Panel suggests the need to find positive tension some other way, for example, through groups such as the ASAP or through the technical expertise of NASA retirees or independent organizations.

The Panel made several narrower Constellation Program observations. First, the Panel agrees that the virtual mission tool makes good sense. MSFC already has modified the structures and approaches based on lessons learned, and the ASAP has confidence that MSFC will continue this iterative process. Second, Mr. Frost noted that as little as a year ago, the Panel was concerned about human rating requirements for Constellation. Except for a few loose ends, NASA Headquarters in toto now concurs (after give and take on both sides), and the Agency recently released a new human rating requirements document. Third, other problems (such as SRM thrust oscillation and the impact of the BRAC, discussed elsewhere) affect the Constellation Program, so the Panel will continue monitoring them. Panel members did express their desire to obtain additional detail on the Agency's recently published NASA Human-Rating Requirements (NPR 8705.2) at a future session.

#### **MSFC CONSTELLATION PROGRAM LAUNCH VEHICLE RESPONSIBILITIES**

Drilling down into the Constellation Program, Jim Reuter, the Ares Project Office Vehicle Integration Manager, reported that MSFC now is focused primarily on Ares I, which will launch six crew members to the International Space Station and four to the Moon. The Panel noted that production of Ares I stages entails a mix of centers, contractors, and producers and poses a complex management challenge that is being met, but remains complicated.

Admiral Dyer observed that the Ares I initial operating capability (IOC) is scheduled for 2015, which is getting closer every day. The vehicle designs and program components are complex, but are simplified a bit by significant reuse of designs and materials (drawing heavily from the Saturn V and Shuttle) and by reliance on infrastructure investments (some new, but some old and still useful infrastructure). In addition, Ares I requirements are firming up and catching up with plans and builds. Mr. Frost commented that he had always been concerned that the Shuttle had a very limited (if any) capability to survive a bird strike during ascent, but was glad to hear that Ares I will comply with the now-standard NASA 5-pound vulture impact requirement.

The Panel has long been seeking two numbers to identify the design reliability (mission capability) requirements for the vehicle design, and Mr. Reuter reported that for the overall Ares I (combined ISS and lunar crew missions), MSFC is looking at a loss of crew risk on the order of 1 in 2,500 (assuming the ability to return from anywhere during the launch profile) and a loss of mission risk of 1 in 500.

Ares I leaders are targeting design completion in 2013 and IOC by 2015. The Panel was significantly relieved by MSFC progress on SRM-induced pulse vibrations and longitudinal control authority issues (noted previously). The upcoming BRAC move into Huntsville (discussed subsequently) is a risk element that Ares I program management must consider. The ASAP has identified a new issue to watch closely, the complex Ares separation design, specifically between the first stage and the interstage.

## **MSFC SCIENCE AND MISSION SYSTEMS RESPONSIBILITIES**

John Horack, the Director of the MSFC Science and Mission Systems Office (S&MSO), made a primarily informational presentation on past and current projects. Mr. Frost noted that S&MSO is an interesting directorate with numerous responsibilities (for example, the science related to robotics and human missions), managing everything at MSFC but for the Shuttle and Ares programs. The ASAP had not previously heard much about S&MSO, which performs very impressive science, thinking about the future and what it will take to get there. The Panel notes a particularly interesting fact, that NASA has maintained a continuous human presence in space since November 2, 2000.

## **PERSONNEL RETENTION AND EFFECTS OF BRAC PLAN**

Tereasa Washington, Director of the MSFC Office of Human Capital, reported that BRAC shifts are often viewed negatively, but the economic impact in this case is a significant gain in positions at the Redstone Arsenal (coming from the Naval Materiel Command, Missile Defense Agency, and others). The BRAC impact extends beyond NASA to the entire Huntsville region, which has to invest in infrastructure (for example, schools, roads, hospitals, emergency care) to serve the significant influx of new residents.

Admiral Dyer noted that there is always risk associated with large personnel shifts. As Commander of the Naval Air Systems Command (NAVAIR), he faced a challenge of comparable scope and complexity in moving 6,000 personnel from Northern Virginia to Patuxent River, Maryland. He expressed his belief that Huntsville is behind the curve because it takes 3 to 3.5 years to prepare for such a move and avoid adverse impacts.

Focusing on MSFC, the ASAP confirmed a significant risk to effective workforce planning. Admiral Dyer's back-of-the-envelope analysis indicated that MSFC employs a round-number total of 5,000 civil servants and contractors (including 500 who directly support Ares), compared to 10,000 incoming BRAC positions. DoD experience is that 75 to 80 percent of personnel do not move when asked to relocate hundreds of miles away, so roughly 8,000 positions would need to be filled. If DoD stripped NASA to the bone, it still could not fill all of the necessary positions. Admiral Dyer declared that if he were a manager at MSFC and in the midst of a major program, he would view the imminent BRAC influx with serious safety concern, maybe even alarm.

Moreover, the peak BRAC year for Huntsville, 2010, is rapidly approaching. Mr. Frost noted that is also the transition year when the Shuttle ceases operations and Constellation ramps up, making this an emergency situation for MSFC. He worried that the Center is not sufficiently alert to, and prepared for, a possible sudden targeting of its most vulnerable and qualified personnel whose skill sets correlate closely to those needed by the Army. Although MSFC recognizes the issue, it also downplays the risk to some extent based on current trends, which do not yet reflect the BRAC impact.

The ASAP concluded that planning for BRAC moves is much more urgent and time sensitive at MSFC than at other centers. MSFC therefore should identify key and critical personnel (from the integrated civil service and contractor workforce) whose knowledge is absolutely crucial to the Center and the Constellation Program. Using an estimated ratio based on Admiral Dyer's NAVAIR work, MSFC probably will identify some 2 dozen to 3 dozen personnel whom it must do everything possible to retain. The Panel noted two related statistical issues. First, Mr.

Marshall encouraged MSFC to further quantify real losses to the required level of specificity (such as other key career fields and Constellation Program schedule delays). The numbers will be raw, but will enable MSFC to determine the national impact and decide how to handle it. Second, Mr. Frost acknowledged the difficulty in gathering real numbers on the number of BRAC positions and skill sets. Only a few organizations have reported, accounting for 1,700 of the 10,000 Huntsville positions, a misleadingly small picture of the problem. MSFC should use currently available figures to build the best possible model, estimate the most probable BRAC numbers, create a position summary and skill set chart, and adjust the model over time.

To protect the Constellation Program, if it is not too late, MSFC should request relief (similar to the exceptions granted to DoD) from term appointment constraints and from retirement salary reduction offsets for reemployed annuitants. The Federal Government requires NASA to hire 15 percent of its civil service workforce as term appointments (introducing some softness in employee retention), but DoD is not subject to this requirement. In addition, under Office of Personnel Management rules, DoD can reemploy retirees from other agencies without a salary offset, so an eligible MSFC engineer or other civil servant could retire, accept an Army job, and draw 100 percent of the Army salary in addition to full retirement pay. NASA cannot match that very attractive economic package. MSFC has 664 personnel who are already retirement eligible, and that number will grow considerably by 2010.

#### **MSFC TECHNICAL AUTHORITY**

The ASAP concluded resoundingly that “MSFC gets it” after hearing presentations on technical authority (TA) by Roy Malone, Director of the MSFC S&MA Directorate; Dan Dumbacher, Director of the MSFC Engineering Directorate; and Robert Lightfoot, MSFC Deputy Director. The Panel is very pleased with MSFC’s level of understanding, development, and integration of TA within the Center.

Mr. Marshall explained the importance of TA to the ASAP, which has addressed the topic since the CAIB recommendations identified the loss of TA and failure to execute a process as direct contributing factors to the loss of Columbia. The ASAP and the NASA Administrator have discussed his clear vision of TA at NASA, which the Panel has repeatedly endorsed.

Unfortunately, the ebb and flow of emphasis on TA as well as inconsistencies and lack of execution at the center level have caused consternation to this Panel and affected the Agency’s ability to address critical issues.

At every center, the Panel looks for a formal process that ensures that the correct level of technical competencies are used to resolve and revisit issues; enables all cognizant parties to express their views, concerns, and enthusiasms; and resolves internal Agency disputes. At MSFC, that process includes a number of components. First, the governance council includes the Strategic Planning Council, Integrated Management Systems Board, and Center Management Council. Second, TA execution by the MSFC Director incorporates vertical and horizontal interfaces, multiple opportunities for discussions, emphasis on routinely involving the most technically competent professionals in the process so that they can express concerns and dissents, and provisions to elevate disagreements to the proper level of expertise to obtain resolution. Third, a particularly impressive MSFC-developed tool, the Center Management System, enables the Center Management Council to monitor project status from the management perspective and to track financial status and schedule performance. Fourth, reviews encourage the project manager, engineers, and S&MA community to look at technical status updates. Fifth, when

disagreements occur, a forum (the Safety and Mission Assurance Council) fosters give-and-take dialogs, creating a healthy tension between technical and safety issues to resolve problems or escalate them to the next level if necessary.

Dr. Bagian observed that Mr. Lightfoot not only described the MSFC project status dashboard (which assigns red, yellow, and green indicator lights), but correctly emphasized that the dashboard is strictly an aid—one tool among many—in identifying issues that deserve more discussion and better understanding.

Ms. McDevitt noted some excellent MSFC safety initiatives related to TA. For example, MSFC created Chief Safety Officer (CSO) positions at the GS-15 level, on par with their engineering counterparts, and has assigned a number of top MSFC engineers to these CSO positions. The ASAP has not seen this approach at other NASA centers and commends S&MA leadership. Such numerous reassignments elevate the level of S&MA competence and prestige, change the image of safety from an afterthought to an integral process, and indicate that MSFC is a good place to work. Ms. McDevitt expressed the Panel's hope that such personnel rotations are not a short-term measure.

Mr. Marshall was struck by the S&MA reorganization to optimize its ability to address the transition under way from the Shuttle to Ares I and V programs. S&MA leaders have brought respect to the organization, which is hard to accomplish in the safety community. S&MA not only has taken steps to improve the organization, but also is producing tangible effects. For example, no meeting proceeds without a safety officer in attendance, and personnel from prestigious MSFC organizations are applying to join S&MA. Mr. Frost concluded that the MSFC solution is not just theoretical; it is working, and if it works at MSFC, it can work everywhere.

## **ASAP RECOMMENDATIONS, THIRD QUARTER, 2008**

**2008-03-01.** The ASAP recommends that the staff of the NASA Chief of Safety and Mission Assurance should assess the Agency-wide applicability of the MSFC approaches for implementing a successful industrial safety program.

**2008-03-02.** To expedite future ASAP site visits, the Panel recommends that other centers present leading and lagging industrial safety performance metrics similar to those tracked by MSFC, establishing a basis for discussions with the ASAP. This approach would give the Panel opportunities for gaining a better, more consistent understanding of safety processes; improving the bases for comparing and contrasting programs; and perhaps also supporting NASA cross-pollination of good ideas.

**2008-03-03.** The ASAP agrees with the new Constellation Program approach to integration, which places NASA in the position of prime systems integrator, but the Panel notes that it is a high-risk proposition. Although NASA and MSFC deserve high marks for a good start, the ASAP recommends that this Panel and others should continue to closely monitor the progress of Constellation Program operations for years to come.

**2008-03-04.** The ASAP concluded that planning for BRAC moves to the Huntsville area is life-critical at MSFC, so (1) the Center should review Constellation and other core ongoing programs to identify key and critical personnel whom the Center absolutely must retain to deliver required Constellation Program services; and (2) to protect the integrity of the Constellation Program and level the employment playing field with DoD, MSFC should immediately request Government waivers from term appointment constraints and from retirement salary reduction offsets.

