Aerospace Safety Advisory Panel

Annual Report for 2009

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

January 15, 2010

The Honorable Charles F. Bolden, Jr.
Administrator
National Aeronautics and Space Administration
Washington, DC 20546

Dear General Bolden:

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 2009 to the U.S. Congress and to the Administrator of the National Aeronautics and Space Administration (NASA). ASAP members believe that NASA and the Administration face significant challenges for the Nation's space program. Following the precedent set in 2008, the ASAP again provides this letter report in lieu of the lengthier annual report submitted in previous years.

This letter report is based on the Panel's 2009 quarterly meetings (and public session minutes), fact-finding meetings, and formal recommendations, as well as ASAP members' past experiences.

In Section II of this report, the Panel provides a summary of key safety-related issues that the Agency confronts at this time. The most important relate to the future of the Nation's human space flight program, and the ASAP hopes to encourage key stakeholders to immediately consider the critical decisions relating to this mission.

Significant issues include human rating requirements for potential commercial and international entities, extension of Shuttle beyond the current manifest, workforce transition from the Shuttle to the follow-on program, the need for candid public communications about the risks of human space flight, and the more aggressive use of robots to reduce the risk of human exploration.

Towards the end of the reporting period, a number of alternatives to the Exploration "program of record" began to surface. The Panel has not yet had the opportunity to evaluate any of these concepts with regard to inherent safety issues, but cautions against abandoning the baseline vehicle for an unproven alternative without demonstrated capability. The inherent safety of any and all approaches must be fully assessed to ensure that a level of safety necessary to support human transport is offered. Additionally, there must be a balance and harmony between the size and scope of the undertaking and the budget provided to design, develop and execute it. The Panel stands ready to evaluate the safety aspects of alternative concepts if such a change is considered.

The Panel hopes that our summary of critical safety-related issues will help focus attention on the important decisions and the direction of the Agency.

NASA's senior leaders and staff members offered significant cooperation to support the completion of this document. I therefore submit the ASAP Annual Report for 2009 with 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

January 15, 2010

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

Dear Mr. President:

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 2009 to the U.S. Congress and to the Administrator of the National Aeronautics and Space Administration (NASA). ASAP members believe that NASA and the Administration face significant challenges for the Nation's space program. Following the precedent set in 2008, the ASAP again provides this letter report in lieu of the lengthier annual report submitted in previous years.

This letter report is based on the Panel's 2009 quarterly meetings (and public session minutes), fact-finding meetings, and formal recommendations, as well as ASAP members' past experiences.

In Section II of this report, the Panel provides a summary of key safety-related issues that the Agency confronts at this time. The most important relate to the future of the Nation's human space flight program, and the ASAP hopes to encourage key stakeholders to immediately consider the critical decisions relating to this mission.

Significant issues include human rating requirements for potential commercial and international entities, extension of Shuttle beyond the current manifest, workforce transition from the Shuttle to the follow-on program, the need for candid public communications about the risks of human space flight, and the more aggressive use of robots to reduce the risk of human exploration.

Towards the end of the reporting period, a number of alternatives to the Exploration "program of record" began to surface. The Panel has not yet had the opportunity to evaluate any of these concepts with regard to inherent safety issues, but cautions against abandoning the baseline vehicle for an unproven alternative without demonstrated capability. The inherent safety of any and all approaches must be fully assessed to ensure that a level of safety necessary to support human transport is offered. Additionally, there must be a balance and harmony between the size and scope of the undertaking and the budget provided to design, develop and execute it. The Panel stands ready to evaluate the safety aspects of alternative concepts if such a change is considered.

The Panel hopes that our summary of critical safety-related issues will help focus attention on the important decisions and the direction of the Agency.

NASA's senior leaders and staff members offered significant cooperation to support the completion of this document. I therefore submit the ASAP Annual Report for 2009 with 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

January 15, 2010

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

Dear Madame Speaker:

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 2009 to the U.S. Congress and to the Administrator of the National Aeronautics and Space Administration (NASA). ASAP members believe that NASA and the Administration face significant challenges for the Nation's space program. Following the precedent set in 2008, the ASAP again provides this letter report in lieu of the lengthier annual report submitted in previous years.

This letter report is based on the Panel's 2009 quarterly meetings (and public session minutes), fact-finding meetings, and formal recommendations, as well as ASAP members' past experiences.

In Section II of this report, the Panel provides a summary of key safety-related issues that the Agency confronts at this time. The most important relate to the future of the Nation's human space flight program, and the ASAP hopes to encourage key stakeholders to immediately consider the critical decisions relating to this mission.

Significant issues include human rating requirements for potential commercial and international entities, extension of Shuttle beyond the current manifest, workforce transition from the Shuttle to the follow-on program, the need for candid public communications about the risks of human space flight, and the more aggressive use of robots to reduce the risk of human exploration.

Towards the end of the reporting period, a number of alternatives to the Exploration "program of record" began to surface. The Panel has not yet had the opportunity to evaluate any of these concepts with regard to inherent safety issues, but cautions against abandoning the baseline vehicle for an unproven alternative without demonstrated capability. The inherent safety of any and all approaches must be fully assessed to ensure that a level of safety necessary to support human transport is offered. Additionally, there must be a balance and harmony between the size and scope of the undertaking and the budget provided to design, develop and execute it. The Panel stands ready to evaluate the safety aspects of alternative concepts if such a change is considered.

The Panel hopes that our summary of critical safety-related issues will help focus attention on the important decisions and the direction of the Agency.

NASA's senior leaders and staff members offered significant cooperation to support the completion of this document. I therefore submit the ASAP Annual Report for 2009 with respect and appreciation.

Sincerely,

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

Enclosure

Table of Contents

I. Introductory Remarks 1
A. The Aerospace Safety Advisory Panel 1
B. ASAP Observations about NASA Accomplishments in 2009 1
1. Five Successful Shuttle Launches 1
2. Progress on International Space Station (ISS) Build Out 1
3. Ares I-X Rocket Flight Test 2
4. NASA Safety Center (NSC) Safety & Mission Assurance Technical Excellence Program (STEP) 2
5. ISS Cargo Resupply 2
6. Safe and Successful Hubble Servicing Mission (SM)-4 3
7. Constellation Program (CxP) Ground Project Efforts 3
8. NASA and the OSHA Voluntary Protection Program (VPP) 3
9. Continuing Successes in Deep Space Missions. 4

II. Critical Issues. 4
A. Human Space Flight. 5
1. Human Rating Requirements (HRR) for Follow-On Vehicles 5
2. Shuttle Extension 6
B. Other Critical Issues. 7
1. External Communication: NASA/Public/Congressional Dialogue on Risks Associated with Exploration 7
2. Shuttle to Constellation Workforce Transition. 8
3. Integration of Robotics Agency-Wide 8
4. Timeliness in Completing Mishap Investigations. 10

III. Other Issues 10
A. NASA Facilities/Aging Infrastructure 10
B. Timeliness of NASA Responses to ASAP Recommendations 11
C. CAIB Recommendations 11

III. Conclusion 11
Appendix 1: Summary and Status of ASAP 2009 Recommendations. 13
Appendix 2: Administrator Charles F. Bolden, Jr.'s Response to ASAP Recommendations 19

CD Table of Contents

Attachment 1: Charter of the Aerospace Safety Advisory Panel
Attachment 2: ASAP 2009 Recommendations, NASA Responses, and Status
Attachment 3: ASAP 2009 Quarterly Meeting Minutes
Attachment 4: 2009 Activities of the Aerospace Safety Advisory Panel
Attachment 5: Aerospace Safety Advisory Panel Members and Staff

I. Introductory Remarks

A. The Aerospace Safety Advisory Panel (ASAP)

Since establishment by Congress in 1968, after the Apollo 1 spacecraft fire, the ASAP (the "Panel") has been operating under a broad charter (Attachment 1 on the enclosed CD) to provide advice and make recommendations to the NASA Administrator on matters related to safety. In 2005, the ASAP Charter was expanded to include advising the Administrator and Congress with respect to hazards to the adequacy of proposed or existing safety standards, and with respect to management and culture related to safety. Additionally, after the Columbia accident, Congress required that the ASAP submit an annual report to Congress as well as the NASA Administrator documenting the Panel's observations and recommendations.

This year, the Panel has advised NASA on issues that have significant potential to directly or indirectly impact the safety of NASA's astronauts, personnel, contractors, programs, and missions. The Panel recommendations submitted to the Administrator during 2009 are summarized in Appendix 1 at the end of this report (and detailed in Attachment 2 on the enclosed CD). They are based on ASAP 2009 quarterly meetings, public session minutes, and fact-finding meetings (all documented in Attachments 3 and 4 on the enclosed CD), as well as direct observations of NASA operations and decision-making and the Panel members' past experiences.

B. ASAP Observations about NASA Accomplishments in 2009

(1) Five Successful Shuttle Launches

The landing of the Space Shuttle Atlantis on November 27, 2009, marked the fifth successful Shuttle mission of 2009, a flight rate not seen since 2002, before the tragic Columbia accident. Since 2005, NASA has steadily and safely increased the flight rate. Over the 5 missions, a total of 19 extravehicular activities (EVAs) were safely and successfully performed.

The Shuttle program team's continued dedication, focus, and discipline was responsible for the success of these missions. Additional mitigation measures were needed to maintain an acceptable safety level, and in-depth, expanded analyses were required to address new risks. The Panel commends the Shuttle program team for their vigilance and scrutiny.

(2) Progress on International Space Station (ISS) Build Out

In 2009, the ISS saw substantial build-out toward completion. Four Shuttle missions were ISS assembly flights that required 14 successful EVAs. Major ISS elements were taken to orbit and installed. The S6 Truss provided a fourth and final set of solar arrays and radiators. The addition of the Japanese Experiment Module Exposed Facility (JEM EF) provided an external platform that can hold up to 10 experiment payloads. The Multi-Purpose Logistics Module (MPLM) Leonardo carried a collection of physics and chemistry microgravity experiments. The additional equipment, supplies, and scientific experiments will be used by the continuing crew of six aboard the ISS.

(3) Ares I-X Rocket Flight Test

On October 28, 2009, NASA's Ares I-X test rocket lifted off from the Kennedy Space Center's (KSC) newly modified Launch Complex 39B for a 2-minute powered flight. The flight test lasted about 6 minutes until splashdown of the booster stage about 150 miles downrange. The flight test will provide NASA with data that will be used to improve the design and safety of the U.S. next generation space flight vehicles that could take humans beyond low-Earth orbit (LEO). By flying the vehicle through first stage separation, the test flight provided data regarding the performance and dynamics of the Ares I solid rocket booster in a "single stick" arrangement. The data also allows NASA to establish confidence in the preflight design and analysis techniques. It should be noted that Time magazine cited the Ares rocket as the "best invention of 2009."

(4) NASA Safety Center (NSC) Safety & Mission Assurance Technical Excellence Program (STEP)

STEP is NASA's new discipline-focused, career-oriented, professional development path for individuals working in the Safety and Mission Assurance (S&MA) disciplines. The NSC works with representatives from the NASA Centers to build curricula that are relevant to the S&MA community. One STEP goal is to transition the S&MA professionals' focus from an operating focus for Shuttle and Space Station to a design focus for building the next generation of manned space vehicles. The program intends to accomplish this goal by using an orderly and consistent training curriculum path. STEP will embrace the S&MA program's six disciplines—System Safety, Reliability and Maintainability, Quality Engineering, Software Assurance, Operational Safety, and Aviation Safety. The NSC rolled out Level 1 this year and will follow with Levels 2 through 4 during 2010. The Panel will watch this training initiative closely and envisions much success.

(5) ISS Cargo Resupply

While many threats impact the safety of the astronauts and the ISS, one of the biggest challenges is resupply and sustainability. A combination of Shuttle, Soyuz, and Progress flights has performed this mission admirably over the past six years. With the expected retirement of the Shuttle in 2010, NASA awarded contracts in December 2008 for commercial Cargo Resupply Services (CRS) for the ISS. While these commercial-type contracts give significant flexibility to the contractor for the vehicle's design and launch, NASA is working closely to provide support, lessons learned, and appropriate oversight. The Panel is satisfied by the program's evolution, progress, and the two-phase approach: (1) demonstration of a vehicle in orbit, including approach and docking with ISS; and (2) commercial delivery.

The ISS partners are also developing resupply capability. The Automated Transfer Vehicle (ATV), developed by the European Space Agency (ESA), was first launched in March 2008, carrying propellant and equipment to the ISS. The H-II Transfer Vehicle (HTV), provided by the Japanese Aerospace Exploration Agency (JAXA), was successfully launched in September 2009. This first flight was a capability demonstration carrying four and a half tons of payload.

There are three viable international programs that can deliver cargo to ISS—Russia, Europe, and Japan. The Panel believes that the cargo resupply issue is on the path to a solution if both HTV and ATV programs continue to receive adequate funding. The two potential additional suppliers in the U.S. will add flexibility to that solution.

(6) Safe and Successful Hubble Servicing Mission (SM)-4

In May 2009, Atlantis's astronauts repaired and upgraded the Hubble Space Telescope (HST), safely conducting five spacewalks during their mission to extend the life of the orbiting laboratory. SM-4 was perhaps HST's most challenging and intense servicing mission, with many complex tasks completed over the five spacewalks. This Shuttle mission had a unique safety challenge not faced by other missions since the Columbia mishap. The orbit required for HST rendezvous meant that Atlantis could not reach the ISS for safe haven in the event problems were encountered. NASA mitigated this risk by having a Launch-On-Need vehicle ready for a potential rescue flight on very short notice and by taking steps to increase the time that Atlantis could safely wait for rescue. While these back up plans never had to be used, the planning and commitment that this effort took demonstrate the rigor with which NASA is approaching human flight safety.

(7) Constellation Program (CxP) Ground Project Efforts

The modifications to the ground facilities for the Ares rocket have been a tremendous undertaking, and NASA deserves special recognition for the aggressive action to get Ares operational as quickly as possible. Ground operations include activities such as vehicle stacking, integration, rollout, and liftoff, while ground systems include vehicle interfaces and lightning protection. Several new procedures and hardware items were developed for Ares I-X including a new, taller lightning protection system for Launch Complex 39B, removal of a platform inside the Vehicle Assembly Building, a new vehicle stabilization system, and improved computer systems at Launch Complex 39B.

(8) NASA and the OSHA Voluntary Protection Program (VPP)

NASA has implemented the OSHA VPP at 40 percent of its locations with impressive results. Approval into this program is OSHA's official recognition of personnel who have made outstanding efforts to achieve exemplary occupational safety and health. The VPP promotes effective worksite-based safety and health. The average VPP worksite reports a lost workday rate that is at least 50 percent below the average for its industry. In the VPP, NASA management, labor, and OSHA establish cooperative relationships at those Centers that have implemented a comprehensive safety and health management system. Other Centers are considering entering the VPP process.

(9) Continuing Successes in Deep Space Missions

NASA's deep space missions continue to make fantastic contributions to the world body of knowledge. This year's launches included the Kepler mission and the Wide-field Infrared Survey Explorer (WISE). These new missions join the HST, the Spitzer Space Telescope, and the Chandra X-ray Observatory in accomplishments as diverse as mapping the Milky Way, discovering new and unusual elongated double helix nebula, and discovering clues to Black Hole Growth. The Panel again visited Jet Propulsion Laboratory (JPL) during 2009 and applauds its deep space efforts. JPL accomplishments and capabilities continue to make cutting-edge contributions to NASA, the Nation, and the world at large.