**2008-03-05.** In accordance with its mandate, the ASAP will continue to monitor new developments relevant to the three CAIB recommendations that have not been closed out, but the Panel does not have the resources necessary to conduct the extensive review and analysis necessary to recommend closeout. NASA must decide whether to accept the risks associated with the remaining three CAIB recommendations before the Panel can decide whether to concur.

**2008-03-06.** When the timing is appropriate, the ASAP requests a briefing from NASA on the new, recently published NASA Human-Rating Requirements (NPR 8705.2).

**2008-03-07.** The ASAP recommends that NASA perform an updated risk-based analysis in the near future to assess the crew-performance impacts of thrust oscillations generated within the Ares I SRMs. This timely analysis will enable NASA to quantify, manage, and if necessary mitigate operational risks associated with such oscillations.

NASA AEROSPACE SAFETY ADVISORY PANEL  
National Aeronautics and Space Administration  
Washington, DC 20546  
VADM Joseph W. Dyer USN, (Ret.), Chair

January 21, 2009

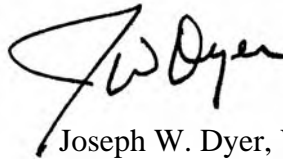
Mr. Christopher Scolese  
Acting Administrator  
National Aeronautics and Space Administration  
Washington, DC 20546

Dear Mr. Scolese:

The Aerospace Safety Advisory Panel held its 2008 Fourth Quarterly Meeting at NASA Ames Research Center, Moffett Field, CA, on October 22-23, 2008. We greatly appreciate the support received from NASA subject matter experts.

The Panel submits the enclosed Minutes with Recommendations resulting from this meeting for your consideration.

Sincerely,

A handwritten signature in black ink, appearing to read "J. W. Dyer". The signature is fluid and cursive, with a large initial "J" and "W".

Joseph W. Dyer, VADM, USN (Ret.)  
Chair

Enclosure

**Aerospace Safety Advisory Panel  
2008 Fourth Quarterly Report  
Minutes and Recommendations**

Aerospace Safety Advisory Panel (ASAP)  
Public Meeting  
October 23, 2008  
Ames Research Center  
Palo Alto, California

**ASAP Members Present**

- Vice Admiral Joseph W. Dyer, USN (Retired), Chair
- Dr. James P. Bagian
- Major General Charles F. Bolden, Jr., USMC (Retired)
- Mr. John C. Marshall
- Ms. Joyce A. McDevitt, P.E.

**ASAP Staff and Support Personnel Present**

- Ms. Katherine Dakon, ASAP Executive Director
- Ms. Susan Burch, ASAP Administrative Officer
- Ms. Sallie Birket Chafer, Reports Editor

**OPENING REMARKS**

The Aerospace Safety Advisory Panel (ASAP) held the public session of its 2008 fourth quarterly meeting at Ames Research Center (ARC) in Palo Alto, California. Admiral Joseph Dyer opened the session by thanking the ARC staff for its assistance during the Panel's fact-finding sessions and for the opportunity to tour select ARC facilities. Both the Admiral and Mr. John Marshall observed that ARC personnel evince obvious pride in, and enthusiasm for, their work. Admiral Dyer commended ARC for the high level of professional, work-related morale throughout the facility and for an outstanding job of onsite historical preservation (as evidenced by the unaltered preservation of the former Moffett Naval Air Station Bachelor Officers' Quarters, now the Ames Lodge).

Mr. Marshall addressed ARC airfield operations, noting his concern from a safety perspective because of the small number of operations on a daily, weekly, and monthly basis. He emphasized that the ASAP did not review (or intend to perform) operation checks and that his comments should not be construed as criticism, but rather as an expression of concern about normal airfield, tower, and air traffic control (ATC) operations and airfield management proficiency—simply because of a lack of regular demand for services. He also declared that the ARC airfield facilities represent a wonderful resource that currently is not fully utilized.

**OVERVIEW OF ARC FACILITIES**

Admiral Dyer reviewed ARC facilities and operations based on a presentation by the ARC Deputy Director, Mr. Lewis Braxton, III. The Admiral reported that the Center has served NASA for seven decades since its founding in 1939, developing innovations that cut across a



wide breadth of technical fields, from lifting bodies to tiltrotor aircraft to science missions. For example, ARC personnel currently support the science associated with the Stratospheric Observatory for Infrared Astronomy (SOFIA), which is under the operational control of the Dryden Flight Research Center and the management direction of NASA Headquarters (HQ); the Kepler mission to search for habitable planets and life in the universe; high-speed supercomputing capabilities for multiple missions; and a number of Federal Aviation Administration (FAA) activities that encourage commercial aviation.

Admiral Dyer briefly summarized the ARC financial and personnel profile. With an annual budget of approximately \$900 million, ARC employs about 1,250 civil servants and 1,300 contractors—a decline of slightly more than 50 percent since the early 1990s, when the integrated workforce totaled approximately 5,500.

The top five ARC priorities (and associated budget allocations) are (1) real prowess in supercomputing and information technology (IT) support for the entire NASA enterprise, basically the ARC center of gravity (\$200 million); (2) aeronautics and aerospace infrastructure that is tied to geography (i.e., to proven existing facilities, activities, and personnel) and underpins NASA operations as well as some Department of Defense classified work (\$100 million); (3) a heavy emphasis on science (e.g., astrobiology, Earth sciences, space biosciences) in support of NASA missions (\$80 million to \$100 million, much of it in grants); (4) support for small satellite start-up operations that focus on low-cost, entrepreneurial payloads (\$60 million to \$70 million); and (5) forward-leaning public-private cooperative ventures, most notably ARC's hosting of Google corporate aircraft (\$10 million to \$20 million).

Admiral Dyer noted that ARC confronts representative NASA workforce challenges, including the demographics of the workforce and the mean age of ARC civil servants (approaching 50). Thus, in roughly 5 years, the potential for a significant number of ARC civil servant retirements is a real concern, although perhaps somewhat less of an issue in the current financial environment. The ARC contractor workforce is significantly younger, with a mean age of approximately 30. The Admiral observed that ARC confronts a significant recruiting challenge because of the difficulty in finding affordable housing in the Silicon Valley area. General Bolden was impressed by the willingness of ARC executives and employees to live frugally so that they can continue to perform rewarding and important work at ARC, declaring that, at the end of the day, one cannot find better people doing more important tasks.

### **ARC SAFETY STATUS UPDATE**

General Charles Bolden updated the status of ARC safety operations and identified three primary issues. First, as Mr. Marshall discussed previously, the Agency needs to review safety issues associated with decreased operations at the ARC airfield. Second, as NASA HQ is aware, ARC expends some \$50 million a year on maintenance because of the age and condition of its facilities. General Bolden observed that ARC has played a critical role in several Shuttle missions over the last 2 years—and undoubtedly will fulfill a vital role in developing and flying Constellation and Orion—so additional attention to this issue is warranted. Third, as Admiral Dyer previously documented, the ARC workforce (particularly the civil servant component) is aging.

General Bolden cited the presentation to the ASAP by Mr. David King, the ARC Associate Director for Safety, Environmental and Mission Assurance. The General was happy that ARC is

emphasizing environmental issues (as reflected in Mr. King's title), not unlike industry in general today, where environmental issues frequently are incorporated into safety and quality groups. This emphasis is especially important when confronting the particular environmental challenges presented by California law.

General Bolden specified five positive developments at ARC. First, ARC makes exceptionally effective use of its metrics and operates a Web-based metrics database that all other NASA Centers can share, just by obtaining a password. In addition, after monitoring the operations of other centers, ARC adopted a contractor monthly accident report process to work more effectively with its contractors.

Second, ARC actively cultivates cross-cultural interactions with other NASA centers, including encouraging regular communications, looking for best practices at other centers that ARC can adopt, and openly sharing good ideas with other centers.

Third, ARC is very proud of its original Occupational Safety and Health Administration (OSHA) Voluntary Protection Program (VPP) Star certification in 2002 as well as its recertification in 2005 and its upcoming renewal in 2010. ARC personnel concluded that the turning point for VPP certification was holding supervisors accountable and assigning responsibility for safety to the lowest possible organizational level.

Fourth, ARC implemented the Ames Safety Accountability Program to generate a wide range of safety metrics that enable Center management to compare the performance of various directorates and to improve operations throughout the year. ARC also established the Ames Safety Awards Program, an event-oriented and activity-focused program that recognizes supervisors and employees for exceptional accomplishments in safety during the year. Although these two programs are not new or original, ARC has used them effectively to reduce accidents and enhance Center safety. For example, ARC is piggybacking its close call system by not only tracking close calls, but also proactively using that information as feedback to internal directorates that can take action to avoid such accidents.

Fifth, ARC is employing several new safety strategies. These include creating a number of internal control boards that report their insights directly to the Executive Safety Committee (ESC), chaired by the ARC Deputy Center Director. The ESC includes leaders from all 10 directorates and is facilitated by Mr. King. An example of one of these control boards is the ARC Electrical Review Team, established and specifically trained to assess electrical systems and high-voltage electrical safety facility-wide; identify unnecessary risks; and recommend risk mitigation options (e.g., training classes, safety manual revisions). The Electrical Review Team's thorough and rigorous activities helped ARC personnel to avoid electrical accidents by applying best practices (and in some cases exceeding OSHA regulations). As General Bolden noted, such approaches put safety first and foremost in the minds of leaders.

The ASAP encouraged Mr. King to continue emphasizing personal and organizational responsibility for safety, including conducting more frequent and routine briefings for the ARC Center Director on ESC and review group activities. Mr. Marshall agreed, but expanded the thought, noting that most NASA Centers have instituted executive committees that focus on safety and usually are chaired by the center deputy director. However, he suggested that the NASA Safety and Mission Assurance (S&MA) Office should study the need for a more formal requirement that each center director be briefed on all safety activities (e.g., by scheduling annual briefings on the status and progress of the safety program). Ms. Joyce McDevitt observed

that such briefings should not stop at the center director level, but rather should extend to the NASA Administrator. Citing ARC as an example of the use of metrics to motivate each organizational element to achieve outstanding performance, she hypothesized that the same types of performance-driven pressure points could be created at higher management levels. Commenting that the ASAP has completed its most recent cycle of visits to all NASA Centers, Admiral Dyer asked the Panel members how they would evaluate the centers in terms of relative safety, focusing on process rather than ordinal ranking. He submitted that the Panel does not know the answer because each NASA Center exhibits tremendous local character in measuring performance and safety. He recalled that the Panel has found such diversity—and the consistent lack of NASA-wide standardization—frustrating in the past. In the opinion of the Panel, the reluctance of NASA HQ and S&MA to mandate some form of standardization makes it difficult at best to promote exemplary ideas and activities so that they gain the traction necessary to cross-pollinate successfully among the NASA Centers. Consequently, Admiral Dyer envisioned a multi-center safety briefing to the Administrator as comparable to touring many foreign lands and cultures. Dr. Jim Bagian broadened the issue to the perception gained by the Panel during its meetings that NASA leaders view standardization as stifling innovation. NASA HQ and S&MA should be more proactive in using effective safety tools and best practices from individual centers to establish a basic set of S&MA-related standards and processes that function as minimum requirements while still allowing centers to institute more restrictive, demanding standards and processes.

#### **ARES I DEVELOPMENT STATUS**

Dr. Bagian updated the status of Ares I development based on a teleconference presentation on thrust oscillation by Mr. Garry Lyles, Associate Director for Technical Management in the Marshall Space Flight Center (MSFC) Engineering Directorate. This thorough follow-up to a presentation at the ASAP third quarterly meeting at MSFC addressed concerns about, and strategies for, mitigating thrust oscillation problems.

Dr. Bagian summarized the first-stage thrust oscillation problem, which might create a maximum acceleration due to gravity (g) force or level of vibration that would make it physiologically difficult for astronauts to respond to instructions, monitor displays, or take needed actions—or, in the worst case, would affect their long-term health. Noting that slight variations in the baseline architecture could trigger crew health issues, he commended NASA for diligently reviewing this issue rather than simply resorting to a hastily developed design change.

Dr. Bagian addressed several risk mitigation options—at the top level (strictly external to Orion), in the Ares stack, or a combination of both—that NASA is addressing. He highlighted two plausible options that had been identified, interstage isolation with mass dampers and crew seat damper versus active mass damping at the interstage, which will not impact Orion payload or weight factors.

Dr. Bagian identified the missing information on crew performance as a critical determinant in selecting the appropriate risk mitigation option. He reported that ARC centrifuge testing is being completed, so results are not yet available, but informed the Panel that the current centrifuge test will not necessarily be adequate to support a decision on the likelihood of persistent acceleration and vibration effects on crew performance during second-stage operations because a parametric

study was being conducted versus a simulation of the launch profile. Dr. Bagian proposed recommendation 2008-04-01.

Admiral Dyer confirmed that the Panel expressed some significant concerns about vibrations at the last quarterly meeting. He indicated that after considerable work, Panel members are considerably less anxious about vibration issues. Admiral Dyer agreed, concluding that although progress has been made, trade-offs must be made (in an already weight-constrained platform) based on a broader understanding of thrust oscillation and effects on the crew. He affirmed the need for additional study and ongoing ASAP monitoring.

## **OVERVIEW OF NEW HUMAN RATING STANDARD**

Mr. Marshall addressed the new Human-Rating Requirements for Space Systems (NPR 8705.2B), issued in May 2008 and summarized in a presentation by Mr. Wilson Harkins, Director of the Mission Support Division of NASA HQ. Mr. Marshall noted that the ASAP has been interested in these requirements for some time, but additional dialogue and technical review are necessary for the Panel to understand the rationale for the new changes. He also emphasized the need to understand the history underlying the evolution of the human-rating requirements (HRR) system, which began at the Johnson Space Center (JSC) in 1991; this release is the fourth revision. He suggested that after 16 years, a review of the system history and evolution is probably very timely. This NASA Procedural Requirement does not represent a replacement of program management staff, just the definition and implementation of the standards required to protect astronauts.

Mr. Marshall cited the implication of the HRR for, and their application to, the Commercial Orbital Transportation Services (COTS) mission and NASA as one of the issues of concern to the ASAP. He reported that the HQ Office of S&MA has confirmed that the FAA holds responsibility for oversight of commercial activities in space, so the HRR will not normally apply to COTS vendors of space tourism. However, if a commercial firm is carrying NASA astronauts or other mission personnel, the HRR would apply, so COTS manufacturers have an incentive to participate in, and comply with, the HRR system (beyond protecting their own personnel). As Mr. Marshall explained, the HRR standards provide the maximum capability to safely recover crew members from hazardous situations, but they are not, and do not conflict with, other in-place reviews and procedures. The HRR standards do not apply to the Shuttle, International Space Station (ISS), or Soyuz, which are mature programs in the latter stages of their lifetimes. However, the HRR will be available for, and applicable to, the Constellation Program. (In fact, as Mr. Marshall pointed out, the HRR revision process focused on Constellation and was heavily influenced by the members of the Constellation team, yet the change will be implemented NASA-wide.)

Mr. Marshall briefly described the six significant changes in the new HRR version. First, the certification official is now a body of people, specifically the NASA Associate Administrator (AA) supported by the AA for Space Operations, AA for Exploration Systems, technical authorities, and JSC Center Director. Second, the required Human-Rating Certification Package (HRCP) is now a series of discrete deliverables submitted at program milestones. Third, the HRR standards now apply to crewed test flights, which previously were not explicitly documented. Fourth, this HRR version implements changes to the technical mandatory standard citations, adding new documents and deleting those that no longer apply or have been

superseded. Fifth, the failure tolerance standard changed from no two failures resulting in crew or passenger fatality or permanent disability to the current minimum of one failure tolerant to catastrophic events, with the specific level of failure tolerance derived from an integrated design and safety analysis. As Mr. Marshall observed, the ASAP spent quite a bit of time discussing what this change means, but still requires further definition and enhanced clarity. The new standard introduces tremendous flexibility in satisfying this requirement, so significant focus is necessary to understand its scope and implications. Sixth, the inadvertent actions standard shifted from no two inadvertent actions (during operation or in-flight maintenance)—or a combination of one inadvertent action and one system failure—resulting in crew or passenger fatality or permanent disability to the current standard of a minimum of one inadvertent operator action (as identified by the human error analysis) without causing a catastrophic event and tolerance of one inadvertent operator action in the presence of a single system failure. Mr. Marshall concluded that this change also requires further definition and dialogue.

Ms. McDevitt observed that the probability of loss of crew (LOC) or loss of mission (LOM) underlies the HRR, which means that objectives must be declared, consistent with other requirements that necessitate the conduct of probabilistic risk assessments (PRAs). On the basis of previous and current use of PRAs in NASA, she concurred with NASA that the best application is performing trade studies (usually at the subsystem or element level), that is, reviewing various options and making the best decision on the appropriate course of action. However, the HRR standard specifies an “integrated design and safety analysis.” Ms. McDevitt said that comments from engineers at the NASA Centers indicated serious concern about whether PRA is sufficiently solid to use as a validation of compliance. She also expressed concern about the involvement and training of responsible personnel, who reside not only within the Agency, but also with the various contractors that develop elements and subsystems; these personnel must support the validation and verification of compliance to the numerical goals. Ms. McDevitt concluded that a considerable culture change will be required at NASA in implementing the new HRR; therefore, the Agency must devote its attention to delivering the necessary orientation and training so that all of the supporting organizations will consistently perform and apply the required integrated design and safety analysis.

Mr. Marshall expressed his concern that the results of PRA trade studies indicate that one option is better than another, but the “minimum” HRR standard demands that an option be as good as; without that, failure tolerance drops from two to one.

Admiral Dyer attempted to simplify the multivariate problem down to a two-level issue. The designer can incorporate a lot of weight and safety margin or less of both, but needs both a decision from management and good engineering practices (whatever that means in this context) to proceed. The ASAP therefore is concerned that the clarity of guidance required for design is not sufficiently transparent under the new HRR standard.

## **ARC CONSTELLATION PORTFOLIO**

Ms. McDevitt reviewed ARC activities in support of the Constellation Program, noting examples of particular relevance to program safety and referencing a presentation by Dr. Carol Russo, ARC Deputy Director of Exploration Technology. First, she reported that ARC has assumed the lead role on development of the thermal protection system (TPS) for the Orion Crew Exploration Vehicle (CEV), a natural role given the Ames arcjet facility and ARC’s considerable experience

in TPS development for the Space Shuttle. Second, ARC is developing a single heat shield for CEVs returning from both lunar orbit and low-Earth orbit (LEO) and, at the preliminary design review, will deliver the heat shield design to the prime contractor for subsequent production.

Ms. McDevitt commented that testing the various LEO and lunar orbit return conditions (the latter flying 70 percent faster than a returning Shuttle) will require more sophisticated arcjet facilities than those currently available at ARC, which are scheduled for upgrading.

Ms. McDevitt noted that ARC is supporting Orion by developing aerodynamic and aerothermal databases; conducting high-fidelity modeling and simulations; and performing aerodynamic and aeroacoustic testing and analysis (including use of the ARC wind tunnels). She reported that the ARC modeling and simulation capabilities have improved significantly over the last decade as ARC has assembled supercomputing resources that nearly doubled from 2007 to 2008 and are expected to triple from 2008 to 2009 (based on the number of processors). ARC now operates the third most powerful supercomputer in the world, offering NASA a unique capability that is well suited to complex Constellation simulations.

Ms. McDevitt emphasized that ARC also is working on the Simulation-Assisted Risk Analysis (SARA) project, which uses probabilistic risk analysis (PRA) and multidisciplinary physics-based models to analyze the launch abort system, stage separation, and blast wave propagation. As Dr. Bagian mentioned, ARC also is conducting centrifugal research to support the Ares thrust oscillation study of the effects of vibration and acceleration on crew performance.

In addition, Ms. McDevitt highlighted ARC work on mission assurance systems for Constellation, applying the commercially available Bugzilla software to develop a centralized, NASA-wide, Web-based, open source system that offers integrated searching and linking capabilities with other Constellation S&MA database systems, such as the Problem Reporting and Corrective Action (PRACA) system, Hazard Analysis database, Failure Modes Effects Analysis and Critical Items List databases, and Government Mandatory Inspection Point database. She concluded that ARC had achieved a huge success previously in developing a PRACA system that overlays existing database systems; both the Space Shuttle and ISS programs adopted this system.

## **ARC AERONAUTICS OPERATIONS**

Admiral Dyer emphasized the value of this opportunity to closely observe ARC operations, including its very interesting and important work on air traffic management (ATM) and ATC. He observed that existing delays will be compounded by the projected doubling of air traffic in the coming decade, creating a serious need to manage higher-density air traffic in all areas, including terminals and the ever-increasing number of high-density airports throughout the nation. ARC is working in cooperation with the FAA and other NASA Centers to address and offload the human element, transferring the ATM and ATC burden to automated computer operations. The Admiral noted that ARC is reviewing new means of aircraft separation.

As a resident ASAP civil aviation expert, Mr. Marshall commented that ARC is clearly a component of a much larger picture, but a very important component. Aviation safety is confronting increasingly formidable ATM and ATC challenges as the number of aircraft grows, augmented by the introduction of very light jets in the next 10 years (which will add some 5,000 aircraft to the nation's skies) and the expansion of general aviation and commercial flights. In short, the air traffic system is saturated, and a new system of control is absolutely required to

provide the necessary redundancy and safety while simultaneously addressing on-time performance. Mr. Marshall observed that ARC personnel are endeavoring to deconflict the passage of aircraft in limited and restricted airspace, and they earn very high marks for their contributions. In addition, ARC is supporting the FAA (the executive agency lead) and other Government agencies (e.g., the Department of Transportation, Department of Commerce, Department of Defense) to develop the Next-Generation Air Transportation System (NextGen).

General Bolden concurred, reporting that his opportunities to work with the FAA have confirmed that ARC work is particularly important in the development of NextGen and future aircraft. As new aircraft and systems emerge, ARC is cooperating with the FAA to maintain the nation's world-class air traffic system, and the General was impressed with ARC efforts.

General Bolden also described the ARC Vertical Motion Simulator (VMS), which he characterized as a national treasure, a one-of-a-kind simulator that can travel 60 feet vertically and 40 feet horizontally. The VMS system includes five interchangeable cabs that can be configured to simulate any aerospace vehicle (existing or planned). During its tour of the VMS, the ASAP observed a rudder loss test that ARC was conducting for the FAA.