II. Critical Issues

This continues to be a challenging time for NASA. The Agency has been carefully executing the former President's authorized national space policy, including the rapid development of new boosters, crew capsule, and Lunar Surface Access Module. This year, President Obama directed his administration to scrutinize existing national space policy as part of a sweeping review that could culminate in a new strategy governing U.S. civil and military space activities and direction to develop alternative vehicles and modules. In May 2009, the White House Office of Science and Technology Policy called for an independent review of the Nation's human space flight program, both present and planned, as well as alternatives to that program. The Review of U.S. Human Space Flight Plans Committee, better known as the "Augustine Committee," released its report in October 2009.

Among the many assumptions and recommendations made by this committee, one of the most profound was that appropriate consideration be given to using the commercial space industry to fulfill NASA crew-delivery services to LEO. In making this recommendation, the committee also noted that while human safety never can be absolutely assured, safety was assumed to be "a given." The Panel believes that this assumption is premature and oversimplifies a complex and challenging problem because there is not a "cookie-cutter approach" to safety in space.

The Panel strongly reaffirms, as a basic principle, that whatever new policies or vehicles are selected for America's space activities, ensuring human safety must continue to receive the appropriate funding, visibility, and support to prevent another Columbia-like tragedy.

With this basic principle in mind, the Panel has set its focus on the following critical safety issues associated with the present program and its potential alternatives.

A. Human Space Flight

(1) Human Rating Requirements (HRR) for Follow-On Vehicles

There are two safety issues associated with the human rating process for future human space flight transportation systems: (a) development of HRR standards for potential Commercial Orbital Transportation Services (COTS) and international orbital transportation systems; and (b) the importance of inherent crew safety through design architecture in any discussions about Ares I versus potential alternatives.

In its last Annual Report, the Panel stated that proposed COTS vehicles being developed by SpaceX and Orbital Sciences Corporation thus far had not been required to meet HRR standards nor were they proven to be appropriate to transport NASA personnel. This is understandable since COTS vehicle contractors are currently tasked only with developing cargo delivery systems. However, since expanding the commercial vehicle mission to include human transport has become an active topic, the Panel highlighted the HRR standards issue at every quarterly meeting in 2009. A principal concern identified at the first meeting in 2009 was that the current HRR procedures, when applied to the development of future human-related vehicles, were not specifically intended to establish requirements for vehicles produced by entities external to NASA, such as COTS firms or international programs. The Panel recommended that NASA stipulate directly the applicable HRR standards and share acceptable risk levels with those other entities. It is essential that any entity that might be creating human-rated transport systems that may transport NASA astronauts must understand the safety requirements that will be mandatory for such services. Not only should the standards be provided, but the certification mechanism and required validation data should be made clear.

Standards, the requirement for any vehicle to meet those standards, and the mechanism by which compliance with the standards will be validated represent the "three legs" of the platform upon which the certification of human transport vehicles must be based. This issue was emphasized at the ASAP's second, third, and fourth quarterly meetings, as well as during testimonies before the House Science and Technology Committee hearings in June and December. Based on our findings, the Panel issued four recommendations on HRR. One of those recommendations specifically addressed HRR for COTS.

In the fourth quarter of 2009, NASA finally made a start at achieving progress to more clearly develop and communicate the standards necessary for any COTS manufacturer if astronauts are to be transported on non-NASA vehicles. However, this will only partially answer the challenge. After the criteria and their applicability are clearly established, a process must be developed for validating and certifying compliance with those criteria. Validation and certification itself has two components: that which takes place at the front end (at various stages) and one that follows the program in the form of insight, oversight etc. Although the Panel strongly supports the start

that NASA has made, the Panel continues to believe that NASA is behind where it needs to be at this point in time. Considerable work must be done, and priority efforts should be established to accelerate the level of effort underway.

It is the Panel's position that no COTS manufacturer is currently HRR qualified, despite some claims and beliefs to the contrary. Questions that must be answered are: What is the process for certifying that potential COTS vehicles are airworthy and capable of carrying astronauts into space safely? How is compliance assured over the life of the activity? The same questions would apply to any potential international orbital transportation systems.

International transportation service that would extend beyond that currently in use (Russia) should be evaluated against the same performance standard as COTS human transportation services from U.S. vendors. This will require a more intense effort to coordinate with our international partners and reach agreement on performance-based standards that will apply to any vehicle being offered to transport humans into space. The current international aviation certification system seems a good model for this type of activity. There is no question that as international cooperation expands, there will be a need to develop equivalent HRR standards and validation.

NASA's follow-on "program of record" identifies the Ares I launch vehicle as the vehicle selected to send future astronauts into orbit. The Ares I vehicle has been designed from the beginning with a clear emphasis on safety. Its architecture was selected by NASA's Exploration System Architecture Study (ESAS) team because of its potential to deliver at least 10 times the level of crew safety as the current Shuttle. The launch vehicle configuration has been developed to provide the best possible allowances for crew escape in the event of a launch failure. The independent launch escape system pulls the capsule clear of the launch pad and any attendant explosion or fire. The demonstrated high reliability of the solid rocket booster (SRB) suggests a low likelihood of first stage failure on ascent, but the launch escape system would cover even this low probability of failure.

To abandon Ares I as a baseline vehicle for an alternative without demonstrated capability nor proven superiority (or even equivalence) is unwise and probably not cost-effective. The ability of any current COTS design to "close the gap" or even provide an equivalent degree of safety is speculative. Switching from a demonstrated (design approach proven by Apollo, use of heritage hardware, and Ares 1-X flight success), well designed, safety optimized (ESAS) system to one based on nothing more than unsubstantiated claims would seem a poor choice. Before any change is made to another architecture, the inherent safety of that approach must be assessed to ensure that it offers a level of safety equal to or greater than the program of record.

(2) Shuttle Extension

The Panel is very concerned about discussions regarding possible extension of Shuttle operations beyond the current manifest to complete the construction of the ISS. The Augustine Committee concluded that the only way to reduce the "gap" in human space flight launch capability between ISS completion and the planned flights of Ares 1 is by extending the Shuttle program well beyond 2010. The Columbia Accident Investigation Board (CAIB) recommended that before the Shuttle

flew beyond 2010, vehicle recertification at the material, component, subsystem, and system levels should be developed and completed. One of the options considered by the Augustine Committee was extension of the Shuttle at a "minimum safe flight rate" to preserve U.S. capability. The Committee acknowledged that if this option was selected, a "thorough review of Shuttle recertification conducted to date and overall Shuttle reliability . . . be performed by an independent committee."

The Panel does not support extending the Shuttle significantly beyond its current manifest. We are especially concerned over any kind of "serial extension" where a few flights at a time might be added. The risk of continuing to fly the Shuttle without a recertification and expending the resources to bring the vehicle up to modern standards is more than what we should ask astronauts to shoulder. The Panel does not believe that there is full transparency to the risk. We recognize that such transparency is challenging due to the difficulty in communicating highly technical issues to a largely nontechnical public. Still, NASA must find a way to successfully communicate the level of risk inherent in experimental space flight. The Agency must be supported in doing so by Congress and the Administration. In our opinion, the time to extend the Shuttle was several years ago when there was an opportunity to go forward with an extension certification program of reasonable scope and cost. With sufficient money, manpower, and recertification efforts, it is possible that the Shuttle could be extended. While we are aware of no major systems that are "on the knee of the curve" of wear out, the funds needed to allow full recertification are substantial, and the probability of finding things that demand even more resources during recertification is very real.

The Shuttle is complex by inherent design, and risk is increasing due to aging, wear, and the lack of engineering support from second and third-tier suppliers. Subcontractors who are responsible for key systems, knowing that the demand for those systems is declining or ended, move on to other business leaving key knowledge and capability gaps for the support of continued operations. The current workforce, both contractor and NASA personnel, is declining. They are moving on to other work or seeking employment outside of the Shuttle program. The decline in this experienced workforce raises risk levels for continued operation. The Shuttle is a 1970s design system that has operated post-Columbia with an enviable record of both safety and performance, but the Panel believes that its probable decline is upon us. Extension significantly beyond what is planned through the current manifest would be unwise.

B. Other Critical Issues

(1) External Communication: NASA/Public/Congressional Dialogue on Risks Associated with Exploration

It is a critical time for the future of NASA's human space flight efforts, which makes communications with the public and Congress more important than ever before. NASA has made significant cultural progress evolving and strengthening internal communications as well as communications within the technical community. Internally, the Agency now speaks more plainly, openly discusses risk and risk management, and better ensures dissenting voices are heard. Largely gone is the "spin" noted by the CAIB.

External communications has been slower to evolve, and "spin" still remains a part of these communications. The Panel does not believe this practice best serves the Agency.

NASA must be fully candid with the public and Congress, and those audiences must fully understand what risks are involved. There can never be zero risk, and the rate of progress can be limited by the amount of risk one is willing to take. Space exploration is a dangerous enterprise, and the Nation is fortunate to have courageous people willing to accept the risk. In going forward with exploration, the shouldering of risk needs to be undertaken not only by NASA, but by Congress and the Administration. The risks must be communicated clearly to Congress and the public. To do otherwise is disingenuous and does the Nation a disservice.

(2) Shuttle to Constellation Workforce Transition

The Panel commends the Centers' leadership and contractors in working to ease the transition from the Shuttle program to CxP. The Center teams have been working diligently to evaluate and maintain the skill sets that will be needed in the transition from Shuttle to Constellation. NASA is fortunate to have a very focused, dedicated, and motivated workforce that is committed to bringing safe closure through to the very last Shuttle flight. However, the workforce is worried about the uncertainty of NASA's mission and the five- to eight-year gap between Shuttle and its successor. Human space flight is a business in which safety rides on the shoulders of skilled, hard-working people.

Successful workforce transition depends heavily on a decision being made about NASA's direction. The Panel's concern continues to grow as NASA's future in human space flight remains undecided. The current "transition" plans were drawn up assuming that the program of record would be executed. The Panel is impressed by the level of detail in the plans and the diligence with which they are being carried out. A programmatic decision regarding exploration and a possible change to the program of record is under review as a result of the Augustine Committee report. At the time this Annual Report went to press, the future path forward for the space program had not been announced. When it is announced, the transition plans will need to be reevaluated and redefined.

(3) Integration of Robotics Agency-Wide

The Panel continues to urge NASA to take a more open-minded and aggressive view towards using robots to reduce human risk whenever possible, consistent with mission accomplishment. This means using robots to replace humans on some missions and to support astronauts on others.

The Panel notes that the vision for exploration includes dangerous and challenging work like construction, mining, and manufacturing. In accomplishing this work, there is significant risk to astronauts in their fragile but critical spacesuits.

In 2008, the Panel recommended that "NASA formulate a decision tree for optimizing the use of robotics in exploration, so as to diminish the risks to humans . . . ." NASA formally responded to this recommendation in March 2009 and provided in Figure 1.

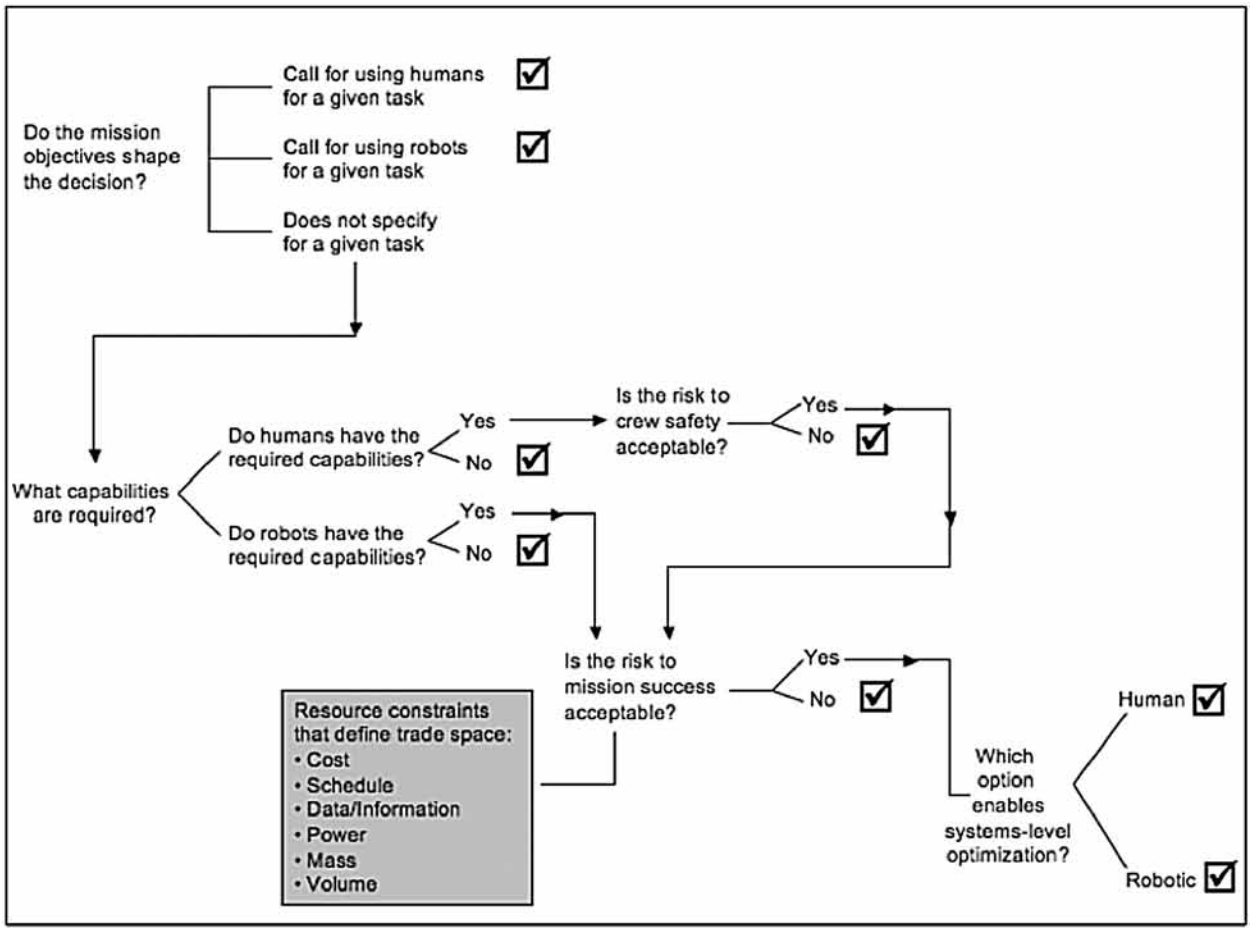


Figure 1. *Mission objectives, required capabilities, risks to crew safety and mission success, and resource constraints shape human-robotic decisions.*

While we take some comfort that NASA is giving more consideration to robots, we still find a wide discrepancy between how the Agency views robots and the current state of practice in the commercial and military arenas. For example, NASA's response to the Panel's recommendation included: "Current robots lack the fine coordination to perform certain tasks such as changing out cards in a science instrument . . . ." This statement seems to stand in stark contrast to the fact that medical robots are used in today's operating rooms and military robots are used to defuse improvised explosive devices. To evaluate NASA's seriousness in taking more and better advantage of robots, the Panel collected anecdotal evidence during visits to NASA Centers. Specifically, the Panel asked the Agency's robot developers: "Have you seen a material increased investment in robot research and development in support of Exploration?" Universally, the response was "No."