## **ASAP RECOMMENDATIONS, FOURTH QUARTER, 2008**

**2008-04-01.** The ASAP notes that there is not a consistent Agency-wide understanding of the technical concerns associated with thrust oscillation for the Ares vehicle, especially with respect to the impact on crew performance due to the immediate and residual effects of launch vibration and acceleration. The ASAP therefore recommends that NASA ensure that all concerns are appropriately evaluated and communicated to stakeholders and that a consensus exists on the rationale for the solutions ultimately adopted.

**2008-04-02.** The ASAP recommends that NASA obtain greater validation that the new Human-Rating Requirements Standard meets the safety requirements of a broad range of future human spaceflight programs by scheduling an external review by an independent “gray-beard” assessment panel.

**2008-04-03.** After the Human-Rating Requirements Standard is reviewed and validated, the ASAP recommends that NASA develop specific guidelines and tools, widely available training courses, and implementation evaluation criteria that enable system safety and reliability personnel to effectively define and apply the new integrated design and safety analysis approach specified by the standard.

**2008-04-04.** The ASAP recommends that NASA designate an office of prime responsibility that will serve as the champion of the Human-Rating Requirements Standard process to ensure that every program and relevant subject-matter expert uniformly, objectively, and aggressively implements the new NPR 8705.2B standard.

**2008-04-05.** The ASAP recommends that the Executive Safety Committee (ESC) at each NASA Center ensure that the Center Director is fully informed about ESC activities and conclusions.



# NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

## CHARTER OF THE AEROSPACE SAFETY ADVISORY PANEL

### 1.0 OFFICIAL DESIGNATION

This charter sets forth the purpose for the Panel officially designated as the Aerospace Safety Advisory Panel, originally established under Section 6 of the National Aeronautics and Space Administration Authorization Act, 1968, as amended (P.L. 90-67, codified at 42 U.S.C. § 2477). The Panel was reauthorized in Section 106, Safety Management, Section 6, of the National Aeronautics and Space Administration Authorization Act of 2005, (P.L. 109-155). Further, the NASA Administrator hereby renews and amends the Panel's charter, pursuant to the Federal Advisory Committee Act (FACA), U.S.C. App. §§ 1 et seq.

### 2.0 PURPOSE AND DUTIES

2.1 The Panel shall draw on the expertise of its members and other sources to provide advice and make recommendations to the NASA Administrator on matters related to safety.

2.2 In accordance with 42 U.S.C § 2477 (as reauthorized in 2005), the Panel shall review safety studies and operations plans referred to it, including evaluating NASA's compliance with the return-to-flight and continue-to-fly recommendations of the Columbia Accident Investigation Board, and shall make reports thereon, shall advise the NASA Administrator and the Congress with respect to the hazards of proposed or existing facilities and proposed operations with respect to the adequacy of proposed or existing safety standards, and with respect to management and culture related to safety. The Panel shall also perform such other duties as the NASA Administrator may request.

### 3.0 REPORTING

The Panel will function in an advisory capacity to the NASA Administrator, the Congress, and through the NASA Administrator to those organizational elements responsible for the management of the NASA safety and mission assurance activities.

### 4.0 PANEL ORGANIZATION AND SUPPORT

4.1 Panel Members: In accordance with 42 U.S.C. § 2477 (as reauthorized in 2005), the Panel will consist of a maximum of nine members who will be appointed by the NASA Administrator. Members will be appointed for six-year terms. Members shall receive compensation as authorized in the NASA Authorization Act of 2005. Most members will serve as Special Government Employees (SGEs).

4.2 Panel Chairman: In accordance with 42 U.S.C. § 2477 (as reauthorized in 2005), one member shall be designated by the Panel as its Chairman.

4.3 Panel Composition: The Panel will be comprised of recognized safety, management, and engineering experts from industry, academia, and other Government agencies.

4.4 NASA Membership: In accordance with 42 U.S.C. § 2477 (as reauthorized in 2005), not more than four Panel members shall be chosen from the officers and employees of the National Aeronautics and Space Administration.

4.5 Panel Support: The Office of External Relations, NASA Headquarters, will provide staff support to the Panel. The Designated Federal Officer (DFO) will be appointed by the NASA Administrator and will serve as the Executive Director of the Panel.

## **5.0 PANEL REPORTS**

5.1 Findings and Recommendations: The Panel shall deliberate and report its findings and recommendations to the NASA Administrator. Findings that are time critical will be reported immediately.

5.2 Annual Report: The Panel shall submit an annual report to the NASA Administrator and to the Congress. Each annual report shall include an evaluation of the Administration's compliance with the recommendations of the Columbia Accident Investigation Board through retirement of the Space Shuttle.

5.3 Special Reviews and Evaluations: The NASA Administrator may request certain special studies, reviews, and evaluations. The Panel will submit reports with findings and recommendations, as deemed appropriate by the Panel, to the NASA Administrator within the timeline specified by the NASA Administrator.

## **6.0 ESTIMATED ANNUAL COSTS**

NASA Headquarters will provide the budget for operation of the Panel. The estimated annual operating costs total \$1,300,000, including two Full Time Equivalents (FTEs) for NASA civil servant staff support, technical report writing, travel, and meeting logistics support.

## **7.0 ESTIMATED NUMBER AND FREQUENCY OF MEETINGS**

7.1 Meetings: There will be four full Panel meetings held each year, on a quarterly basis, to perform the duties as described in Section 2.0.

7.2 Special Meetings: Special meetings of the full Panel may be required and supported as needed.

7.3 Additional Meetings: Additional meetings of individual Panelists or small groups of Panelists may be required for fact finding, preparatory or administrative work, and supported as needed.

## **8.0 DURATION**

Since the Panel is a nondiscretionary federal advisory committee required by statute, this charter shall become effective upon the filing of this charter with the appropriate U.S. Senate and House of Representative oversight committees. It shall terminate two years from the date of the filing of this charter unless renewed or terminated earlier by the NASA Administrator.

(Signed)

November 14, 2007

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Michael D. Griffin  
NASA Administrator

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Date

A large space shuttle is shown in the process of launching, ascending vertically against a dark blue sky. The shuttle is white with orange external tank and white boosters. A massive plume of white smoke and fire is visible at the base of the shuttle, indicating the start of the ascent. The shuttle is angled slightly to the right.

NASA Status of RTF Task Group  
"CAIB intent not met"  
CAIB Recommendations

John H. Casper

Associate Manager, Space  
Shuttle Program

July 16, 2008



## Today's Objective

Presenter **John H. Casper**

Date **07/16/08**

Page **2**

- **Closeout the three areas the Return To Flight Task Group determined “did not meet the intent” of the CAIB RTF recommendations:**
  - **External Tank (ET) Thermal Protection System (TPS) Modifications**
  - **Orbiter Hardening and TPS Impact Tolerance**
  - **TPS On-Orbit Inspection and Repair (repair portion only; inspection portion met)**



## Status of CAIB Recommendations - Background

Presenter **John H. Casper**

Date **07/16/08** Page **3**

- In August 2003, the CAIB provided 15 recommendations to be completed before the Space Shuttle Program (SSP) returned to flight
  - NASA agreed to comply with all CAIB Recommendations and to report progress to Congress
  - The SSP translated all CAIB Recommendations into program actions to the SSP projects and elements (for example, external tank, orbiter, and booster projects)
  - SSP added 15 “Raising the Bar” actions above and beyond the CAIB Recommendations
- After the CAIB disbanded in late 2003, NASA established the RTF Task Group (RTFTG) to assess how well NASA was implementing the CAIB Recommendations
  - The RTF Task Group reported findings in July 2005 and was disbanded
    - RTFTG found that NASA had fully implemented all but three of the CAIB RTF recommendations
    - ET Thermal Protection System (TPS) modifications, Orbiter Hardening, and TPS On-Orbit Repair
  - The Aerospace Safety Advisory Panel (ASAP) assumed responsibility for assessing the SSP’s continuous improvements to fly the Space Shuttle safely
- Prior to STS-114, the first RTF mission in July 2005, SSP closed all CAIB RTF recommendations and SSP “Raising the Bar” actions through the formal PRCB process
  - Closures were documented in NASA’s *Implementation Plan for Return to Flight and Beyond (RTFIP)*
    - This document was released periodically from 2003-2007
    - Provided public and congressional insight into the RTF process
  - Non-SSP actions were closed at the appropriate organization level
  - NASA HQ approved CAIB action closures and the Administrator signed the RTFIP, dated June 3, 2005





## Status of CAIB Recommendations - Background

Presenter **John H. Casper**

Date **07/16/08** Page **4**

- All CAIB Recommendations are closed
  - Closures were documented by the Program at PRCB prior to the first RTF mission in 2005
  - NASA HQ and the Administrator signed off the RTFIP closing the CAIB actions and presented the plan to Congress
- The SSP continuously improves and reassesses its operation to assure the goal of flying the Shuttle safely, accomplishing the mission, and completing the program by 2010
  - Implementation of the CAIB Recommendations is now embedded in the daily work processes, production procedures, and standards followed by the SSP
  - Following the Columbia accident, SSP projects/elements redesigned hardware and software, changed requirements, processes, and developed a new governance model which incorporated a strong institutional technical and safety authority
    - ET requirements were changed to reflect hardware redesigns and new production processes
    - Orbiter processing requirements were changed to accommodate more detailed inspections
    - Testing was implemented to augment analyses on RCC and tile durability
    - Procedures were developed for new on-orbit inspection techniques to verify integrity of the TPS
- NASA's ISS/SSP Standing Review Board in June 2008 suggested closing out all RTF Task Group "did not meet the intent" CAIB recommendations with the ASAP



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## EXTERNAL TANK (ET) THERMAL PROTECTION SYSTEM (TPS) MODIFICATIONS



## External Tank Initial Programmatic Initiatives

Presenter **John H. Casper**

Date **07/16/08** Page **6**

- **CAIB R3.2-1: Initiate an aggressive program to eliminate all ET TPS debris-shedding at the source with particular emphasis on the region where the bipod struts attach to the ET.**
  - **RTFTG comment: In spite of a great deal of excellent work on the part of the Agency and its contractors, the ET can still shed critical debris that could potentially result in critical damage to the Orbiter. It should be noted that the potential to liberate critical debris has been significantly reduced. (p38 of report, July 2005)**
- **Status Summary**
  - **Hardware and process changes implemented through RTF1, RTF2, and ET-128/STS-124 efforts have performed nominally**
    - **Overall damage volume has decreased significantly**
    - **Critical debris potential mitigated to acceptable level (see next chart)**
  - **Peer-reviewed post-flight evaluation process provides tight linkage to SSP for programmatic risk assessment and Engineering for consideration for hardware improvement/correction.**
  - **SSP continues to focus on continuous improvement and process control**
    - **Two additional TPS redesigns are in-work to reduce future debris potential**
      - **+Z Aerovent closeout**
      - **LOX Feedline Bracket Base Fitting closeout**





## Foam Debris Risk Summary

Presenter **John H. Casper**

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- **Risk profile improvements:**
  - The risk from the 1.6 lbm foam release on STS-107 has been reduced by a factor of over 1000
  - The highest foam debris risk to RCC has been reduced since RTF from approximately 1/250 to 1/2,500
  - The highest foam debris risk to tile has been reduced since RTF from approximately 1/300 to 1/3,330
- Since the removal of the Protuberance Airload (PAL) Ramp after STS-114, the largest piece of foam released since RTF is more than 25 times smaller than the piece of foam that struck Columbia
- On average, the Orbiter belly TPS damage volume has been decreased by more than 50% since RTF
  - This is attributed primarily to a reduction in the amount and size of foam debris
- The risk level in the Shuttle Integrated Risk Management Application (SIRMA) system has been reduced from a 5x5 (very likely) to a 2x5 (very unlikely) in terms of likelihood since RTF



## External Tank Initial Programmatic Initiatives

Presenter **John H. Casper**

Date **07/16/08**

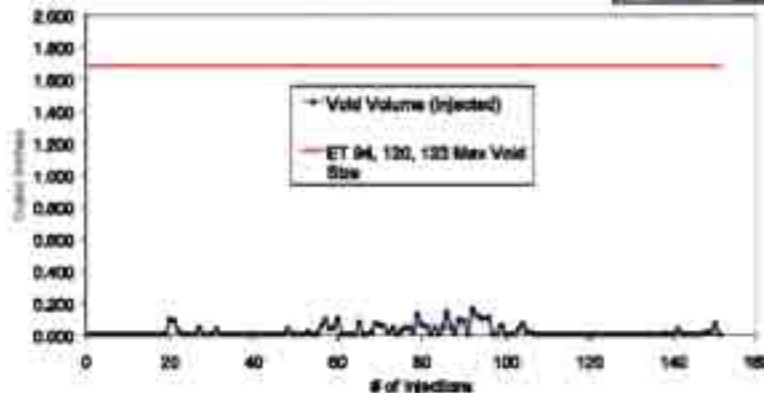
Page **8**

*External Tank recognized the need to increase integrity of TPS from a engineering and manufacturing standpoint. It instituted two plans in the ET contract (NAS8-36200 and continued under NAS8-00016).*

- **ET Process Control Plan (MMC-ET-SE66)**
  - manages process control over all TPS and TPS repairs
  - all TPS was considered for redesign that would incorporate changes in process design, spray technique development, training/certification of TPS technicians, proficiency demonstrations, usage of high fidelity production test articles, and video recording of process
  - all TPS was considered for new and/or enhanced TPS process controls, verifications, and inspections
  - installed Process Control Board that integrates Engineering, Safety, and Production disciplines and available to assess new issues relative to process control
- **ET Postflight Engineering Evaluation Plan (MMC-ET-SE67)**
  - provides clear postflight assessment direction and to communicate concise guidelines and information
  - Provides for clear 'closed loop' process from postflight hardware assessment (via separation image analysis) to programmatic communication to ET corrective action



Stringer Void Volumes



**STS-114 Design Changes for Debris Minimization**

Presenter **John H. Casper**  
 Date **07/16/08** Page **9**

- Redesigns for Debris Mitigation – RTF I
- STS-114/July 2005



*Remove/Replace Longeron Closeouts*

*LO2 Feedline Bellows  
 TPS Drip Lip  
 (3 Stations) & Heater  
 @ XT 1106*



*Redesigned Bipod Fitting & TPS Closeout*



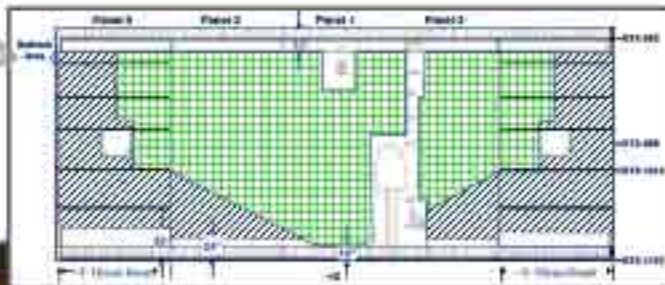
*Intertank/LH2 Tank Flange Closeout Enhancement*



*Partial LH2 PAL Ramp Replacement (fwd 10 ft.)*



*LO2 Feedline Fairing Camera*



*Increased venting I/T foam*



## STS-114 Mission Performance Summary In-Flight Anomaly Foam Loss Events

Presenter **John H. Casper**

Date **07/16/08** Page **10**

### Thrust Strut Flange TPS Closeout

- **Most Probable Cause Scenario(s):** Secondary impact or multiple subsurface voids resulting in observed foam loss



### Intertank/LH2 Tank Flange, 2 locations

- **Most Probable Cause Scenario:** Foam loss caused by voids in the close-out manual spray foam subjected to ascent thermal and pressure environments

### LH2 Tank Acreage, 2 locations

- **Xt 1160 Most Probable Cause Scenario:** Work induced damage or delta pressure void in adjacent repair
- **Xt 1851 Most Probable Cause Scenario:** Cryopumping divot event due to voids, cracks and/or delaminations



### Bipod Fitting Closeout

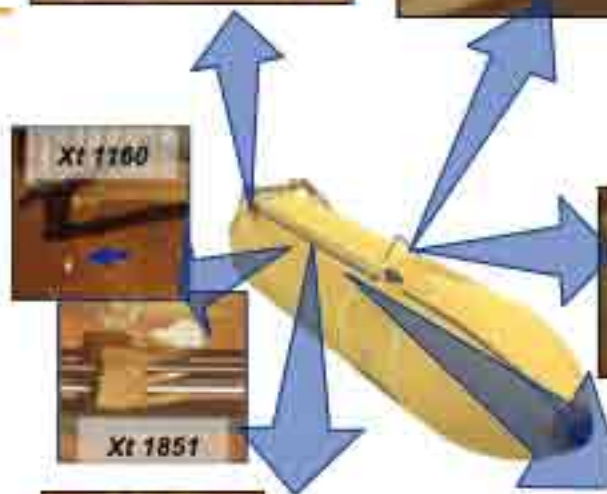
- **Most Probable Cause Scenario:** Divot caused by cryoingestion through and into cable



### LH2 PAL Ramp

#### • **Most Probable Cause Scenario (combination of the following)**

- Cryopumping of outside air through leak path connecting to atmosphere
- Defects(s) and or damage to initiate failure or driving force to peel foam from tank



### LH2 Ice/Frost Ramps (IFRs), 3 locations

- **Xt 1262 and 1841 Most Probable Cause Scenario:** Divotting due to an internal process-induced void and delta pressure
- **Xt 1525 Most Probable Cause Scenario:** Impact during ascent due to TPS, ice or other Shuttle element debris

# External Tank Design Changes for Debris Minimization

Presenter	John H. Casper	
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- Redesigns for Debris Mitigation – RTF II
  - STS-121/July 2006

*Bipod Harness Mods  
(Debris Mitigation for  
STS-114 IFA Cause)*



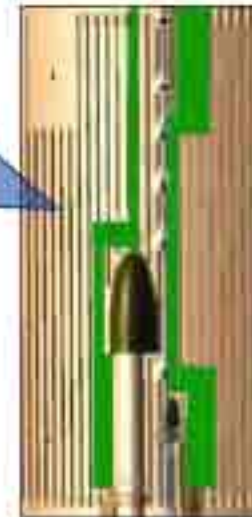
*LH<sub>2</sub> PAL Ramp*



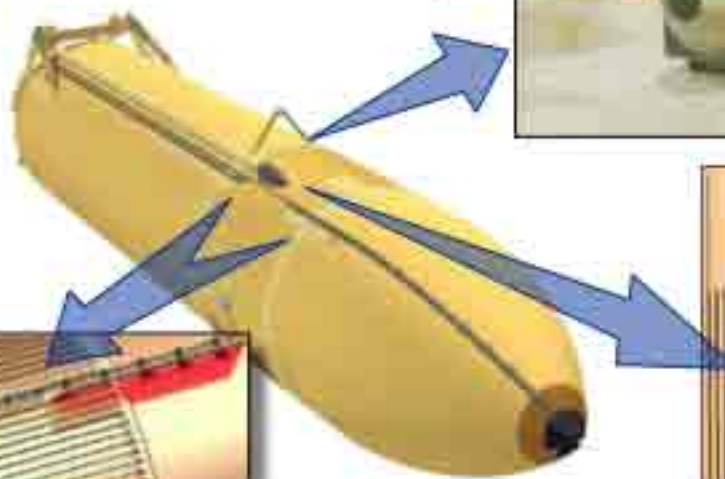
*LO<sub>2</sub> and LH<sub>2</sub> PAL Ramp  
Elimination (Debris Mitigation)*



*LO<sub>2</sub> PAL Ramp*



*Increased venting I/T foam*







## External Tank Recurring Anomaly Review

Presenter **John H. Casper**

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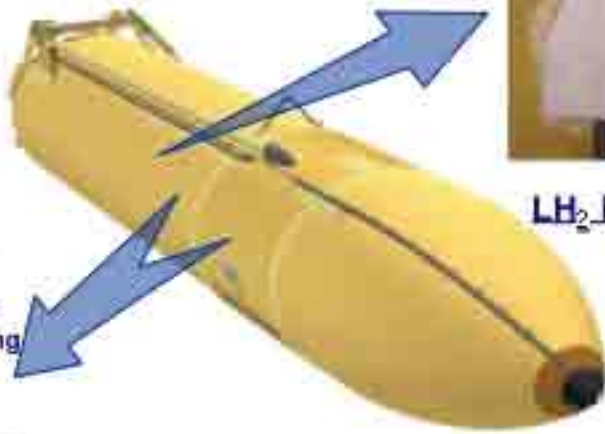
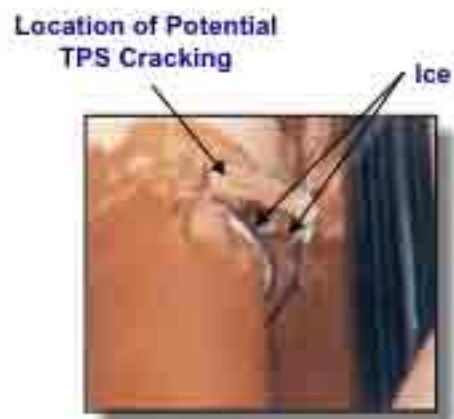
### • Post-RTF Performance – Recurring Events

- IFR and adjacent foam loss
  - Redesigned LH2 IFR's on ET-128 and subs
  - Prior to RTF, 180 losses experienced (no losses observed on ET-128 IFRs postflight inspection)
- Intertank-to-LH<sub>2</sub> Tank flange losses
  - RTF redesign includes features to reduce leak paths and reservoirs
  - Currently observed flange losses are relatively small (<0.025 lb) and late relative to sensitive transport time (low risk).
- LH<sub>2</sub> Tank Acreage (Barrel 4)
  - Process enhancements include protective pads ET-128 and subs
  - NDE/tactile inspections implemented at KSC on ET-120, -125, -126, and -128.
- LO<sub>2</sub> Feedline Bracket to LOX feedline TPS interface
  - Implemented Titanium LO<sub>2</sub> Feedline Bracket Yokes and modified upper TPS closeout ET-128 and subs (no losses observed on ET-128 during postflight inspection)
  - Prior to RTF, 20 losses experienced (no losses observed on ET-128 IFRs postflight inspection)
- LO<sub>2</sub> Feedline Bracket adjacent acreage losses
  - Redesign LO<sub>2</sub> feedline bracket base closeout at X<sub>T</sub> 1129 – target implementation ET-130

***RTF mods have performed well. Confidence in physical understanding of failure modes which served as basis for redesigns has been supported. Minor corrections (e.g. LH2 flange losses) to debris predictions have been incorporated into programmatic risk assessment. Currently observed losses are bounded by previous observations in high fidelity ground-based testing and low mass potential (due to design change).***