It is expected that robotic exploration will precede eventual human exploration. This gives rise to an important function that should be carried out by robotic missions. The robots should be equipped to analyze, measure, or determine the things that are most important to the human

astronauts that follow. By optimizing robots to gather these measurements, we will maximize the robot's value and minimize the risk to the human astronauts that will follow them. Through this linkage between human and robotic explorers we will maximize benefit and minimize risk.

During 2010, the Panel will undertake a more in-depth assessment of NASA's investment in and planning for using robots in place of and in support of human astronauts.

(4) Timeliness in Completing Mishap Investigations

Mishap investigations are undertaken to determine the cause of problems so that corrective actions can be taken to prevent or minimize recurrences. Information on NASA mishaps provides one of the most valuable sources of safety lessons-learned for the Agency. This is because these mishaps reflect the very people, culture, management systems and processes, equipment, and technology actually involved in NASA's work. It is critical that mishap investigation results be promptly disseminated throughout the Agency to prevent future mishaps, correct unsafe conditions, and improve NASA's safety program.

In 2007, the Panel recommended that NASA reevaluate the mishap investigation process to provide for more timely release of information across the Agency. The Panel has followed up with two more recommendations in 2008 to spur this effort forward; NASA has also made progress. A Warning-Action-Response process provides preliminary notification to the Centers so that they are alerted to potential problems. The NSC provides additional resources to reduce the backlog in these activities. Trained investigators are located regionally to facilitate the initial investigative activities. A root cause analysis software tool is undergoing beta testing and data analysis of the investigation results is evolving. Senior management is receiving periodic status reports on these activities.

Despite this progress, the Panel continues to be concerned about the need to correct each phase in the process to shorten the overall timeline: (1) accomplishing the investigation itself; (2) developing the investigation report; (3) obtaining the NASA Headquarters endorsements; (4) obtaining the Center approval; (5) developing the corrective action plan and implementing it; and (6) verifying implementation so that the case can be closed. There has been progress at the Field Centers to reduce the timeline for the phases that are under their control, but it will take more effort, especially at NASA Headquarters, before an overall improvement in the final report's timeline is seen. What is still lacking are the metrics that show the tracking and trending for all phases of the mishap investigation process so that one can see whether positive changes in the timelines are occurring.

III. Other Issues

A. NASA Facilities/Aging Infrastructure

Over 80 percent of NASA facilities are beyond their design life, and annual maintenance is underfunded.[1] Facilities continue to degrade and facilities failures are starting to impact missions and have safety implications Agency-wide. Evidence for this can be seen in the increasing number

[1] Presentation "NASA's Construction Program" by Frank Bellinger, Director Facilities Engineering & Real Property Division, NASA Headquarters, to American Council of Engineering Companies, April 27, 2009.

of small fires, key equipment losses through failures in material handling and transportation facilities, and in the "weak signals" that we observe in current safety reports. The infrastructure used to launch complex vehicles into space must be reviewed and maintained down to the smallest component to remain safe. In the past, one of NASA's goals was "ten healthy Centers." A considerable investment in facility maintenance, repair, and replacement is needed for this goal to be achieved. This may be unrealistic in the current economic climate. If funding is not available, NASA should consider consolidating its programs and efforts at fewer Centers so that its activities may be safely continued at the remaining facilities. This planning needs to be part of a conscious and deliberate facilities strategy.

B. Timeliness of NASA Responses to ASAP Recommendations

The Panel gave 25 written recommendations to NASA in 2009. By the end of the year, NASA had issued a single response, dated August 12, 2009, addressing just three recommendations, all of which were from the Panel's first quarterly meeting in 2009. About half of the remaining responses are in a "concurrence loop" at NASA for signature. The Panel is concerned about NASA's unresponsiveness and recommends that more management attention be placed on streamlining the review and concurrence process for NASA responses to Panel recommendations.

C. CAIB Recommendations

As Congress mandated in the NASA Authorization Act of 2005, the ASAP is responsible for evaluating and reporting annually on NASA compliance with CAIB return-to-flight (RTF) and continue-to-fly (CTF) recommendations. In 2009, there were three outstanding CAIB recommendations: (1) Eliminate all External Tank (ET) Thermal Protection System (TPS) debris-shedding at the source; (2) Increase the orbiter's ability to sustain debris damage; and (3) Develop an on-orbit repair capability. In 2008, the Panel concluded that NASA must decide whether to formally accept the risks associated with these three outstanding recommendations.

The Panel believes that informed, formal risk acceptance is essential for a successful safety program. This process provides a formal record of the risks that were accepted and the assumptions used in making those decisions. While NASA has concluded that no further action is warranted on the remaining three CAIB recommendations and has closed these out, it is not clear that the risk acceptance for that decision has been formally documented by NASA management. The Panel continues to recommend that NASA do so. NASA should revisit these decisions if the Agency decides to recertify the Shuttle. Because NASA has moved beyond the RTF phase, the Panel will no longer specifically address RTF in future annual reports. The Panel will continue to monitor, review, and provide recommendations on CTF issues.

IV. Conclusion

The Panel continues to believe, as it did in 2008, that NASA faces unprecedented challenges, perhaps greater than any time in the Agency's history. Important decisions on the future of human space flight face NASA, as well as the White House, Congress, and the Nation.

Commercial entities and international partners will likely have a larger role in transporting both cargo and crew to orbit. It is crucial that NASA focus on establishing the certification requirements, a certification process for orbital transportation vehicles, and a process for validating compliance. The performance and safety requirements must be stated promptly and clearly to enable NASA and non-NASA entities to proceed in the most productive and effective manner possible.

The Ares I vehicle has been designed from the beginning with a clear emphasis on safety. Before any change is made to another architecture, the inherent safety of that approach should be assessed to ensure that it offers a level of safety equal to or greater than the program of record.

We recognize that the Shuttle is risky by inherent design, and it is becoming more so because of aging and wear. Extension of its use significantly beyond what is planned through the current manifest is not recommended.

Space exploration is a dangerous enterprise. The risks must be shouldered by NASA, Congress, and the Administration, and those risks must be communicated clearly to the public.

The Panel hopes that our summary of critical safety-related issues will help focus attention on the important decisions and the direction of the Agency.




Appendix 1:

Summary and Status of ASAP 2009 Recommendations

Rec. #	Description Of Recommendation	Status
2009-01-01a	**Human Rating Requirements (HRR) and Data Mining.** NASA should rigorously research, compare, and contrast the different HRR approaches used on all of NASA's human space flight programs. Using this information, assess the validity of assumptions used in the Hazard Analysis (HA) and Failure Modes and Effects Analysis (FMEA) and evaluate the benefits that the various approaches yield that would enhance future HRR modifications.	Open
2009-01-01b	**HRR and Engineering Standards.** The recently revised HRR standard does not include a requirement to implement, tailor, or obtain approval to waive NASA's other engineering design requirements for critical systems. NASA should formally establish and stipulate the direct link between the HRR and the applicable NASA standards.	Closed
2009-01-02a	**Constellation Program (CxP) Implementation of HRR and Design Safety.** NASA should stipulate directly the HRR acceptable risk levels—including confidence intervals for the various categories of activities (e.g., cargo flights, human flights)—to guide managers and engineers in evaluating "how safe is safe enough." NASA should share these risk values with other organizations that might be considering HRR systems.	Open
2009-01-02b	**CxP Implementation of HRR and Data Mining.** The CxP should apply a data mining methodology that captures failures, near misses, and other anomalies in hardware and software from other NASA programs. This methodology should identify personnel issues that affect these previous problems.	Open
2009-01-02c	**CxP Implementation of HRR and the Constellation and Engineering Review Panel (CSERP).** NASA should make one of two modifications to the CSERP organization and review process: either (1) elevate the CSERP to a program-level panel with the responsibility and authority to review and approve all integrated risks; or (2) direct that all hazard reports approved by the CSERP be forwarded to the CxP Control Board for additional integrated risk analysis and approval.	Open

Rec. #	Description Of Recommendation	Status
2009-01-03a	**Risk Management Models and Risk Acceptance.** NASA's Office of Safety and Mission Assurance (OSMA) should analyze and emulate the risk management model used by the Exploration Systems Mission Directorate (ESMD), with a particular emphasis on matching the level of risk to be accepted with the level of manager who makes a decision on that risk. NASA should review the authority levels in Agency-level policy documents to ensure that authority for risk decisions is consistent with the levels of risk involved.	Open
2009-01-03b	**Risk Management Models and Risk Definition.** NASA should evaluate whether project and program managers Agency-wide consistently and reliably assign the level of risk for a specified set of examples to the same categories in the risk matrix. If warranted, NASA might need to expand the safety hazard risk matrix to include clear guidance on risk.	Open
2009-01-04	**Safety, Reliability, and Mission Assurance (SR&MA) Technical Fellows.** NASA should provide funding to fill the Technical Fellows positions for the primary Safety, Reliability, and Mission Assurance (SR&MA) technical disciplines.	Closed
2009-02-01	**CxP Technical Baseline and Metrics.** In maintaining the CxP's technical baseline, NASA should develop, use, and report in-process and outcome metrics to assure risk management processes are being followed and the progress is being measured.	Open
2009-02-02	**Communication of Changes on the CxP.** NASA should be more aggressive and transparent in communicating changes—and rationale for changes—relating to some areas of the CxP design and development process.	Open
2009-02-03	**Hazard and Risk Management.** Hazard and Risk Matrix definitions should be more precise and quantitative in nature. NASA should train all new engineers and managers in its hazard and risk management processes.	Open
2009-02-04	**Safety of Aircraft in Host Countries.** NASA should exercise appropriate diligence with respect to insuring the acceptable safety for aircraft employed in all host countries.	Open

Rec. #	Description Of Recommendation	Status
2009-02-05	**Communication of Skip-Level Assessments.** The Industrial Safety Team should more openly communicate the results of Skip-Level Assessments of supervisors to senior leadership.	Open
2009-02-06	**Identification of Workforce and Management Issues.** NASA should acquire a means to continually identify workforce and management issues before they grow into larger problems. The Panel suggests using a workforce survey, integrated within normal Human Resources and program activities.	Open
2009-02-07	**Culture Assessment.** NASA needs a strong quantitative and qualitative measurement of culture changes, done with rigor and frequency. A periodic culture assessment should be reinstituted.	Open
2009-02-08	**Standardize Knowledge Capture and Management Practices.** NASA should adopt a best practice to standardize knowledge capture and management practices across all Centers.	Open
2009-03-01	**Jet Propulsion Laboratory (JPL) Safety Performance.** To improve the current excellent safety record even further, JPL should develop an action plan that implements improvements using an approach similar to the "continuous improvement process" used in manufacturing, track progress using explicit metrics, and establish a closer working relationship with the NASA Safety Center and capitalize on its strengths and experience.	Open
2009-03-02	**JPL Risk Assessment Process.** The current well-organized process should be expanded to include a formal risk acceptance document signed by the authority designated with that responsibility in accordance with the risk level presented by that risk	Open
2009-03-03	**Tracking and Trending Metrics on Mishap Investigation Board (MIB) Report Authorization and Release from NASA Headquarters.** The NASA Headquarters Mishap Investigation Office should continue to collect data on tracking and trending of MIB administrative turnaround of reports at NASA Headquarters and present this data to the Panel on a quarterly basis.	Open

Rec. #	Description Of Recommendation	Status
2009-03-04	**Integration of Robotics.** NASA needs to examine the benefits of developing a consolidated and integrated robotics research program to capitalize on the numerous independent programs the have been developed and more fully exploit robotics utilization throughout all missions.	Open
2009-03-05	**HRR Technical Standards.** The Panel reiterates its previous recommendations 2009-01-01 and 2009-01-02. NASA needs to share the risk values with other organizations, e.g., Commercial Orbital Transportation Services (COTS), which might be considering the creation of human transport systems so that they are aware of the criteria to be applied when transporting NASA personnel in space.	Open
2009-03-06	**HRR for COTS.** NASA must establish COTS HRR as soon as possible and promulgate them to those that seek to design systems for future commercial human space flight.	Open
2009-03-07	**NASA External Communications.** Attention is needed on how NASA communicates to the public and Congress. The plainspoken nature of the in-house technical NASA is out of harmony with its public communications. The Panel recommends an evolution in external communications commensurate with that achieved in its internal communications.	Open
2009-04-01	**Formal Governance Process for Kennedy Space Center's (KSC) Safety and Mission Assurance (S&MA) and Shuttle Workforce Management.** The KSC S&MA organization should put into place an internal management process that includes clear and transparent metrics with respect to other skill sets required for current and future human space flight activities. There should be a "quick feedback" process that reaches into each current near miss and mishap to examine the role that "lack of right skill at the right time and right place" has had on each incident.	Open
2009-04-02	**Center-Wide OSHA Compliance Surveys.** NASA Headquarters S&MA should assure that Centers are current in performing OSHA compliance inspections and that there is a sharing of results among the Centers.	Open

Appendix 2:

Administrator Charles F. Bolden, Jr.'s Response to ASAP Recommendations

National Aeronautics and Space Administration

Office of the Administrator
Washington, DC 20546-0001

August 12, 2009

Vice Admiral Joseph W. Dyer, USN (Ret.)
Chairman
Aerospace Safety Advisory Panel
National Aeronautics and Space Administration
Washington, DC 20546

Dear Admiral Dyer:

Enclosed are NASA's responses to two recommendations from the 2009 First Quarterly Meeting of the Aerospace Safety Advisory panel (ASAP). Please do not hesitate to contact me if the Panel would like further background on the information provided in the enclosures.

I look forward to receiving continued advice from the ASAP that results from your important fact-finding and quarterly meetings.

Sincerely,

Charles F. Bolden, Jr.
Administrator

Enclosures

Tracking Number 2009-01-01a
Human-Rating Requirements (HRR) and Data Mining

Recommendation

2009-01-01a. Human-Rating Requirements (HRR) and Data Mining. The ASAP recommends that NASA rigorously research, compare, and contrast the different human-rating approaches used during the Apollo, Shuttle, International Space Station, and other programs. NASA should take advantage of this significant history and body of knowledge not only to assess the validity of the assumptions used in the new hazard analysis (HA) and in failure mode and effects analyses (FMEAs), but also to evaluate the benefits that the various approaches yield in terms of safety and mission assurance, which enhance future HRR modifications.

NASA Response

NASA concurs. The teams that developed the various revisions to the NASA HRR (NPR 8705.2) performed exhaustive research into the activities analogous to human rating that were applied to the Apollo, Space Shuttle, ISS, Orbital Space Plane (OSP), as well as other programs. More importantly, the Apollo, Space Shuttle, ISS, and OSP engineers and managers that applied these analogous requirements provided their opinions on the strengths and weaknesses of their respective requirements. NASA incorporated the knowledge gleaned from that research into the various versions of the NASA HRR, culminating in the current NPR 8705.2B. NASA agrees to perform additional research to support development of the HRR implementation handbook (described in NASA's response to ASAP recommendation 2008-04-03) that will include examples from previous programs to assist in effective and consistent application of the HRR. In addition, NASA will factor in the results of the independent assessment (conducted in response to ASAP recommendation 2008-04-02) to augment the implementation handbook. As appropriate, NASA will also make changes to the HRR based on this research.

Tracking Number 2009-01-01b
Human-Rating Requirements (HRR) and Engineering Standards

Recommendation

2009-01-01b. Human-Rating Requirements (HRR) and Engineering Standards. The recently revised HRR standard focuses principally on the process used to reach a human-rating certification. Although it does specify some design requirements (such as fault tolerance and some human factors design standards), it does not include a requirement to implement, tailor, or obtain approval to waive NASA's other engineering design requirements for critical systems. These requirements embody the experience of NASA's best designers and the lessons learned throughout the Agency's vast experience in human spaceflight. These lessons might not be properly applied without such a requirement.