# ET-128 (Inline) LH<sub>2</sub> Ice Frost Ramp and LOX Feedline Bracket Redesign

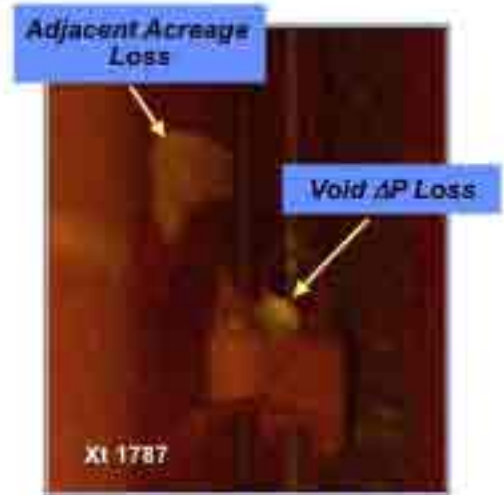
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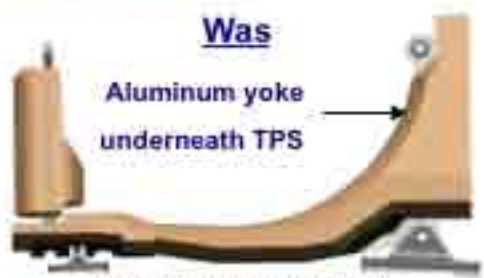
LH<sub>2</sub> Ice/Frost Ramp



LO<sub>2</sub> Feedline Support Yoke Redesigned to Address Ice and Reduce Potential for TPS Cracking



STS-123 / ET-126  
LH<sub>2</sub> Ice Frost Ramp Losses



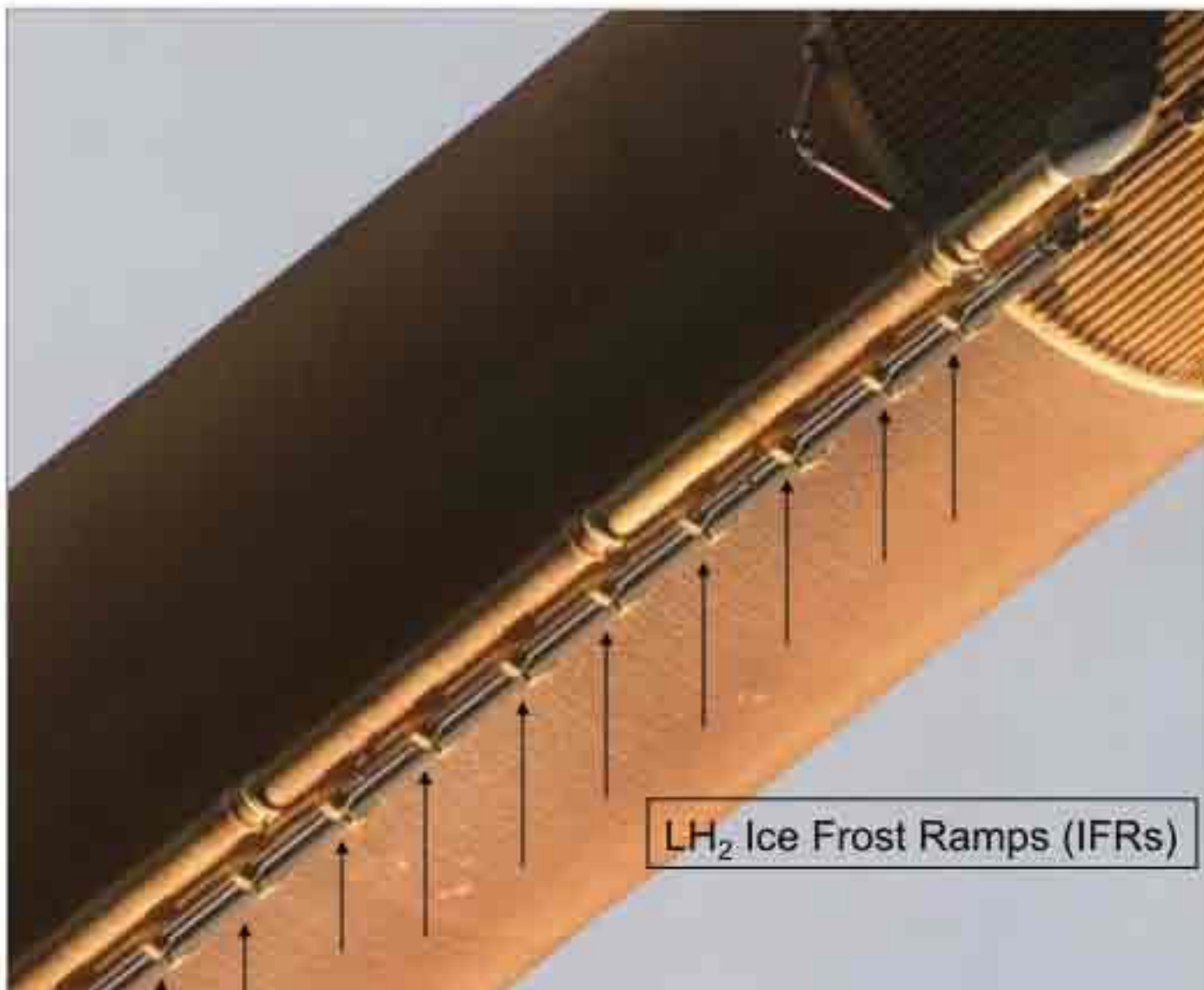
Foam removed between yoke & yoke removed for clarity

# STS-124/ET-128 Postflight Assessment

Presenter **John H. Casper**

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LH<sub>2</sub> Ice Frost Ramps (IFRs)



# External Tank: Examples of losses from pre-RTF to post-RTF

Presenter: John H. Casper

Date: 07/16/08

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Summary of STS-114/ET-121 Foam Loss

No.	Location	Model Stage	Model Status	MET	Size			Coordinates				Material Density (lb/ft <sup>3</sup> )	Volume (ft <sup>3</sup> )	Mass (lbsm)
					Length (in.)	Width (in.)	Depth (in.)	X	Y	Z	Disp (inches)			
1	LH2 PAL Ramp	ET-114	Under Review	127 F	35.1	11.0	0.7	1281	100	535	0	2.12	350.0	1.051

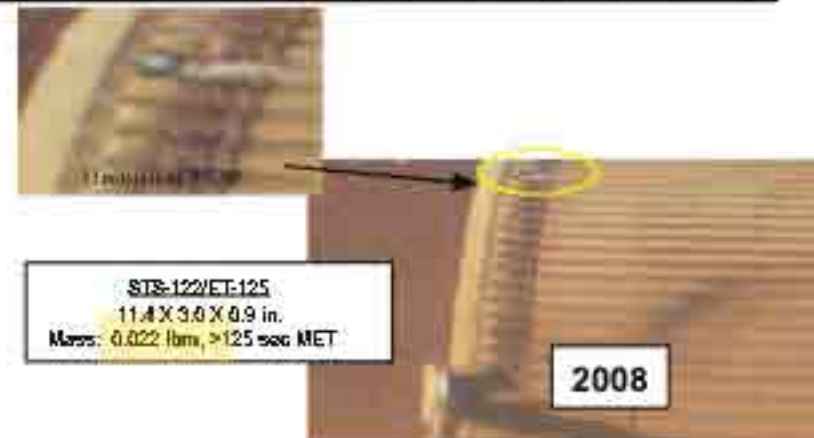
Potential large debris locations such as Bipod closeout, LOX and LH PAL Ramps and Ice/Frost Ramps have been addressed through design or process change



STS-107 Configuration



STS-114 Configuration



<b>External Tank</b>		Presenter	<b>John H. Casper</b>
<b>In-Line Design Changes planned for Debris Minimization</b>		Date	<b>07/16/08</b>
		Page	<b>16</b>

- **Baselined Debris Minimization Plan for Future In-Line Redesigns**
  - Twenty-four (24) debris minimization initiatives were developed, analyzed for their technical feasibility/ value and assessed against programmatic risk reduction potential
    - ET originally developed 3/2007
    - SE&I/DIG screening 11/2007
    - final determination – PRCB – 3/2008
  - Two incorporated (LH<sub>2</sub> IFR and LOX feedline yoke)
  - Two in-work (+Z Aerovent, LOX feedline base closeout)

In-Work (target ET-135)




**+ Z Aerovent**

- *Eliminates non-thermal TPS per CAIB*




In-Work (target ET-130)



**LO2 Feedline Yoke IB & OB Base Closeout**

- *In-line TPS Closeout Mitigates Critical Debris Liberation Mechanism*

• *Observed LO2 Feedline Bracket Base Closeout Adjacent Acreage Losses at Station 1129 on 3 of 8 Post RTF missions*



## ET Summary

Presenter **John H. Casper**

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- NASA has initiated and continues to improve an aggressive program to eliminate all critical ET TPS debris-shedding
  - **Hardware and process changes implemented since RTF have performed nominally**
  - **No releases of critical debris have occurred since STS-114**
  - **Since removal of the PAL ramps for STS-121, the largest piece of foam released since RTF is more than 25x smaller than the 1.67 lbm of foam that struck Columbia**
- We have significantly reduced the risk of Orbiter damage due to ET debris
  - **Foam debris risk to RCC has been reduced from approximately 1/250 to 1/2,500**
  - **Foam debris risk to Tile has been reduced from approximately 1/300 to 1/3,330**
  - **The risk from the 1.67 lbm foam release on STS-107 has been reduced by a factor of over 1000**
- We continue to focus on continuous improvement and process control



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## ORBITER HARDENING





**CAIB Recommendation 3.3-2  
Orbiter Hardening (RTF)**

Presenter **John H. Casper**

Date **07/16/08**

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- ***CAIB R3.3-2: Initiate a program designed to increase the orbiter's ability to sustain minor debris damage by measures such as improved Reinforced Carbon-Carbon and acreage tiles. This program should determine the actual impact resistance of current materials and the effect of likely debris strikes.***
  - **RTFTG comment: the lack of a long-term approach to RCC hardening --- Shuttle to retire in 2010 ---- and the amount of remaining non-standard open work on ice debris, risk analysis, and verification of damage models. (report p48)**
- **Status Summary**
  - **SSP initiated a program appropriate for the remaining service life of the Shuttle and has hardened critical areas of the TPS**
  - **We have a mature set of tools for analyzing and mapping the TPS**



## Orbiter Hardening Summary

Presenter **John H. Casper**

Date **07/16/08** Page **20**

- **NASA has initiated and aggressively implementing TPS hardening modification on all three Orbiters since RTF.**
  - **MLGD corner void elimination (complete)**
  - **FRCS bonded stud elimination (complete)**
  - **Wing spar protection (complete)**
  - **BRI-18 modification (in process)**
  - **Thicker window modification (complete)**
- **Special tile replacement with BRI-18 continues on all three Orbiters**
  - **OV-103 and OV-104 are 100% complete for the top 5 priority areas**
  - **OV-105 is 100% complete for the top 4 priority areas and 10% complete for Priority 5 (BRI-18 tile change-out on LESS carrier panels)**
  - **In addition to the top five priority areas, BRI-18 tiles are also being aggressively implemented at other lower priority areas (ET, MLGD, NLGD, and windows)**
- **Since the RTF Task Group report in June 2005, significant work has been performed on foam debris, ice debris, risk analysis, and verification of damage models**

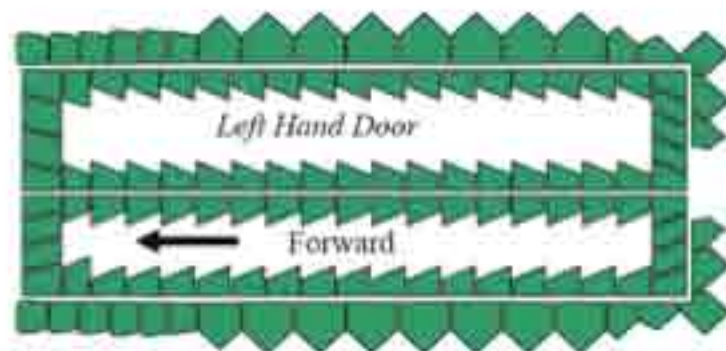
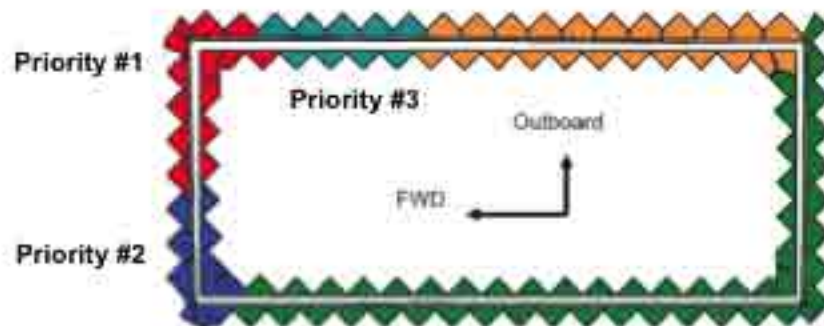
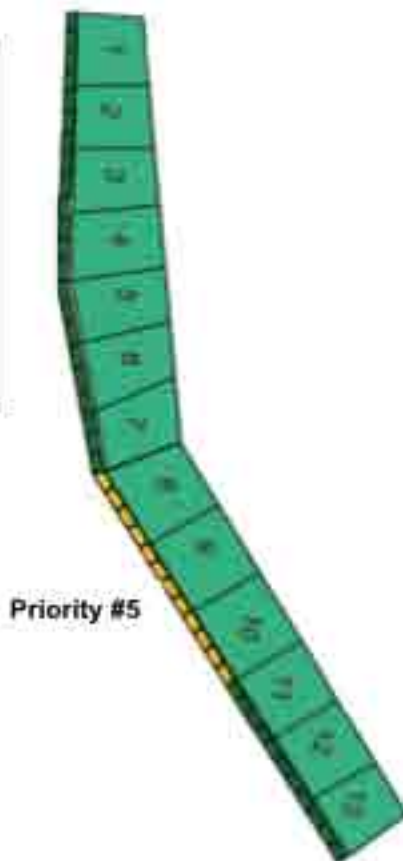
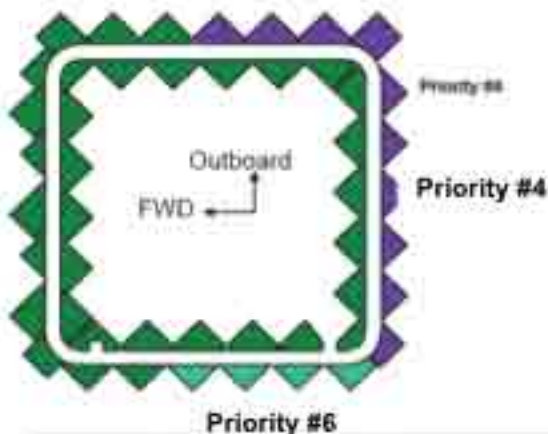
# Orbiter BRI-18 ATTRITION MOD STATUS

Presenter **John H. Casper**

Date **07/16/08** Page **21**

## BRI-18 Priority 1-6 Areas

1. MLGD - Fwd/OB Corner
2. MLGD - (2A) Subset
3. MLGD - (2A) Subset
4. ET Doors – AFT STR Side
5. LESS "Hot Panels" 8-10
6. ET Doors – I/B STR Side



PRIORITY AREA	1	2	3	4	5	6	Total (1-6)	Others	Total (All)
<b>Total Per Vehicle</b>	<b>28</b>	<b>22</b>	<b>18</b>	<b>20</b>	<b>24</b>	<b>8</b>	<b>120</b>		
<i>OV-103 Complete as of 7/1/08</i>	28	22	18	20	24	8	120	20	140
<i>OV-104 Complete as of 7/1/08</i>	28	22	18	20	24	1	113	27	140
<i>OV-105 Complete as of 7/1/08</i>	28	22	18	20	2	8	98	57	155





## Orbiter TPS Damage Assessment Team

Presenter **John H. Casper**

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- The Thermal Protection System (TPS) Damage Assessment Team (DAT) process is well established and has been executed successfully on all missions since return to flight
- Tile and RCC damage allowable maps as well as a large database of site specific assessments have been produced
- Physics-based models used in the damage assessment process have been extensively *validated* through impact, wind tunnel and arc jet testing
  - Phase I validated the model elements individually
  - Phase II is validating the integrated model with over 100 cases and comparing model predictions to flight data
- All assessment tools are configuration-controlled in the Orbiter Critical Math Model Database
  - Analysis uncertainties are well documented and communicated to the Mission Management Team
- Using these models and tools, impact tolerance allowables for tile and RCC have been provided to the SE&I team for risk assessment of all ascent debris sources





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## **Thermal Protection System Inspection and Repair**



<b>CAIB Recommendation 6.4-1</b> <b>Thermal Inspection System Inspection and Repair (RTF)</b>	<b>Presenter</b> <b>John H. Casper</b>
	<b>Date</b> <b>07/16/08</b> <b>Page</b> <b>24</b>

- ***CAIB R6.4-1: For missions to the ISS, develop a practicable capability to inspect and effect emergency repairs to the widest possible range of damage to the TPS, including both tile and RCC, taking advantage of the additional capabilities when near to or docked at the ISS.***
  
- **RTFTG comments: NASA has satisfied the inspection portion of this recommendation. The TPS repair options manifested on STS-114, even if they are certified, cannot repair the range of damage that could occur. There is a gap between possible debris liberation and the ability of the Orbiter TPS to withstand damage and to repair damage. (report p93)**
  
- **Status Summary**
  - **The Shuttle Program has continued to improve its repair capabilities**
  - **We have an operational capability to repair most likely damage, should it occur**



## Repair Capabilities

Presenter **John H. Casper**

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- Tile repair hardware are available for on-orbit tile repair
  - **Emittance Primer Coating (EPC), a.k.a. Emittance Washer Applicator (EWA)**
    - **Minor tile coating and shallow tile damage**
  - **Tile Repair Ablator Dispenser (T-RAD)/STA-54**
    - **Limited volume tile damage and door seal penetration**
  - **GFE Tile Overlay Repair (GTOR)**
    - **Large tile damage/missing tiles**
- RCC repair hardware are available for on-orbit RCC repair
  - **Non-Oxide Adhesive Experimental (NOAX)**
    - **Coating loss, cracks, gouges, and small holes (<.5" in diameter)**
  - **Plugs**
    - **Intermediate holes (1.1" to 4" in diameter)**

# On-Orbit Tile Repair: EPC Repair

Presenter **John H. Casper**

Date **07/16/08**

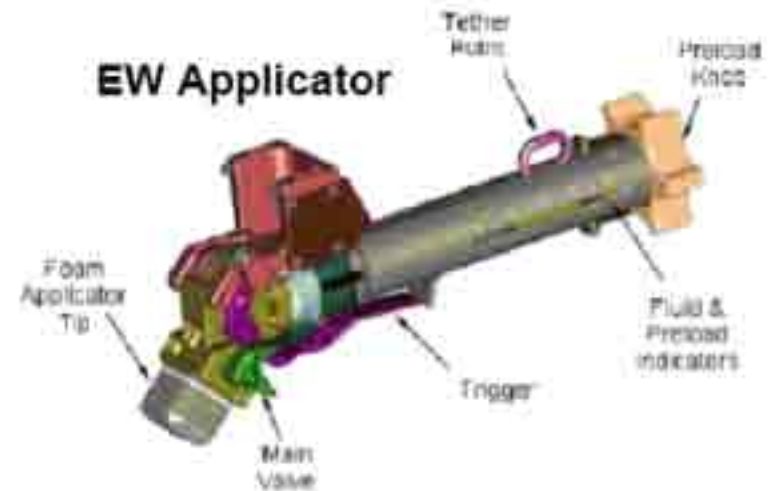
Page **26**

## • Concept Description

- EPC is a RTV base material with silicon carbide filler and is dispensed/applied on damaged tile surfaces via Emittance Wash Applicator (EWA) and/or foam tip brushes
- Each applicator has 0.12L of EPC material
- Real-time assessment will be conducted using baselined 3D thermal math model with updated emittance (0.76) and catalytic factors from arc-jet testing to determine the effectiveness of this repair

## • Demonstrated Capability

- EPC application was successfully demonstrated during STS-114 DTO
- Arc-jet testing has conclusively demonstrated its thermal performance for shallow tile and tile coating damage



STS-114 DTO Tile



EW Being applied to damaged tile



# On-Orbit Tile Repair: T-RAD/STA-54 Repair

Presenter **John H. Casper**

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## • Concept Description

- A two-part RTV based material (STA-54) dispensed via a pneumatic dispenser on-orbit to fill damaged tile cavities.
- Tile Repair Ablator Dispenser (T-RAD) is capable of delivering up to 100 in<sup>3</sup> of STA-54 material.
- EPC will first be applied onto damaged tile substrate as an adhesive primer for STA-54.
- Real-time thermal analytical tool/ablation model will be run to predict material performance.

## • Demonstrated Capabilities

- Multiple STA-54 dispenses in dual glove boxes were successfully completed including a simulated nose landing gear door (NLGD) tile damage.
- Successfully completed an end-to-end T-RAD/STA-54 on-orbit DTO.
- Postflight evaluation of the DTO samples indicated similar material properties as ground prepared samples. Arc-jet testing of DTO samples scheduled for August 2008.