To clearly articulate the consistent and comprehensive integration of human safety considerations and mission assurance needs into the integrated design analysis (as required by the HRR), the ASAP recommends that NASA formally establish and stipulate the direct link between the HRR and the applicable NASA standards, such as the NASA-STD-5000 series of engineering directives, as well as relevant technical standards.

NASA Response

NASA concurs. Although the first section of the HRR document states that human rating involves many more requirements and standards than are listed in the document itself, it does not specify (other than four direct references to human system unique standards) what those other requirements are. NASA will address this issue with a change to the first section of the HRR document that makes it clear that human rating consists of tailoring all NASA requirements contained in Agency directives that are categorized as mandatory for all high-priority space systems. The change will also make it clear that human rating includes tailoring of all "mandatory standards" managed by the Office of the Chief Engineer, the Office of Safety and Mission Assurance, and the Office of the Chief Health and Medical Officer. The current list is attached for reference. Finally, NASA will ensure that the language in the first section of the HRR document makes it clear that the Technical Authority may suggest other NASA, military, voluntary consensus, or industry standards or requirements (beyond the mandatory list) as appropriate to the design concept and mission on a case-by-case basis.

STANDARD NUMBER	STANDARD TITLE	SOURCE OF MANDATORY DESIGNATION*
AFSPCMAN 91-710	Range Safety User Requirements Manual	NPR 8715.5, Range Safety Program
AFSPCMAN 91-710	Range Safety User Requirements Manual	September 6, 2007, Chief Engineer Memorandum, Subj: Mandatory Standards
AIA/NAS NAS410	National Aerospace Standard Certification and Qualification of Nondestructive Test Personnel	September 6, 2007, Chief Engineer Memorandum, Subj: Mandatory Standards
AIAA S-080-1998	Space Systems, Metallic Pressure Vessels, Pressurized Structures, and Pressure Components	September 6, 2007, Chief Engineer Memorandum, Subj: Mandatory Standards
ANSI/AIAA S-080	Space Systems Metallic Pressure Vessels, Pressurized Structures, and Pressure Components	NASA Policy Directive 8710.5D, Policy for Pressure Vessels and Pressurized Systems
AIAA S-081A-2006	Standard for Space Systems - Composite Overwrapped Pressure Vessels (COPVs)	September 6, 2007, Chief Engineer Memorandum, Subj: Mandatory Standards
ANSI/AIAA S-081A	Space Systems Composite Overwrapped Pressure Vessels (COPV)	NASA Policy Directive 8710.5D, Policy for Pressure Vessels and Pressurized Systems
AIAA S-111-2005	Qualification and Quality Requirements for Space Solar Cells	September 6, 2007, Chief Engineer Memorandum, Subj: Mandatory Standards
AIAA S-112-2005	Qualification and Quality Requirements for Space Solar Panels	September 6, 2007, Chief Engineer Memorandum, Subj: Mandatory Standards
Air Force AFOSH Standard 48-12	Health Hazard Control for Laser Operations	NPR 8715.3, NASA General Safety Program Requirements
ANSI 358.1	Emergency Eyewash and Shower Equipment	NPR 8715.3, NASA General Safety Program Requirements
ANSI D6.1	Manual on Uniform Traffic Control Devices for Streets and Highways	NPR 8715.3, NASA General Safety Program Requirements
ANSI Z117.1	Safety Requirements for Confined Space	NPR 8715.3, NASA General Safety Program Requirements
ANSI Z136.1	American National Standard for Safe Use of Laser	NPR 8715.3, NASA General Safety Program Requirements
ANSI Z136.1	American National Standard for Safe Use of Laser	NPR 8715.5, Range Safety Program
ANSI Z136.6-2000	American National Standard for the Safe Use of Lasers Outdoors	NPR 8715.5, Range Safety Program
ANSI/DWS D14.1	Specifications for Welding Industrial and Mill Cranes	NASA-STD-8719.9, Standard for Lifting Devices and Equipment

STANDARD NUMBER	STANDARD TITLE	SOURCE OF MANDATORY DESIGNATION*
ANSI/ESD S20.20	Protection of Electrical and Electronic Parts, Assemblies and Equipment (Excluding Electrically Initiated Explosive Devices)	NPD 8730.5, NASA Quality Assurance Program Policy
ANSI/ISO/IEC 17025:2000	General Requirements for the Competence of Testing and Calibration Laboratories	NPD 8730.1B, Metrology and Calibration
ANSI/NCSL Z540.1-1994 (R2002)	General Requirements for Calibration Laboratories and Measuring and Test Equipment	NPD 8730.1B, Metrology and Calibration
ANSI/SIA A92.2	Vehicle-Mounted Elevating and Rotating Aerial Devices	NASA-STD-8719.9, Standard for Lifting Devices and Equipment
ANSI/SIA A92.5	Boom Supported Elevating Work Platforms	NASA-STD-8719.9, Standard for Lifting Devices and Equipment
AS9003	Inspection and Test Quality System	NPD 8730.5, NASA Quality Assurance Program Policy
AS9100	Quality Management Systems - Aerospace - Requirements	NPD 8730.5, NASA Quality Assurance Program Policy
AS9100	Quality Management Systems - Aerospace - Requirements	NPR 8735.2, Management of Government Quality Assurance Functions for NASA Contracts
AS9101	Quality Management Systems Assessment	NPR 8735.2, Management of Government Quality Assurance Functions for NASA Contracts
ASME B30.1	Jacks	NASA-STD-8719.9, Standard for Lifting Devices and Equipment
ASME B30.10	Hooks	NASA-STD-8719.9, Standard for Lifting Devices and Equipment
ASME B30.2	Overhead and Gantry Cranes	NASA-STD-8719.9, Standard for Lifting Devices and Equipment
ASME B30.23	Personnel Lifting Systems	NASA-STD-8719.9, Standard for Lifting Devices and Equipment
ASME B30.5	Mobile and Locomotive Cranes	NASA-STD-8719.9, Standard for Lifting Devices and Equipment
ASME B30.9	Slings	NASA-STD-8719.9, Standard for Lifting Devices and Equipment
ASME B56.1	Safety Standard for Low-Lift and High-Lift Trucks	NASA-STD-8719.9, Standard for Lifting Devices and Equipment

STANDARD NUMBER	STANDARD TITLE	SOURCE OF MANDATORY DESIGNATION*
EM 385-1-1	U.S. Army Corps of Engineers, Safety and Health Requirements	NPR 8715.3, NASA General Safety Program Requirements
EWR 127-1	Range Safety Requirements	NPR 8715.3, NASA General Safety Program Requirements
Federal Aviation Administration Human Factors Design Standard	Federal Aviation Administration Human Factors Design Standard	NPR 8705.2, Human-Rating Requirements for Space Systems
Federal Standard 313	Material Safety Data, Transportation Data and Disposal Data for Hazardous Materials Furnished to Government Activities	NPR 8715.3, NASA General Safety Program Requirements
GIDEP S0300-BT-PRO-010	GIDEP Operations Manual	NPR 8735.1, Procedures for Exchanging Parts, Materials, and Safety Problem Data Utilizing the Government-Industry Data Exchange Program and NASA Advisories
GIDEP S0300-BU-GYD-010	GIDEP Requirements Guide	NPR 8735.1, Procedures for Exchanging Parts, Materials, and Safety Problem Data Utilizing the Government-Industry Data Exchange Program and NASA Advisories
IEEE 730-2002	IEEE Standard for Software Quality Assurance Plans	NASA-STD-8739.8, Software Assurance Standard
IEEE C95.1-1991	American National Standard Safety Levels with Respect to Human Exposure to Radio Frequency Electromagnetic Fields, 30 KHz to 100GHz	NPR 8715.5, Range Safety Program
ISO 9001	Quality Management Systems - Requirements	NPD 8730.5, NASA Quality Assurance Program Policy
ISO 9001	Quality Management Systems - Requirements	NPR 8735.2, Management of Government Quality Assurance Functions for NASA Contracts
MIL-STD-1472	Department of Defense Design Criteria Standard - Human Engineering	NPR 8705.2, Human-Rating Requirements for Space Systems
MIL-STD-454	Standard General Requirements for Electronic Equipment	NPR 8715.3, NASA General Safety Program Requirements
MIL-STD-461	Requirements for the Control of Electromagnetic Interference Characteristics of Subsystems and Equipment	September 6, 2007, Chief Engineer Memorandum, Subj: Mandatory Standards

STANDARD NUMBER	STANDARD TITLE	SOURCE OF MANDATORY DESIGNATION*
NASA-GB-8719.13	NASA Software Safety Guidebook	NASA-STD-8719.13, Software Safety Standard
NASA-STD-3000 Volume I and II	Man-Systems Integration Standards	NPR 8705.2, Human-Rating Requirements for Space Systems
NASA-STD-3000 Volume I	Man-Systems Integration Standards	September 6, 2007, Chief Engineer Memorandum, Subj: Mandatory Standards
NASA-STD-3000 Volume II	Man-Systems Integration Standards	September 6, 2007, Chief Engineer Memorandum, Subj: Mandatory Standards
NASA-STD-3001, Volume 1	Spaceflight Human Systems: Crew Health	NPR 8705.2, Human-Rating Requirements for Space Systems
NASA-STD-4003	Electrical Bonding for NASA Launch Vehicles, Spacecraft, Payloads, and Flight Equipment	September 6, 2007, Chief Engineer Memorandum, Subj: Mandatory Standards
NASA-STD-4005	Low-Earth Orbit Spacecraft Charging Design Standard	September 6, 2007, Chief Engineer Memorandum, Subj: Mandatory Standards
NASA-STD-5001	Structural Design and Test Factors of Safety for Spaceflight Hardware	September 6, 2007, Chief Engineer Memorandum, Subj: Mandatory Standards
NASA-STD-5002	Load Analyses of Spacecraft and Payloads	September 6, 2007, Chief Engineer Memorandum, Subj: Mandatory Standards
NASA-STD-5006	General Fusion Welding Requirements for Aerospace Materials Used in Flight Hardware	September 6, 2007, Chief Engineer Memorandum, Subj: Mandatory Standards
NASA-STD-5017	Design and Development Requirements for Mechanisms	September 6, 2007, Chief Engineer Memorandum, Subj: Mandatory Standards
NASA-STD-6001	Flammability, Odor, Offgassing, and Compatability Requirements and Test Procedures for Materials in Environments that Support Combustion	September 6, 2007, Chief Engineer Memorandum, Subj: Mandatory Standards
NASA-STD-6002	Applying Data Matrix Identification Symbols on Aerospace Parts	September 6, 2007, Chief Engineer Memorandum, Subj: Mandatory Standards
NASA-STD-7001	Payload Vibroacoustic Test Criteria	September 6, 2007, Chief Engineer Memorandum, Subj: Mandatory Standards
NASA-STD-7002	Payload Test Requirements	September 6, 2007, Chief Engineer Memorandum, Subj: Mandatory Standards
NASA-STD-7003	Pyroshock Test Criteria	September 6, 2007, Chief Engineer Memorandum, Subj: Mandatory Standards

STANDARD NUMBER	STANDARD TITLE	SOURCE OF MANDATORY DESIGNATION*
NASA-STD-8719.11	Safety Standard for Fire Protection	NPR 8715.3, NASA General Safety Program Requirements
NASA-STD-8719.13	Software Safety Standard	NPR 8715.3, NASA General Safety Program Requirements
NASA-STD-8719.13	Software Safety Standard	NPR 8715.5, Range Safety Program
NASA-STD-8719.13	Software Safety Standard	NASA-STD-8739.8, Software Assurance Standard
NASA-STD-8719.14	Process for Limiting Orbital Debris	NPR 8715.6, NASA Procedural Requirements for Limiting Orbital Debris
NASA-STD-8719.17	NASA Requirements for Ground-Based Pressure Vessels and Pressurized Systems	NASA Policy Directive 8710.5D, Policy for Pressure Vessels and Pressurized Systems
NASA-STD-8719.7	Facility System Safety Guidebook	NPR 8715.3, NASA General Safety Program Requirements
NASA-STD-8719.8	Expendable Launch Vehicle Payload Safety Review Process Standard	NPR 8715.5, Range Safety Program
NASA-STD-8719.9	Standard for Lifting Devices and Equipment	NPR 8715.3, NASA General Safety Program Requirements
NASA-STD-8739.1	Workmanship Standard for Staking and Conformal Coating of Printed Wiring Boards and Electronic Assemblies	NPD 8730.5, NASA Quality Assurance Program Policy
NASA-STD-8739.2	Workmanship Standard for Surface Mount Technology	NPD 8730.5, NASA Quality Assurance Program Policy
NASA-STD-8739.3	Soldered Electrical Connections	NPD 8730.5, NASA Quality Assurance Program Policy
NASA-STD-8739.4	Crimping, Interconnecting Cables, Harnesses, and Wiring	NPD 8730.5, NASA Quality Assurance Program Policy
NASA-STD-8739.5	Fiber Optics Terminations, Cable Assemblies, and Installation	NPD 8730.5, NASA Quality Assurance Program Policy
NASA-STD-8739.8	Software Assurance Standard	NPR 8715.3, NASA General Safety Program Requirements
NASA-STD-8739.8	Software Assurance Standard	NASA-STD-8719.13, Software Safety Standard
NFPA 1	Uniform Fire Code	NPR 8715.3, NASA General Safety Program Requirements

STANDARD NUMBER	STANDARD TITLE	SOURCE OF MANDATORY DESIGNATION*
NFPA 101	Life Safety Code	NPR 8715.3, NASA General Safety Program Requirements
NFPA 1561	Standard on Emergency Services Incident Management System	NPR 8715.3, NASA General Safety Program Requirements
NFPA 45	Standard on Fire Protection for Laboratories Using Chemicals	NPR 8715.3, NASA General Safety Program Requirements
NFPA 70	National Electrical Code	NPR 8715.3, NASA General Safety Program Requirements
NFPA 70E	Standard for Electrical Safety in the Workplace	NPR 8715.3, NASA General Safety Program Requirements
NFPA 921	Guide for Fire and Explosive Investigations	NPR 8715.3, NASA General Safety Program Requirements
NIOSH Publication 87-113	A Guide to Safety in Confined Spaces	NPR 8715.3, NASA General Safety Program Requirements
NSS 1740.12	Safety Standard for Explosives, Propellants, and Pyrotechnics	NPR 8715.5, Range Safety Program
NSS/WS-1740.10	NASA Safety Standard for Underwater Facility and Non-Open Water Operations	NPR 8715.3, NASA General Safety Program Requirements
NSS-1740.12	Safety Standard for Explosives, Propellants, and Pyrotechnics	NPR 8715.3, NASA General Safety Program Requirements
PCSA Standards No. 4	PCSA	NASA-STD-8719.9, Standard for Lifting Devices and Equipment
PCSA Standards No. 5	PCSA	NASA-STD-8719.9, Standard for Lifting Devices and Equipment
RCC 313	Range Commanders Council Test Standards for Flight Termination Receiver/Decoders	NPR 8715.5, Range Safety Program
RCC 319	Range Commanders Council Flight Termination Systems-Commonality Standard	NPR 8715.5, Range Safety Program
RCC 321	Range Commanders Council Common Risk Criteria for National Test Ranges: Inert Debris	NPR 8715.5, Range Safety Program
RCC 323	Range Commanders Council Range Safety Criteria for Unmanned Air Vehicles	NPR 8715.5, Range Safety Program

STANDARD NUMBER	STANDARD TITLE	SOURCE OF MANDATORY DESIGNATION*
RCC Document 316-91	Laser Range Safety	NPR 8715.3, NASA General Safety Program Requirements
Standard Number	Standard Name	Document(s) Designating the Standard as Mandatory
	American Industrial Hygiene Association Emergency Response Planning Guidelines	NPR 8715.5, Range Safety Program

*Always Check the Mandatory Citation for Specific Applicability

Tracking Number 2009-01-04
Safety, Reliability, and Mission Assurance (SR&MA) Technical Fellows

Recommendation
To raise the level of technical expertise available to the Agency to solve challenging SR&MA technical and programmatic issues, NASA has worked diligently to establish Technical Fellow positions for the primary SR&MA technical disciplines. The Panel is pleased that NASA allocated appropriate grades to these positions to attract highly qualified candidates, demonstrating the Agency's level of commitment to the SR&MA effort. The Panel was disappointed to learn at this review that NASA currently is not filling these positions because of budgetary constraints.

The ASAP recommends that funding be provided to complete this important step in the process of raising the capability and credibility of the SR&MA discipline at NASA.

NASA Response
NASA concurs with this recommendation. The Agency has approved four Safety and Mission Assurance Technical Discipline Fellows positions: Systems Safety, Reliability and Maintainability, Quality Engineering, and Software Assurance. The NASA Safety Center will advertise for, screen applicants (along with the Office of Safety and Mission Assurance Safety and Assurance Requirements Division Director), and recommend candidates for approval to the Chief, Safety and Mission Assurance. The initial term of the temporary promotion will be for three years, with two additional one-year options. The successful candidates will be allowed to serve as Technical Discipline Fellows from their host Centers and will not be required to relocate. The NASA Safety Center has developed a split funding arrangement with the Centers to cover these Scientific and Technical positions, has polled the Safety and Mission Assurance Directors for their concurrence, and is working with Human Resources to fill the four Safety and Mission Assurance Technical Fellow positions.

We are hopeful that we can have the Safety and Mission Assurance Technical Discipline Fellow positions filled by August 1, 2009.

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

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

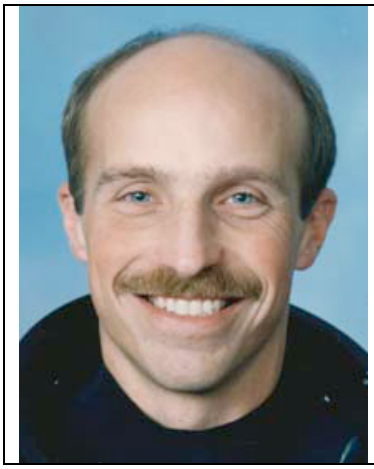
Vice Admiral Joseph W. Dyer currently serves as President of the Military Government & Industrial Division of iRobot Corporation and works closely with the U.S. Department of Defense to develop reconnaissance robots, which will change the way that wars are fought in the future.

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.

*General Bolden retired from the ASAP in July 2009, after his appointment as NASA Administrator.

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.

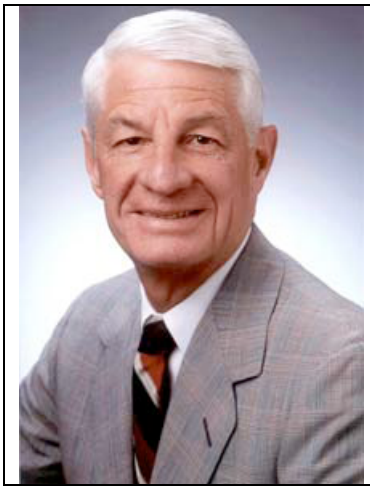
Mr. Frost earned a B.S. in electrical engineering from the University of Virginia, where he was a DuPont Scholar. He holds an M.S., specializing in safety engineering, from Texas A&M University, where he also completed an additional year of advanced safety engineering training.

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 aComputer 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.

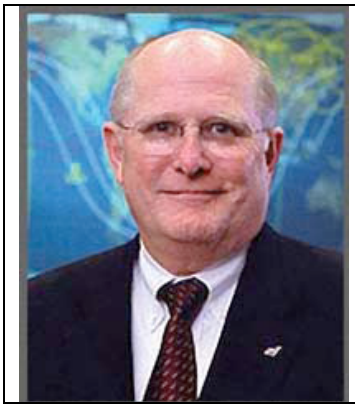
In 2003, Dr. McErlean was appointed Deputy Assistant Commander for Research and Engineering (Naval Aviations Chief Engineer). He previously served as the Deputy Assistant Commander for Logistics and Fleet Support and oversaw the Naval Aviation buildup for operations in Iraq and Afghanistan. He joined 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.

*Mr. Brock retired from the ASAP in July 2009.

ASAP Staff Members

Kathy M. Dakon, ASAP Executive Director

Susan M. Burch, ASAP Administrative Officer

Paula Burnett Frankel, ASAP Annual Report Editor

2009 ACTIVITIES OF THE AEROSPACE SAFETY ADVISORY PANEL

First Quarter Meeting

NASA Headquarters
Washington, DC
February 17-18, 2009

Second Quarter Meeting

Johnson Space Center
Houston, TX
April 29-30, 2009

Third Quarter Meeting

Jet Propulsion Laboratory
Pasadena, CA
July 22-23, 2009

Fourth Quarter Meeting

Kennedy Space Center
Cape Canaveral, FL
October 21-22, 2009

Insight Meetings (Site Visits)

Stennis Space Center &
Michoud Assembly Facility
New Orleans, LA
March 5-6, 2009

Wallops Flight Facility
Wallops Island, VA &
NASA Headquarters
Washington, DC
September 24-25, 2008

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

April 7, 2009

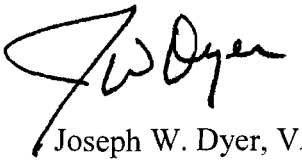
Mr. Christopher Scolese
Acting Administrator
National Aeronautics and Space Administration
Washington, DC 20546

Dear Mr. Scolese:

The Aerospace Safety Advisory Panel held its 2009 First Quarterly Meeting at NASA Headquarters on February 17-18, 2009. 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,



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

Enclosure

Aerospace Safety Advisory Panel
2009 First Quarterly Report
Minutes and Recommendations

Aerospace Safety Advisory Panel (ASAP)
Public Meeting
February 18, 2009
NASA Headquarters
Washington, DC

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.
- Mr. John C. Frost
- Ms. Deborah Grubbe
- Dr. Don P. McErlean
- Mr. Brock "Randy" Stone

ASAP Staff and Support Personnel Present

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

Attendees, Public Session

- Mr. Dan Devlin, NASA Office of the Inspector General, Office of Audits
- Mr. Bill Bihner, NASA Space Operations Mission Directorate, Space Shuttle
- Mr. John Marinaro, NASA Safety Center
- Mr. G. Warren Hall, NASA Safety Center
- Mr. Rick Irving, NASA Office of Legislative Affairs
- Ms. Diane Rausch, NASA Office of External Relations, Advisory Committee Management Division
- Ms. Kim Terrell, Katz International Management Solutions (KIMS)

OPENING REMARKS

The Aerospace Safety Advisory Panel (ASAP) held the public session of its 2009 first quarterly meeting at NASA Headquarters in Washington, DC. Admiral Joseph Dyer opened the session by thanking the Headquarters staff for its assistance during the Panel's fact-finding sessions. He noted the Panel's agenda topics, including the Human-Rating Requirements (HRR); Constellation Program implementation of the HRR; update on the Exploration Systems Mission Directorate (ESMD); report on human capital progress; overview of technical excellence; a conversation with Acting Administrator Chris Scolese; the Shuttle, Soyuz, and their interface; and an opportunity to discuss a range of

issues with Mr. Wayne Hale. The Admiral also reported that the Panel successfully completed the required annual ethics briefing.

DEVELOPMENT OF HUMAN-RATING REQUIREMENTS

Admiral Dyer indicated that the ASAP has focused for at least the last three meetings—and to a lesser extent at least one meeting before that—on the HRR. Although this topic has been a difficult one for the Panel to understand in terms of intent, purpose, and direction, he concluded that this meeting significantly clarified the HRR for the ASAP.

As Admiral Dyer described, the HRR represents a significant and substantive shift from a prescriptive approach to one of applying good judgment. Not unlike alpha specifications in the aerospace world, prescriptive standards describe how to do things and are applied fairly rigidly. Although the previous prescriptive technique did limit creativity and did not always produce optimum safety, it did at least provide a checklist, or scorecard, which simplified judging compliance. At the other end of the continuum lies a directive to employ "good judgment," offering less specific direction and guidance. The ASAP sees advantages in both, but while the prior approach provided a clear written record of changes and their justifications, the current approach poses challenges in bookkeeping, accountability, and tracking and communication of those changes as well as establishment of safety performance requirements, in other words, determining how safe is safe enough. As NASA shifts from a how-to specification to a what-is-wanted requirement, the Agency must specify its needs (in this case, level of safety, in a form useful to designers).

The Panel made two relevant recommendations (ASAP 2009-01-01a and 2009-01-01b). First, as Ms. Deb Grubbe noted, for Apollo, Shuttle, International Space Station (ISS), and other programs, NASA has used different approaches to human rating, compiling a significant history and body of knowledge that, if mined, would enhance comparisons of the human-rating approaches of major NASA programs and perhaps inform the future.

Dr. Don McErlean illustrated the value of data mining in a simple example. The Shuttle was designed as a one fault tolerant system with redundancy, while the ISS design uses a full-up two fault tolerant system. The question is whether and how often a two fault tolerant system prevented events that a one fault tolerant system would not avert. It is also important to gather information on the historical record of prior system designs that are included in the failure mode and effects analysis (FMEA) so that the reliability values entered in the FMEA can be traced to whatever degree possible to actual data from similar systems. In that fashion, NASA can assess the validity of the numbers that compose the fundamental FMEA calculations.

Ms. Grubbe agreed, emphasizing that NASA needs to capture near misses, close calls, and other anomalies by reviewing written reports, quantitative assessments, logic trees, and FMEAs to confirm their accuracy—and as needed incorporate organizational learning into the new design. The same issue applies to the Constellation Program.

Second, the Panel recommended a more direct link between the HRR documents and the NASA 5000 directive series. Mr. John Marshall focused on the critical need for a direct link or correlation to the NASA engineering documents to give program managers standard, consistent cross-Agency guidance on performing the integrated safety and

design analysis so that it becomes consistent and comprehensive rather than fundamental and cursory.

Mr. John Frost explained that the NASA 5000 series standards establish the engineering basis for design targets as well as specific safety factors. While the original human-rated policy relied heavily on levels of redundancy as its main safety approach, he concluded that this new HRR wisely focuses less on simple redundancy and more on truly understanding the design and performing risk analyses early, using them to drive the design rather than assessing results afterward, a big improvement. At the same time, with no direct link to the technical standards, the current intention (not explicitly stated in the HRR) can only be assumed to be assessing compliance with the technical standards for each project at some time far down the design process timeline, an approach filled with shortcomings. He suggested that a simple sentence in the HRR standard that ties the two together and makes specific technical standards mandatory unless waived will prevent organizations, internal or external, from assuming that mere compliance with the HRR process is sufficient, when in reality only half the job is done.

Admiral Dyer asked whether the Panel believed that improving the current HRR by linking it to the 5000 documents would make the HRR workable and sufficient. Dr. Jim Bagian responded by turning to the equivalency issue and efforts to use common sense and judgment, but expressed concern about the lack of an explicitly stated benchmark and level of confidence (e.g., about the reliability of the vehicle, mission success, or loss of life). NASA does not now set numbers as a bogey target measure for that equivalence. According to Dr. Bagian, NASA clearly has made a genuine effort and had general success in judging that equivalency without specifying it. However, this approach leaves room for ambiguity, so well-meaning people can make decisions and proceed with actions that are not in concert with activities at other Centers. Mr. Frost added that NASA has relied on program managers to establish those numbers, an approach that could lead to different levels of safety in similar programs. He reported that the Constellation Program numbers look reasonable, but he was concerned that the next program, especially if developed outside of NASA, might vary significantly in its safety goals. Dr. Bagian remarked that the numbers always entail a level of uncertainty, but are not meaningful unless confidence intervals are specified (see recommendation ASAP-2009-01-02a).

Citing a phrase used by Mr. Frost, Admiral Dyer asked, "How much safety is enough?" Unfortunately, the current human-rating documents offer no answer. Mr. Frost observed that the approach is certainly mission-dependent (i.e., it is less safe to go to Mars than to the ISS), but design criteria can still be established for classes of missions. As the Panel observed on several occasions, NASA should let the rising-star program, Constellation in this case, establish the ground rules for programs that follow because most of NASA's effort, money, and brainpower are applied to Constellation. Furthermore, Mr. Frost confirmed that Constellation personnel conducted a lot of good work based on the Exploration Systems Architecture Study (ESAS), past experience, and an understanding of optimizing performance; calculated numbers; and then budgeted them down to the subsystems (per the systems engineering practice). Mr. Frost cited this as a great starting point for defining a group of design target numbers based on the probability of loss of crew.

Synthesizing the Panel's views, Admiral Dyer suggested that NASA could improve the HRR document by supplementing respect for good judgment with a little more specificity (informed by data mining and a knowledge of different methods at different times over different programs). At that point, NASA could test the presumed improvement in light of knowledge gained. Ms. Grubbe noted that such an approach serves as organizational learning because NASA can perform a retrospective on assumptions made during the design of those earlier systems.

Mr. Marshall took a slightly more skeptical view because of this identified lack of specificity. He was struck by the solid reasoning that moving away from stovepipe engineering encourages personnel to keep looking for improvements even if they think they are compliant and that two fault tolerance and redundancy do not always constitute the safest design. Nonetheless, he worried that the HRR is a self-serving change, perhaps overly focused on Constellation needs, that must be managed and monitored very carefully, or it can lead to the wrong processes and to dangerous results. Admiral Dyer summarized that right-hearted people produced the HRR, but it is incomplete and carries its own risks.

Ms. Joyce McDevitt reminded the Panel of its previous HRR-related recommendations, including four from the last meeting that amplify ASAP concerns. She focused on the bookkeeping issue, that is, the need to carefully plan decision documentation because the HRR simply points to common safety and reliability deliverables and other relevant documents that include pertinent information. For example, if an early program strategy or specified level of failure tolerance is superseded by a newly discovered alternative as the design matures, the Panel is concerned about how such changes will be tracked and documented.

Admiral Dyer commented that the old, administratively intensive waiver process generated thousands of hide-bound waivers that did not provide the desired design flexibility, but that weakness could also be viewed as a strength because these waivers were booked, signed, tracked, and accountable. In the current HRR, the weaknesses and strengths have reversed. The HRR is now very flexible, depends on good judgment, and provides greater program management freedom, but has lost crisp tracking and accountability at the individual level. He worried that the current process would require a data-mining exercise to locate all of those decisions (and perhaps even the personnel accountable).

CONSTELLATION IMPLEMENTATION OF HUMAN-RATING REQUIREMENTS

Admiral Dyer confirmed that the ASAP is pleased with the Constellation Program implementation of the HRR, notwithstanding Panel concerns about the HRR process itself.