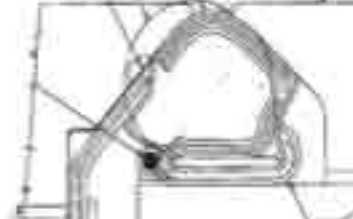
MLGD Seal



TRAD Assembly



NLGD Seal



ETD Seal



Angle Stamp



STA-54 Dispense Demo (MLGD)

# On-Orbit Tile Repair: T-RAD/STA-54 Repair

Presenter **John H. Casper**

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**Repaired NLGD test article  
(Post arc-jet test)**



**STS-123 DTO  
On-Orbit Photo**



**STS-123 DTO  
Post Flight Photo**



**Cross Section of  
Repaired NLGD test article  
(Post arc-jet test)**



**LM Dispensed DTO Sample**

# On-Orbit Tile Repair: GTOR Repair

Presenter **John H. Casper**

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## • Concept Description

- GFE Tile Overlay Repair (GTOR) system re-establish OML by covering the tile damage with a thin, flexible plate; protect structural temperature with insulation
- Tile Overlay repair hardware consists of four components: coated C/SiC overlay plate, compliant alumina (Saffil) as a gasket, saffil blankets for inside the cavity, augers/washers
- Overlay is targeted to repair Orbiter tile acreage areas having radius of curvature greater than 40"

## • Demonstrated Capability

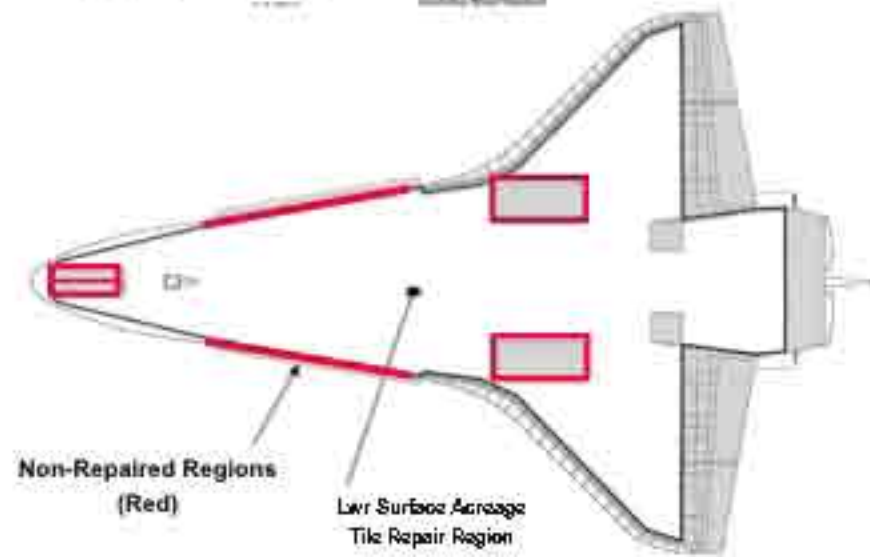
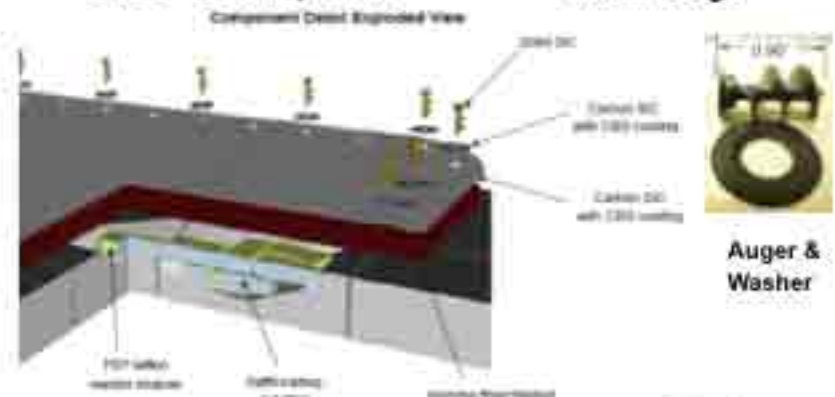
- GTOR system, component, and material analyses and testing performed to-date has demonstrated it's capability in meeting thermal and structural loads resulting from expected environment at two body points (1800 and 1075)
- Full scale system radiant and vibration, and sub-scale arc-jet testing on flat tiles demonstrated its thermal protection and structural capability
- 3 Degrees of Freedom (DOF), 6 DOF, and NBL testing concluded Overlay plate can be installed on-orbit



**C/SiC Overlay Plate**



**Saffil Bags**





## On-Orbit RCC Repair: Plug Repair

Presenter **John H. Casper**

Date **07/16/08**

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### • Concept Description

- Plug Repair designed for through-penetrations and bruised areas of RCC: 1.1 to 4 inches in diameter
  - Coated C-SiC cover plates with molybdenum alloy attach body and T-Bar for backside attachment
  - Custom curvatures (19 Total) fit majority of damage sensitive regions of wing leading edge panels 1-18
  - Non-Oxide Adhesive Experimental (NOAX) sealant applied around edge of Plug cover plate for added gap flow protection



Plug Installation – T-Bar Retracted



T-Bar Fully Extended  
(Backside View)

### • Demonstrated Capability

- Plug Repair installation successfully demonstrated IVA on STS-114
- Completed end-to-end installation and ground testing of two full scale Plug Assemblies (arc-jet tested to 2960 F)
- Completed system level testing of Plug assembly and components including panel fit model mapping and testing, protuberance heating factor test, and high temperature attach hardware load test



# On-Orbit RCC Repair: NOAX/Crack Repair

Presenter **John H. Casper**

Date **07/16/08**

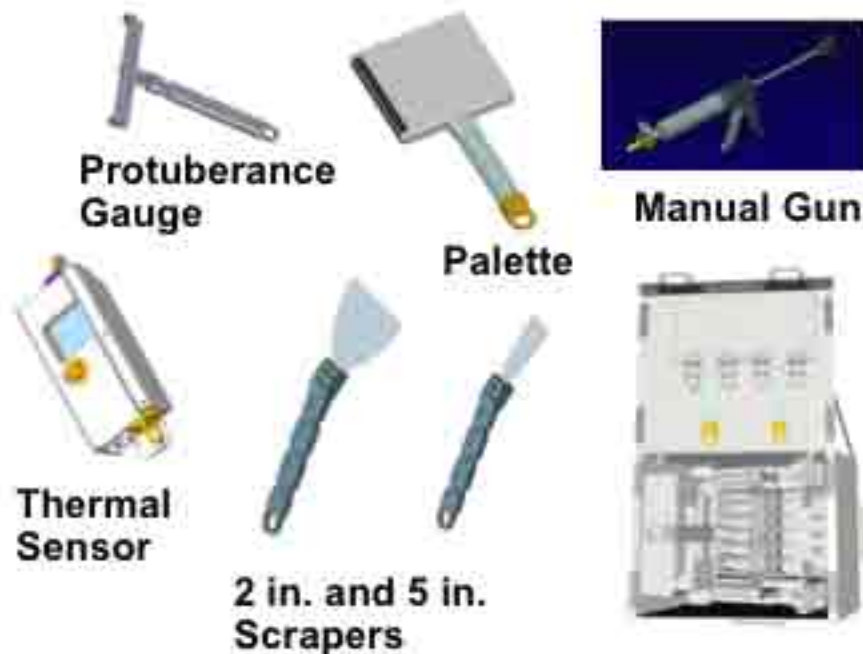
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## • Concept Description

- Non-Oxide Adhesive Experimental (NOAX) is a single part, pre-ceramic polymer heavily loaded with solids; NOAX stowed IVA
- Crack Repair System used to repair RCC coating damage, cracks, gouges, and small holes by applying NOAX using manual applicator and EVA tools
  - Cracks and damaged coating: 0.080" to 4.0"
  - Holes: 0.125" to 0.375"

## • Demonstrated Capability

- NOAX repair successfully demonstrated EVA on STS-114 and STS-121 DTOs
- STS-121 DTO samples successfully repaired and tested in the arc jet postflight
- Empirical testing program performed to address damage types, geometries, and application/cure parameters



**STS-114 DTO Porosity Sample**



**STS-121 DTO Samples (5)**



**Manual Gun**



**Crack Repair Bag**



**Thermal Sensor**



**2 in. and 5 in. Scrapers**



**Protuberance Gauge**



**Palette**



## TPS Repair Summary

Presenter **John H. Casper**

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- NASA has successfully developed three on-orbit tile repair systems and two on-orbit RCC repair systems
- NASA has delivered and flown TPS repair hardware for all flights post STS-114
- Successful ground tests and on-orbit tests of all five repair systems provide the additional confidence that each of the repairs can be implemented on-orbit and serve its repair function for the intended design requirement (design reference case)



## Conclusions

Presenter **John H. Casper**

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- ET modifications: NASA has significantly reduced the potential for critical debris liberation from the ET
  - **Foam debris risk to RCC has been reduced from approximately 1/250 to 1/2,500**
  - **Foam debris risk to Tile has been reduced from approximately 1/300 to 1/3,330**
  - **Hardware and process changes implemented since RTF have performed nominally**
    - **No releases of critical debris have occurred since STS-114**
    - **Since removal of the PAL ramps for STS-121, the largest piece of foam released since RTF is more than 25x smaller than the 1.67 lbm of foam that struck Columbia**
- Orbiter Hardening: NASA has initiated and aggressively implemented TPS hardening modifications on all three Orbiters since RTF
- TPS Repair: NASA has successfully developed three on-orbit tile repair systems and two on-orbit RCC repair systems
  - **NASA has delivered and flown TPS repair hardware for all flights post STS-114**
  - **Successful ground and on-orbit tests of all five repair systems provide confidence they can be implemented on-orbit and will survive re-entry**



## Recommendation to ASAP

Presenter **John H. Casper**

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- **Close the three areas the Return To Flight Task Group determined “did not meet the intent” of the CAIB RTF recommendations:**
  - **External Tank (ET) Thermal Protection System (TPS) Modifications**
  - **Orbiter Hardening and TPS Impact Tolerance**
  - **TPS On-Orbit Inspection and Repair (repair portion)**





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**BACKUP**



## Space Shuttle Missions flown since Columbia/STS-107

Presenter **John H. Casper**

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Mission #	ET	Launch/NET
STS-114	121	Jul 2005
STS-121/ ULF 1.1		Jul 2006
STS-115/12A	118	Sep 2006
STS-116/12A.1	123	Dec 2006
STS-117/13A	124	Jun 2007
STS-118/13A.1	117	Aug 2007
STS-120/10A	120	Oct 2007
STS-122/1E	125	Feb 2008
STS-123/1J/A	126	Mar 2008
STS-124/1J	128	May 2008
<hr/>		
STS-125/HST-SM4	127	Aug 2008
STS-126/ULF2	129	Oct 2008
STS-119/15A	130	Dec 2008

Mission #	ET	NET Date
STS-127/2J	131	Jan 2009
STS-128/17A	132	Apr 2009
<u>Six Person Crew</u>		
STS-129/ULF3	133	Jul 2009
STS-130/19A	134	Sep 2009
STS-131/ULD4	135	Jan 2010
STS-132/20A	136	Apr 2010
STS-133/ ULF 5	137	Jul 2010

**\*NOTE:**  
Dates for missions after  
STS-126 are currently being  
reviewed.

## Failure Mechanism Summary

Presenter **John H. Casper**

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- **Void DP:** a foam failure mode stemming from an existing internal defect or "void"
  - Failure and foam release is a function of several variables, including location and orientation
  - The environments affecting these variables are aerodynamic heating and ascent depressurization
- **Airloads:** aerodynamic loads that peak at or before MaxQ
  - MaxQ varies between 60-65 seconds
  - Peak loads vary as a function of local conditions
- **Cryopumping:** limited to the LH2 tank
  - A void near the tank metal surface with a leak path to ambient air.
  - Air in the void condenses and freezes reducing pressure in the void.
  - Over time more air is slowly drawn into the evacuated void.
  - The process continues until the void fills with solid/liquid air.
  - During ascent, the tank wall is heated rapidly, by heated GH2 tank pressurization gas.
  - Foam loss will occur once the pressure of the liquid/gaseous air mixture trapped in the void exceeds the strength of the foam.
- **Cryo-ingestion:** unique to the LH2 flange
  - A void near the tank metal surface with a leak path to the inter-tank y-joint.
  - The un-insulated portion of the y-joint condenses nitrogen in the inter-tank.
  - The void fills with LN2 from the y-joint.
  - The process continues until the void fills with liquid nitrogen.
  - During ascent, the flange structure is heated from aerodynamic heating and GH2 tank pressurization gas.
  - Foam loss will occur once the pressure of the liquid/gaseous mixture trapped in the void exceeds the strength of the foam.

### Cryopumping induced foam loss



Surface breaking crack communicating with subsurface void



Cold substrate (-423 F) condenses/freezes air



Void slowly fills with condensed/frozen air.



During ascent, substrate heats rapidly. The void either vents or results in a divot.