General Charlie Bolden agreed, citing both kudos and concerns. On the positive side, the best element is the up-front involvement of Constellation safety personnel in the design process. He reported that some NASA veterans recall instances when the analysis and supporting documentation for the Space Shuttle were developed after the design was settled, simply to substantiate existing decisions, but Constellation engineers are incorporating safety in the design phase (specifically in hazard analyses, FMEAs, and

similar analyses) and then integrating them at the program level. The Panel also liked the idea of avoiding the prescriptive, check-the-box mentality. In contrast, the Constellation personnel are trying to understand the requirements; seem to be effectively employing the technical authority governance model, including identifying responsible individuals with go/no-go authority; and are applying heritage processes from earlier programs, from Mercury all the way through the ISS.

General Bolden noted that a major remaining ASAP concern is the residual effects of the zero-based design methodology, which NASA did not adequately define in initial briefings to the Panel. In fact, he declared that today he still does not fully understand the zero-based design because, depending on who is talking, the zero-based design either includes safety considerations or—in line with all of the General's other zero-based design experience—scraps the design down to bare metal and then builds on that. The Panel is concerned because of its lingering feeling that safety had to (or has to) buy its way into the design; this approach is not good safety and mission assurance (SMA) practice. As the flagship program for NASA, Constellation represents an excellent opportunity for the Agency to demonstrate to the world that it can have a successful space exploration program when safety is up front and really means something. The Panel's opinion ebbs and flows about whether the NASA culture fully understands the issue. For example, one presenter commented that once the zero-based design is established, the Agency begins incorporating safety enhancements. As Dr. McErlean appropriately remarked, if it is safety, then it is not an enhancement, it is a necessity. Admiral Dyer described the process as a judgment call of relative comfort about the appropriateness of the task at hand, offering design freedom and program management flexibility, but not crisply answering the question posed.

General Bolden digressed to talk briefly about four overriding themes, specifically (1) foremost, a determination of how safe is safe enough; (2) the timing of NASA involvement in the Commercial Orbital Transportation Services (COTS) Program and in specification of human-rating requirements for COTS vendors, which has not yet been answered (good people are agreeing to disagree); (3) the level of ambiguity in the Constellation risk matrix and the granting of approval authority for hazard reports and risk acceptance to the project level rather than the program level (see recommendation ASAP-2009-01-03a) for one of the largest programs that NASA has ever developed and the first one that the Agency is integrating in decades, an approach that makes the Panel uncomfortable because reason demands that a higher level of approval in the design phase of an integrated project is essential for program oversight and accountability; and (4) the central issue of transparency and clarity when sharing information with the public, particularly the capability to comprehensibly describe the significant risk associated with space exploration.

Acknowledging that General Bolden raised an important point, Admiral Dyer commented that the ASAP would recommend almost a new communications genesis. The ASAP suggested that the new Administration and the in-bound Administrator take time to consider a new approach that would explain not only the level and range of risk associated with space exploration, but also the importance of the work, the reward that justifies the risk, and the acceptance of that risk by willing and knowledgeable astronauts. The public discourse thus would be more direct and clearer, with less interpretation

required. General Bolden agreed, contending that American citizens can handle difficult issues, so NASA should quit treating them as if they are children who do not understand, instead bringing them in as partners.

Dr. Bagian emphasized the need for a more complete definition of risk and safety in the dialogue with the public. When NASA or the ASAP says "safe," the analogy is not taking the elevator to the lobby to get lunch; in reality, the appropriate analog is being shot out of a cannon, base jumping, or worse. Dr. Bagian suggested that perhaps NASA should not even use the word "safe," but should talk instead in terms of the risk that NASA has decided to take because of the potential benefits. Dr. McErlean stressed that nothing about this process is safe in the lexicon of the common man doing everyday activities—nothing is even close. He suggested a transition to "controllable risk" that NASA is mitigating in every way possible because the rewards of exploring and using space are more than sufficient payback for the skilled professionals who knowingly take such risks. Ms. Grubbe observed that the challenge is to articulate the risk so that each respective audience (e.g., appropriators, program managers, the public) understands it and can identify actions that affect that risk. Dr. McErlean rephrased the issue as NASA striving to drive risk down to the level that lowering it any further would require not flying—but that is still a long way from the risk associated with taking the elevator.

Ms. Grubbe warned that managers often take numbers as gospel and do not necessarily understand that such numbers are nothing more than sophisticated guesses. General Bolden deemed that a good segue to the risk analysis process described by NASA, which is quite promising, but the Panel concluded that if NASA more effectively, aggressively, and rigorously mined risk data from previous programs, it would detect facts and events that substantiate current risk analyses and subsequent guesses. He described NASA's approach as a paper program, with numerous up-front hazard analyses and FMEAs that are based on substantial speculation. The ASAP concludes that NASA can better substantiate and validate the analyses underlying such risk decisions by more effectively mining data from past programs and providing valid information to support the Agency's risk-informed decision-making process (see recommendation ASAP 2009-01-02b).

General Bolden reiterated that the Office of Safety and Mission Assurance (OSMA) HRR is neither the integrated picture that the program manager and Administrator should consider, nor the integrated requirements that a customer or vendor building a human-rated spacecraft needs. He stressed that engineering requirements (e.g., the NASA 5000 specifications and some MIL-SPECs still in use) constitute an integral and vital part of the process. Consequently, the Panel suggests that NASA should be more explicit in specifying the engineering requirements and standards that drive human-rated vehicles.

General Bolden affirmed that the Constellation Safety and Engineering Review Process (CSERP) is a great idea, but loses effectiveness when NASA establishes two. The CSERP is supposed to be **the** safety and engineering panel that approves all work, gives the green light to fly, and notifies the program manager and the Administrator. General Bolden contended that establishing two CSERPs at the two NASA Centers with the longest history of competition (Johnson Space Center and Marshall Space Flight Center) is untenable. Dr. McErlean agreed, stating that NASA has not adequately considered interfaces (i.e., one panel cannot allow for risks that the other panel already has accepted, despite crossover effects). He emphasized that this is an integrated project, so NASA

needs an integrated assessment, but instead is bifurcating the overriding philosophy of integrated risk-based design. General Bolden noted that each CSERP is at the project level, but NASA is the program integrator, so it requires a program-level CSERP with a chair who, at absolute minimum, works for the program versus two chairs working for two different projects (see recommendation ASAP-2009-01-02c). Mr. Frost cited a historical example to illustrate the problem: Foam dislodged from an external tank is not a hazard to the tank; the orbiter has no foam on it, so foam failure is not an issue for it; however, an integrated analysis of both reveals the obvious problem.

OVERVIEW OF THE EXPLORATION SYSTEMS MISSION DIRECTORATE

Mr. Frost described the briefing from the ESMD Associate Administrator as a good news story in almost all aspects; ESMD is bending metal, making fire and smoke, and planning for the future. He highlighted a few ESMD successes, including completing the Ares I Preliminary Design Review (PDR) last September, the Orion baseline review, and a number of program starts and milestones. ESMD is still committed to the March 2015 initial operating capability milestone and has undertaken major reviews for the Ares I-X, addressing ground operations, mission operations, and extravehicular activity (EVA) systems. ESMD monitors COTS milestones, and SpaceX recently successfully completed several reviews. ESMD also has started or completed construction of numerous facilities.

As Mr. Frost noted, ESMD expects a bigger year in 2009, including the pad abort test and Ares I-X test, which will show real progress to the American taxpayer. ESMD is working the three main issues properly identified at the PDR, specifically (1) liftoff clearance (the issue of whether the wind can blow the vehicle into the tower), which NASA plans to handle by vectoring nozzles or changing wind ground launch rules; (2) thrust oscillation, which NASA is addressing through a major effort, including making firm decisions to control oscillation on the launch vehicle and conducting crew tests to validate the vibration requirements (although the Panel would like to see more work in that area); and (3) inadvertent contact between the first and upper stages, an engineering problem that NASA identified through its analysis techniques and certainly can solve, preventing it from ever occurring during a test flight (at least one commercial COTS flight failed because of such inadvertent contact).

Mr. Frost concluded that ESMD implemented a number of architecture changes to reach a successful PDR, and the Directorate is still correcting and nudging the design to optimize it. He observed that micrometeoroid and orbital debris (MMOD) still constitutes the leading risk to ISS and Shuttle missions and that this issue will receive increasing attention in the years to come as the quantity of debris multiplies.

Dr. Bagian revisited the thrust oscillation issue, noting that NASA, displaying an abundance of caution, has changed the design to add two mass dampers to mitigate the vibrations from a crew standpoint. Although the Orion PDR is not until the end of the year, NASA should acquire (and slowly is capturing) additional test information to better understand the need for mitigation. Dr. Bagian suggested that Ares and Orion jointly collect such data, sooner rather than later because the data might show no effect on crew

health or performance, so NASA would not need a design change and mass dampers at all.

Mr. Frost described the briefing on the NASA program top risk list and procedures for managing cost, schedule, safety, and performance risks. He commented approvingly that this approach has all of the characteristics of modern risk management systems, including clear delineations of designated decision-makers and lucid definitions of risk levels. He noted with concern, as did General Bolden, that the CSERPs use a different matrix, even though they deal with safety issues that feed the program top-level risks. Moreover, as General Bolden pointed out, the matrix apparently assigns risk acceptance responsibilities for relatively high levels of risk to relatively low-level managers, much lower than the norm. Mr. Frost stressed that it is missing one of the main attributes of a useful risk matrix that can be applied consistently, namely how to tell where a risk sits on the matrix in terms of either numbers or a good narrative description of probabilities and severities; he noted that NASA can handle the severities, but the probabilities need work.

To avoid needless arguments (and wasted time) over defining a moderate or low probability—versus focusing on solving the problem—Mr. Frost suggested aligning the CSERP matrix more closely with the top-level risk matrix, which makes sense from a reporting standpoint and is particularly important as the basis of all other projects. He also recommended that NASA review MIL-STD 882, which could offer useful on-point guidance. Ms. McDevitt cautioned that the latest draft of MIL-STD 882 embodies a change in the whole philosophy of risk management to apply not to the life of the system, as it had for decades, but rather to the next 12 months. Although the new draft maintains a numerical threshold between each of the levels of likelihood of occurrence, this version expresses that risk over the next 12 months. Mr. Frost responded that the most common risk assessment error is not establishing the period of exposure time (i.e., parsing a risk down to a per-minute basis makes it sound acceptable).

Focusing on the matrix definitions of risk, Dr. Bagian suggested that after the definitions are refined (or even now), a natural follow-on would be conducting a reality check at different NASA Centers and projects by posing a technical situation, asking managers where it lies on the matrix, and comparing their results to determine whether the definitions are sufficiently clear to produce consistency. With various entities making same-time decisions, such a reality check is necessary and simple (see recommendation ASAP-2009-01-03b).

Ms. Grubbe contended that the risk lists are very good, but deal entirely with hardware, ignoring people and softer aspects. For example, such matrices could include measures of whether NASA is effectively communicating the right information. As another example, losing the NASA brain trust in one fell swoop (e.g., on the same ill-fated airplane) is not even on the matrix. From a people standpoint, the matrix needs review.

Mr. Frost observed that the COTS program is quite active; work and labor requirements are proceeding for transporting cargo to the ISS, and NASA is managing the safety implications of COTS vehicles contacting the ISS. Orbital Sciences Corporation and SpaceX are both heavily involved, bringing different approaches and skills to the table. In addition, as Mr. Frost and the Space Operations Mission Directorate (SOMD) briefing

indicated, NASA can learn new ways of doing business from COTS firms (although the downside of unsafe commercial procedures still must be monitored).

Mr. Frost also complimented NASA on its systems integration work. Although NASA has not served as the systems integrator for a major program for a long time, the Panel reported that NASA personnel not only are doing the job well, but also are learning and regaining systems integration skills. Ares I is coming together, so the pieces are fitting.

HUMAN CAPITAL UPDATE

Ms. Grubbe summarized the briefing from the Office of Human Capital Management, which has made good progress since its last presentation to the ASAP a year ago. For example, NASA has created one information technology system from the previous myriad of systems, thereby supporting future NASA needs by providing more accurate and readily available data. The team and management architecture that have been in place for a year to 18 months appear to be suited to the current task, although Ms. Grubbe indicated that the sophistication, currency, and necessity of the work should be monitored over time. She observed that NASA is managing immediate personnel needs by making good use of available tools such as term employment, career development, retraining, transition programs, and incentives.

The Agency also is emphasizing multigenerational workforce efforts so that Gen Y employees who join NASA feel as if they are more a part of the organization and the process. Ms. Grubbe noted that many employers now face this issue because young job candidates possess a totally different set of skills and therefore process information in different ways. However, she was heartened to hear that every NASA Center has initiated projects (e.g., cyber cafes) to open up the culture and increase communication.

Ms. Grubbe suggested that the Panel should continue monitoring these efforts and asked the Human Capital Management team to deliver a more detailed analysis, including information on identified skill sets and number of personnel who possess such skills. Some of this information is available, so NASA could apply a team approach (including leaders from major programs) to identify changing elements and how they are managed. She cited this strategy as a possible future recommendation because Headquarters-level personnel probably should not be asked to drill down to that level of detail.

Dr. McErlean added two thoughts. First, he noted that although the human capital briefing explained the Agency's successful changes in the recruiting process and the new-employee process—which are enabling NASA to gain better traction and attract new workers—it did not include an assessment of the process for comparing current and new workforce skills against needs identified by major programs such as Constellation (an evaluation similar to those performed for any acquisition). Expressing his certainty that the information is available, Dr. McErlean asked to see it in the future. Second, he addressed the Panel's small concern that NASA is placing a very heavy emphasis on recruiting from cooperative (co-op) programs. Although that can be an advantage, NASA still must be sufficiently open to acquiring the best available talent that it does not overlook an opportunity to hire a college graduate not in a co-op program. Moreover, the Agency must remain open and available to all college students, avoiding the **appearance** of focusing on co-op students to the exclusion of other recruits. Ms. Grubbe commented

that if the Panel wanted to make a recommendation, it should ask NASA to exert pressure on the Federal system regarding the recruitment of co-op, intern, and college students.

Dr. McErlean raised a question about the Federal Web site process and its relative user friendliness. Although the Web site is designed to offer young people an opportunity to apply for available jobs, the Agency should investigate whether the process is so difficult that students give up, thinking that NASA obviously is not interested.

OVERVIEW OF THE TECHNICAL EXCELLENCE PROGRAM

Dr. McErlean reviewed the briefing from the NASA Safety Center (NSC) and the Technical Excellence Office, which encompassed a couple of prior Panel recommendations. He confirmed that the ASAP views OSMA and SMA as an extraordinarily important skill set in the workforce, serving a vital function in properly addressing SMA in large, complicated programs.

Dr. McErlean summarized two ASAP observations. First, the Panel has suggested raising the "prestige" level of service in this organization so that NASA employees identified as future leaders will tend to process through OSMA. Such assignments will enable future leaders to acquire what the ASAP views as an absolutely essential skill set for their portfolios as they move up the leadership chain.

Dr. McErlean reported that the NSC is making important progress and has established four Technical Fellow (ST) positions, but currently has not filled the jobs (despite its best efforts), apparently because of budget issues. The ASAP is concerned because it has concluded that the Technical Fellows will be role models for other employees who aspire to high-level careers that require these skill sets. The Panel recognizes the importance of these four Technical Fellows and looks forward to seeing the positions filled (see recommendation ASAP 2009-01-04).

Ms. McDevitt suggested the possibility of hiring one full-time Technical Fellow—or one who is assigned part-time to a project or Center-related activity—to demonstrate the benefit of such support. She emphasized that NASA had worked very hard to create these positions and obtain an ST grade level, so the opportunity should not be lost. Dr. McErlean agreed, noting that establishing these four jobs sent the message to management that this is an important capability, but allowing the Technical Fellow positions to remain unfilled sends another, not-so-positive message. Mr. Frost suggested that the Technical Fellows should be treated like a safety-critical Shuttle or ISS subsystem, not just a nicety. As he observed, if NASA keeps doing what it always did, it is going to get what it always got. One of the main changes that NASA can make is to mobilize and exploit the Agency's extensive brainpower. Mr. Frost therefore characterized the Technical Fellows as critical safety positions that ought to be funded and filled immediately and noted that the required funding is small compared to the potential advantages.

Second, the Panel supports NASA in fostering a broader understanding across the total workforce of OSMA functions and their implementation. Dr. McErlean reported that the Technical Excellence Office is instituting a broad-based, multilevel education and training program that drills down into specific competencies (e.g., quality assurance). He suggested that Center directors should encourage personnel to take such training

courses—like the Defense Acquisition Workforce Improvement Act training in the Department of Defense–to raise their competencies in these areas. The Technical Excellence Office is currently assembling courseware packages, launching Internet access, and beginning beta testing. The Panel looks forward to reviewing the results of this promising, apparently robust program. Moreover, as Dr. McErlean observed, the work that NSC is performing should serve as a solid platform for launching such education and training activities.

Ms. Grubbe noted that it is incumbent on the NSC to engage with program personnel to identify their needs and then work backward to essential capabilities and competencies to ensure that the coursework fully matches and delivers the necessary skills. Ms. McDevitt cited this process as an opportunity for the NSC to communicate with human capital workforce personnel to identify the types, meaningfulness, and value of already available data (including defined SMA skill sets), rather than reinventing the wheel by automatically performing its own surveys.

Dr. McErlean indicated that the Panel encourages the NSC to conduct appropriate follow-ups and avoid the throw-it-over-the-transom approach. He confirmed that the NSC is off to a great start and using the right approach, but stressed that the NSC must be engaged with recipients of its services, monitor the match between services and needs, identify potential improvements, and track whether employees are taking the courses, whether the courses serve stated purposes, and whether students acquire targeted knowledge.

UPDATE FROM THE ACTING ADMINISTRATOR

Mr. Marshall declared that, on behalf of all ASAP members, it always is a pleasure to have the opportunity to share thoughts and ideas with NASA Acting Administrator Chris Scolese. Mr. Marshall further noted that the Panel has great confidence in his ability to manage NASA during the interim term and to do an excellent job of ensuring continuity for the next Administrator. Admiral Dyer reaffirmed the high regard that the ASAP has for Mr. Scolese, concluding that the Panel is confident in NASA's technical leadership at the highest levels after discussions with both Mr. Scolese and Mr. Bill Gerstenmaier.

Mr. Marshall reported that Mr. Scolese expressed his appreciation for the support of the new Administration. The ASAP and Mr. Scolese discussed the Shuttle and the future direction of space exploration, which the new Administration still must specify, preferably sooner rather than later because of the significant implications of any change. In the meantime, NASA is pursuing the currently legislatively approved mandate.

The Panel and Mr. Scolese conversed about the COTS program, a central theme of many discussions at this quarterly meeting. The ASAP and Mr. Scolese also revisited the issue of an optimum mix of human and robotic missions. Mr. Marshall noted that Mr. Scolese echoed the need for the Agency to focus more on this issue and expand the concept, perhaps using an alternative or equivalent levels of safety.

Mr. Marshall mentioned two other discussion topics. First, the Panel and Mr. Scolese addressed the recent collision of two satellites. The ASAP generally concludes that NASA does not hold responsibility for monitoring potential collisions and notifying commercial firms. Second, the ASAP and Mr. Scolese discussed the significance of the International Traffic in Arms Regulations (ITAR) and its implications for the Agency,

agreeing that this issue continues to inhibit NASA from fulfilling certain Agency roles and that additional relief from some ITAR provisions is required from the Congress.

SHUTTLE AND SOYUZ RISK ASSESSMENT

Mr. Randy Stone summarized the briefing by the Associate Administrator of the SOMD on the relative risk of flying astronauts on the Shuttle versus the Soyuz. Clearly the Agency has made a long-running decision that the Soyuz is sufficiently safe to fly U.S. crews and to serve as the ISS lifeboat. However, the Soyuz suffered a couple of failures recently when a pyrotechnic system failed to successfully jettison part of the deorbit package, resulting in a fairly rough ride to the ground. Consequently, the ASAP posed a question about NASA's confidence level (from a safety perspective) that the Soyuz will continue to be a safe vehicle for transporting U.S. astronauts to and from the ISS after the Shuttle is retired.

Mr. Stone praised the SOMD analysis. A very different vehicle than the Space Shuttle, the Soyuz is relatively very simple, very structurally robust, and a one-time vehicle (which, by virtue of the single-use airframe, adds a certain degree of robustness). The Soyuz has been a very reliable vehicle, launching on time two to three times annually for a surprisingly long 40 years. Moreover, the Soyuz capsule uses essentially the same launcher as the Progress cargo vehicle, bolstering the 40-year Soyuz record. Any changes are tested first on the cargo module (versus the human module) to gain engineering confidence that the changes are acceptable. If such a pyrotechnic failure occurs again, the Russians have redesigned the system so that its attitude allows the thermal properties of reentry to quickly sever the deorbit package, allowing the vehicle to stabilize.

Mr. Stone stated that NASA does not have nearly as much analytical information on the Soyuz as on the Shuttle, so NASA clearly must review Soyuz performance after every flight, making the same types of judgments about reliability as it does for U.S. spacecraft and adding to the historical record on the vehicle.

Because of the extremely long and successful operational history of the Russian vehicle, the ASAP has concluded that NASA has a good understanding of Soyuz safety and that the processes necessary to maintain its reliability are in place. Admiral Dyer agreed that, from a safety perspective, the Soyuz has the capability to bridge the gap between the end of the Shuttle Program and the availability of Ares and Constellation for transport.

Mr. Stone reported that the Panel asked the SOMD Associate Administrator about the recent unfortunate impact of an operational private U.S. satellite and a decommissioned Russian satellite. The collision produced a fairly large debris field, now orbiting the Earth. Mr. Stone observed that this debris field is not orbiting in the same plane as the ISS, but rather at a cross plane—not necessarily where the ISS is, but in that orbital attitude. Consequently, NASA will increase its vigilance during this time frame, and flight teams will move the ISS if required. Mr. Stone expressed confidence that the Agency can successfully manage this risk.

TRANSITION

Mr. Stone noted that the ASAP always is pleased to talk to Mr. N. Wayne Hale, Jr. Currently the Deputy Associate Administrator of Strategic Partnerships, Mr. Hale has performed many different jobs at NASA and is a trusted voice in the program. Consistent with one of the Panel traditions when conversing with someone who is influential in the program, the Panel asked Mr. Hale what keeps him up at night. Mr. Stone summarized Mr. Hale's thoughtful answer: the momentum-disrupting, potentially significant effects of a major change in Agency direction on the NASA workforce and on cost.

The Panel and Mr. Hale discussed the one outstanding decision that must be made fairly quickly, whether to extend the operational life of the Shuttle. Mr. Stone explained that if the Shuttle program is extended significantly—not just for a few missions—Mr. Hale would worry about lost opportunities over the last 5 years to make a number of Shuttle improvements that would inherently enhance safety and provide greater safety margins, but were rejected because they could not be developed and integrated before the scheduled retirement of the Shuttle fleet at the end of 2010.

Admiral Dyer addressed COTS development of commercial space delivery vehicles, which is focused initially on cargo, and NASA is ensuring freedom of design by taking a hands-off approach. However, the COTS companies, some members of Congress, and other observers contend such vehicles could eventually become human capable. The ASAP is concerned that NASA's hands-off stance has created a potential future capabilities mismatch because COTS firms might make innocent, good-faith design decisions that ultimately preclude future human-rated transport for NASA. Such an outcome would not benefit either the company or NASA, but rather would give the appearance of poor planning and might force NASA to make a time-constrained decision based on duress rather than sound analysis.

Dr. Bagian linked this issue to previous discussions on accepting and quantifying different risks for different operations. To avoid a (potentially) politically untenable position and a technically unfavorable one, in the next few months, NASA should determine the level of risk that the Administrator will accept and communicate that risk to all COTS firms—not instructing them how to get there (a persuasive point about equivalence made by Mr. Bryan O'Conner and others) and not specifying adherence to NASA 5000 series standards—but rather identifying an equivalence level, similar to the approach used in the U.S.-Russia working relationship.

Mr. Marshall cited two resulting dilemmas, specifically (1) NASA does not know what the equivalent level of safety is, does not know that number and how to communicate it, and (2) no one wants to impede current COTS progress and capabilities while adding cost to the current program and associated requirements. As Mr. Marshall noted, the Agency must start that dialogue regardless of the lack of current contractual agreements, and the Panel's consensus is preferably sooner rather than later.

ASAP RECOMMENDATIONS, FIRST QUARTER, 2009

2009-01-01: Human Rating Requirements (HRR)

2009-01-01a. Human-Rating Requirements (HRR) and Data Mining. The ASAP recommends that NASA rigorously research, compare, and contrast the different human-rating approaches used during the Apollo, Shuttle, International Space Station, and other programs. NASA should take advantage of this significant history and body of knowledge not only to assess the validity of the assumptions used in the new hazard analysis (HA) and in failure mode and effects analyses (FMEAs), but also to evaluate the benefits that the various approaches yield in terms of safety and mission assurance, which enhance future HRR modifications.

2009-01-01b. Human-Rating Requirements (HRR) and Engineering Standards. The recently revised HRR standard focuses principally on the process used to reach a human rating certification. Although it does specify some design requirements (such as fault tolerance and some human factors design standards), it does not include a requirement to implement, tailor, or obtain approval to waive NASA's other engineering design requirements for critical systems. These requirements embody the experience of NASA's best designers and the lessons learned throughout the Agency's vast experience in human spaceflight. These lessons might not be properly applied without such a requirement.

To clearly articulate the consistent and comprehensive integration of human safety considerations and mission assurance needs into the integrated design analysis (as required by the HRR), the ASAP recommends that NASA formally establish and stipulate the direct link between the HRR and the applicable NASA standards, such as the NASA-STD-5000 series of engineering directives as well as relevant technical standards.

2009-01-02: Constellation Program Implementation of HRR

2009-01-02a. Constellation Program Implementation of Human-Rating Requirements (HRR) and Design Safety. The recently revised HRR standard represents a fundamental shift from telling developers how to create a safe design (by relying primarily on redundancy) to establishing a process for using a risk-informed design approach to produce a design that is optimally and sufficiently safe. The ASAP applauds switching to such a performance-based approach because it emphasizes early risk identification to guide design, thus enabling creative design approaches that might be more efficient, safer, or both.

However, this approach is viable only if a common understanding of "sufficiently safe" exists, and the current HRR procedures leave that determination to individual programs, which could lead to inconsistent "safe-enough" thresholds among various developers if not carefully managed. This consequence could be especially problematic for development (and possible future use by NASA) of potential future human-rated vehicles produced by organizations external to NASA, such as Commercial Orbital Transportation System (COTS) firms or the programs of other nations.

The ASAP recommends that NASA stipulate directly the HRR acceptable risk levels—including confidence intervals for the various categories of activities (e.g., cargo flights, human flights)—to guide managers and engineers in evaluating "how safe is safe

enough." These risk values should then be shared with other organizations that might be considering the creation of human-rated transport systems so that they are aware of the criteria to be applied when transporting NASA personnel in space. Existing thresholds that the Constellation Program has established for various types of missions might serve as a starting point for such criteria.

2009-01-02b. Constellation Program (CxP) Implementation of Human-Rating Requirements and Data Mining. To strengthen the risk analysis processes that the CxP uses, the ASAP strongly recommends that the program apply a data mining methodology that captures failures, near misses, and other anomalies in hardware and software from other NASA programs (i.e., Mercury through the Space Shuttle and the International Space Station, including expendable launch vehicles). In addition, this methodology should identify personnel issues that positively or negatively affected these previous problems.

2009-01-02c. Constellation Program (CxP) Implementation of Human-Rating Requirements and the Constellation Safety and Engineering Review Panel (CSERP). According to Constellation Program Management (CxPM) Directive No. 013, the CSERP is chartered to provide CxP with an independent review of technical activities and products associated with safety technical risk. Implicit in this directive is a charge to the CSERP to ensure the completion of integrated risk analysis processes, which is a program-level function. The ASAP recommends making one of two modifications to the CSERP organization and review process, specifically (1) elevate the CSERP to a program-level panel or board with the responsibility and authority to review and approve all integrated risks or (2) direct that all hazard reports approved by the CSERP must be forwarded to the Constellation Program Control Board for additional integrated risk analysis and approval.

2009-01-03: Risk Management Models

2009-01-03a. Risk Management Models and Risk Acceptance. In the current Office of Safety and Mission Assurance (OSMA) model, as illustrated in the Constellation Program, the project manager is the responsible authority for accepting all risks except for the most likely and most catastrophic risk (i.e., in the risk likelihood-consequence matrix, the project manager is responsible for accepting 24 of the 25 categories of risk). Given the integrated nature of this program and other comparably large endeavors, the reasonable conclusion is that the program manager should have a stronger voice in the acceptance of risk at the project level. Moreover, the currently decentralized risk assessment approach offers no ready visibility into the overall risk accumulated by these various projects, which must be integrated at the program level.

The ASAP recommends that the OSMA analyze and emulate the risk management model used by the Exploration Systems Mission Directorate, with a particular emphasis on matching the level of risk to be accepted with the level of manager (i.e., project versus program) who must decide whether to accept that risk.

The Panel also recommends that NASA review authority levels in Agency-level policy documents to ensure that authority for medium-level and high-level risk decisions is consistent with the levels of risk involved.

2009-01-03b. Risk Management Models and Risk Definitions. The Panel has been pleased to learn in previous reviews that the Constellation Program has established a Top Risk Review risk management matrix that exhibits the characteristics of a modern effective risk management system. This matrix established clearly defined risk levels (carefully specifying both the probability and severity components of risk) and allocated those risks by category, commensurate with overall risk level. Despite these definitions and processes, however, the Panel is concerned that no quality assurance process is in place to assess, and generate data on, whether the matrix actually makes a difference in achieving consistency.

Building on the experience of other agencies, NASA should evaluate whether project and program managers Agency-wide consistently and reliably assign the level of risk for a specified set of examples to the same categories in the risk matrix (e.g., minor, moderate, likely, and so on). This determination then would form the basis for standardizing the definition of these categories so that risk assessments conducted in various NASA Centers can be better incorporated into the risk calculation for the integrated program.

The ASAP therefore suggests that NASA measure consistency of performance by devising technical risk examples, supplying them to a cross-section of those personnel who are responsible for deciding where a problem falls on the risk matrix, and evaluating the consistency of their risk matrix category decisions. Without conducting this type of exercise (or some comparable process to demonstrate consistent risk matrix category assignments), NASA will find it difficult to contend that its system for evaluating risk level assignments and decision-making is achieving its performance goal. Furthermore, if the Agency documents inconsistency in risk matrix category decisions, NASA should offer (and develop as necessary) appropriate training materials and tools for the relevant Constellation Program personnel. In addition, if warranted by the evaluation, NASA might need to expand the safety hazard risk matrix to include clear guidance on risk probability and severity definitions, enabling consistent application by all practitioners. The ASAP requests that NASA update the Panel at each 2009 quarterly meeting and complete these actions within a year so that the window of opportunity to enhance Constellation Program risk assessments does not close.

2009-01-04: SR&MA Technical Fellows

2009-01-04. Safety, Reliability, and Mission Assurance (SR&MA) Technical Fellows. To raise the level of technical expertise available to the Agency to solve challenging SR&MA technical and programmatic issues, NASA has worked diligently to establish Technical Fellow positions for the primary SR&MA technical disciplines. The Panel is pleased that NASA allocated appropriate grades to these positions to attract highly qualified candidates, demonstrating the Agency's level of commitment to the SR&MA effort. The Panel was disappointed to learn at this review that NASA currently is not filling these positions because of budgetary constraints. The ASAP recommends that funding be provided to complete this important step in the process of raising the capability and credibility of the SR&MA discipline at NASA.

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

June 9, 2009

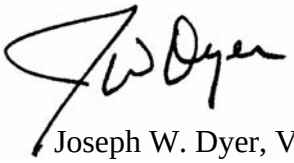
Mr. Christopher Scolese
Acting Administrator
National Aeronautics and Space Administration
Washington, DC 20546

Dear Mr. Scolese:

The Aerospace Safety Advisory Panel held its 2009 Second Quarterly Meeting at NASA Johnson Space Center (JSC) on April 29-30, 2009. We greatly appreciate the support received from JSC subject matter experts.

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

Sincerely,



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

Enclosure

Aerospace Safety Advisory Panel
2009 Second Quarterly Report
Minutes and Recommendations

Aerospace Safety Advisory Panel (ASAP)
Public Meeting
April 30, 2009
Johnson Space Center
Houston, TX

ASAP Members Present

- Vice Admiral Joseph W. Dyer, USN (Retired), Chair
- Dr. James Bagian
- Ms. Joyce McDevitt, P.E.
- Ms. Deborah Grubbe, P.E.
- Dr. Donald P. McErlean

ASAP Staff and Support Personnel Present

- Ms. Katherine Dakon, ASAP Executive Director
- Ms. Susan Burch, ASAP Administrative Officer
- Ms. Yasmin Naficy, Reports Editor

Attendees, Public Session

- Ms. Loretta Atkinson
- Mr. Perry Bennett
- Col. Eileen Collins
- Mr. J. Milt Heflin
- Mr. Larry Neu
- Mr. Ray Tolomeo

OPENING REMARKS

The Aerospace Safety Advisory Panel (ASAP) held the public session of its 2009 second quarterly meeting at the NASA Johnson Space Center (JSC) in Houston, TX. The Panel delivered the results of its findings in this public meeting based on briefings by and discussions with JSC officials, program managers, and chief engineers.

The Director of NASA/Johnson Space Center (JSC), Mike Coats, opened the Panel's visit with an overview of the Center's activities and issues. Director Coats communicated a number of concerns at JSC, including budget reductions, capped full-time equivalents (resulting in work being moved out to other NASA Centers), and uncertainty about when the next Administrator would be selected and announced. Director Coats noted recent EVA accomplishments and significant progress in the integration of major elements of the International Space Station (ISS), and the readiness of the Hubble Mission, which was up next and ready to launch at the time of the meeting. Director Coats noted NASA's professional response to Hurricane Ike, which included publishing and communicating lessons learned with other NASA centers and private industry in the aftermath of the event, and preparation for the upcoming hurricane season.

Director Coats noted that each of the partner nations of the ISS will fly on station in the not too distant future. Another important note is that this period represents the beginning of the end of the Shuttle program, and therefore unique challenges will arise.

Director Coats also noted that every one of the astronauts will have been assigned to a Shuttle mission flight by the end of the Shuttle program. NASA is also actively engaged in selecting a new astronaut class within a month, making this an epic transition from Shuttle flights in Low Earth Orbit (LEO) to long-duration flights.

Constellation Program Manager Jeff Hanley briefed ASAP on the program's budget and project status (i.e., its accomplishments and challenges). The ASAP observed that the Constellation team has done a commendable job within the given constraints, especially in making budgetary decisions, which is beyond the team's control, and in some respects beyond the agency's control. ASAP agrees that Constellation is challenged and needs to be funded adequately to accomplish their mission.

CONSTELLATION PROGRAM – SYSTEMS ENGINEERING AND INTEGRATION

During this Pre-PDR phase, the Constellation program has only spent 10 – 12 percent of the current program budget. This is a reasonable indicator of how early it is in the development of the final design. Therefore it is understandable that some aspects of the program are still being worked out.

The Systems Engineering and Integration Office requirements flow down process, which starts from the President's Vision for Space Exploration (VSE), is communicated down through an Exploration Architecture Requirements Document (EARD). The EARD flows these requirements down to the program level, thus supporting the president's objectives. The requirements (both primary and supporting) are tracked (a best practice) through a program called Cradle. ASAP expressed that this mechanism is an effective way of making sure that all system, sub-system, and component requirements ultimately reflected in the design, are traceable back to the primary objectives. The Panel noted that there is commonality among projects at JSC in that many are using Cradle software.

Further, system engineers have developed detailed Interface Requirements Documents (IRDs) to characterize system interfaces at all levels within the Constellation Program. Once these interfaces become finalized, they are moved to Interface Control Documents (ICDs), which are then placed under formal configuration control. The Constellation program anticipates that all these interfaces will be converted to ICDs by the time the Preliminary Design Review (PDR) is completed.

ASAP found that the requirements flow down is systemized, described in documentation, traceable, and based on good processes. A process of reducing down to only those requested changes that are necessary to insure requirement compliance (using requirements traceability) is essential to cap the ideas coming into a system, and produce a stable design to support a PDR. The management and traceability processes utilize reliable tools and processes, which indicate that the program's engineers are following best practices.

ASAP positively noted the amount and frequency of work process in place to maintain the Constellation Program's technical baseline, as well as the team's capability to not allow things to 'go stale'. However, ASAP indicated that the program needs to develop, use, and report back quantitative measurements to show how well work is progressing.

METRICS – QUANTIFYING PROGRESS

ASAP expressed confidence regarding the team's use of integrated design analysis cycles (their low-level milestones), as this practice allows quick design re-set without a lot of costly investment if issues arise. The Integration Review Board (IRB) can make a decision to discontinue a Design Analysis Cycle (DAC) early on, if a serious deficiency arises. It is clear that the Systems Engineering and Integration Office has assumed the responsibility for conducting integrated analysis, but ASAP still believes that while observation, articulation and integration are in place, identifying the basis for measuring progress (metrics) on a quantitative level is essential. While a process of observing and trending is in place, the Panel posed a question about what indicators this process provides to the team, especially in early stages of design.

As more major contractors come into play, the aforementioned type of communication and data will be important. This underscores the importance of having a set of quantified process metrics to accompany a well-documented process.

During discussions with the Orion team (responsible for Level 3 projects and Level 4 integration), the presenters indicated they would be using TBRs and TBDs to measure progress in addition to the Requirements Compliance Matrix. Those are just two metrics, and there may be others available.

ORION – SYSTEM INTEGRATION PANEL

Lockheed Martin, as prime contractor, leads some of the major engineering forums and boards, with NASA being members. In turn, NASA leads other major engineering forums and boards, including review boards, with Lockheed Martin as a member. Lockheed and NASA have very similar organizational charts, keep close contact, and know each other's counterparts. Authority for the vehicle integration and design control board is delegated accordingly, so that team members have a clear idea of what is required of them, such as tailoring requirements, change directives, and other elements to Orion system documents.

However, some of the current requirements—due to the dynamic nature of this phase of the program—are inconsistent with what is specifically called out in the Lockheed contract. These items are documented and are being addressed through contract changes. This process has been substantially improved and is smoother now than it was in the past.

INDUSTRIAL SAFETY TRENDS

At JSC, injury trends over time have decreased but have reached a plateau. The Industrial Safety team conveyed that JSC can do better, and that there is room to grow, as the "Best in Class" are an order of magnitude lower. The team is growing in this direction, and ASAP agrees a concerted effort will be required to achieve greater improvement. . Skip-Level Assessments provide an opportunity to reach further into the supervisory level to handle Industrial Safety more firmly. However, there also appears to be a gap in that Skip-Level Assessments are required, but there is no subsequent requirement for management to take action on those assessments.

JSC Industrial Safety rates are similar to other NASA centers, but JSC is striving toward improvement. At the same time the data suggests that JSC has performed well with Occupational Safety and Health Administration (OSHA) requirements.

CULTURE SURVEYS

NASA needs a strong quantitative and qualitative measurement/survey of culture, done with vigor and regularity, not only at JSC, but agency-wide. Doing so would identify negative trends, thereby enabling centers to take appropriate action. A previous NASA Administrator organized an excellent approach to integrate culture surveys; however, that process was put aside by the last Administrator. These surveys may be difficult for technical personnel to become familiar with, however ASAP made a recommendation in a prior public meeting to move ahead with this activity.

ASTRONAUT CREW PROFICIENCY

The astronauts with whom ASAP met used as an exemplar what they do for familiarization, robotics, and EVA training. Evaluators put astronauts and candidates through EVA familiarization runs to determine whether they are qualified for further training. As an example, some astronauts are deemed qualified for EVA work, while others are not.

The crew members are further ranked by the EVA Evaluation Board as EVA A or B, which describes their ability level. ASAP witnessed an EVA evaluation during the Neutral Buoyancy Laboratory (NBL) tour.

The final decision whether the astronaut is ultimately deemed qualified and assigned to a flight depends on evaluations that possess both objective and subjective evaluation factors. ASAP noted this is a rational approach.

T-38 OPERATIONS

There will be a future decrease from 23 to 20 T-38s, as well as a simultaneous Block 3 upgrade, which will include a Traffic Collision Avoidance System (TCAS) and an Enhanced Ground Proximity Warning System (EGPWS). There is also consideration being given to building in a data link for weather radar. These upgrades should enhance safety.

The astronauts stated that the T-38 system simulator is being used more often now, and that they are also using the system for Crew Resource Management (CRM) training. The astronauts stated that CRM training is being incorporated into actual flights for both pilots and back-seaters.

Continuing the T-38 flying program during the gap between the Shuttle and Constellation was identified as being important during the public meeting. ASAP feels this program provides an excellent opportunity to observe, train, and evaluate crew office personnel in an environment that can elucidate suitability for future crew assignment. As the Shuttle program terminates these linkages to realism are significantly diminished if T-38 flying is curtailed. ASAP strongly endorses this position, as the realism of T-38 operation provides a valuable complement to ground-based simulations.

INTERNATIONAL ISSUES

A discussion regarding logistics flights between Moscow and Baikonur took place during the meeting with the astronaut office, revealing that crew and other NASA personnel travel this route on Russian aircraft that NASA has little insight into regarding safety-related information. In other environments this would not be allowed. This is worrisome since there are frequently a large number of NASA personnel on board a given flight. If an aircraft is lost, this could have a significant impact on program operation. An explicit evaluation as to the risk imposed by the use

of such uncertain assets should be undertaken to decide if any change to the current use of Russian aircraft is warranted.

The relationship and the working level between NASA personnel and the international partners was described as good, with communication being open and functioning at a high level.

HUMAN RATING AND RISK-INFORMED DESIGN PROCESS

The current mechanism by which Constellation manages and assigns risk is somewhat different from the norm. This mechanism has one typical component that employs a burn-down of risks. On the identification and severity side, however, there is a process in place that the individuals involved understand clearly, but isn't as commonly used. The group has incorporated risk management and hazard identification in ways that are not completely congruent and need to be clarified further. ASAP further recommended to senior Constellation managers that they use either quantifiable metrics or specific examples to illustrate the meaning of certain terminology.

ASAP used emergency systems to describe the potential for miscommunication. In this example, there are those who would argue that because an emergency system is a back-up and is rarely used, it does not have to be as reliable as the primary system. Others, including ASAP, would support the view that when an emergency back-up system is needed, the primary system has already had a failure, thus the back-up system has to be even more reliable than the primary one.

ASAP commented on the Constellation Program's presentation regarding their process for what they call the 'design for minimum risk'. This process includes a mechanism whereby design margin (e.g., in the thickness of pressure vessels) is used to obtain minimum risk. This method requires a separate approval by the Constellation Safety Engineering Review Panel (CSERP) board for acceptability. The presenters informed ASAP about their process for determining when it is appropriate to use design margin instead of fault tolerance for achieving minimum risk. This process was well described and appeared robust.

CSERP (comprising CSERP1 [Ares] and CSERP2 [Orion]) was described as having a good and positive 'checks and balances' process in place. The team described the Integrated Hazard Analysis process (reviewed jointly by CSERP1 and CSERP2), which is reviewed by the Office of Hazard Integration and the CSERP board. This process incorporates an event-driven reduction in risk so that residual risk is both controlled and documented, with retirement taking place only after a specific event is successfully completed.

ASAP was informed that the CSERP board reviews any hazard, and that this board comprises both technical and safety authorities who must concur before a risk can be downgraded. This process is interactive, continually evolving, and incorporates key steps, so that the risk does not sit idle. Further, the information ASAP received on Human Rating and Risk Informed Design highlighted process and analysis cycles with flow diagrams, and described the iterative processes that pick up additional hazards and address them accordingly. This constitutes a good, solid practice at JSC, in ASAP's opinion.

With the Orion risk-informed design improvements there remained some confusion, specifically regarding statements about "zero base" activity and safety having to "buy its way" back in. However, during this visit it was made more clear by those presenting that there is no intention to fly a vehicle in the baseline category, and there is no intention to create a zero base vehicle. These terms were simply used to establish a minimum baseline.

The term “zero base” was then clearly defined as being a ‘floor’, to which design improvements were added to meet the human rating standards and to incorporate appropriate safety measures. This process and these changes were coordinated with Orion’s prime contractor (who is fully on board with the approach). Incorporating the prime contractors gives ASAP additional confidence that the team has a suitable broad based team with respect to safety analysis.

The Constellation team provided an extensive explanation of its mechanism for pushing down risks, noting that risks had to be differentiated between different missions. Based on this briefing, this team appears to be moving ahead and plotting out a reasonable path to PDR. ASAP continued to encourage the team to make hazard risk definitions and terminology more quantitative and precise in nature (referencing terms used, such as “Minor Damage” and “Major Damage”). ASAP fully encouraged the team to offer examples that define this type of terminology. The team agreed they will work on this suggestion to make the meanings more consistent and clear.

ASAP members noted that Mr. John Curry, Manager of the Orion Vehicle Integration and Design Office, delivered a presentation that built confidence. Mr. Curry presented tracking, traceability and other elements clearly, and understood well the LOC/LOM numbers allocated against the Orion vehicle, among other vital factors.

When considering a transition from a mandated redundancy of life critical systems to an approach that states “exercise good judgment,” the point was made that redundancy and a “cookbook” approach added weight. ASAP questioned whether the team was making this transition with specific guidance. The team explained that in the current processes, prior to documenting a risk characterization, all technical, medical, and other channels must concur that the risk has been properly classified. If concurrence cannot be reached, the matter is escalated to a high-level risk board, which constitutes good risk management practice.

ASAP’s view continues to be that documentation is definitely needed where an “exercise good judgment” approach is being implemented. This is an area of some concern, whether decisions would be appropriately documented for future referencing purposes, for example. In discussing risk matrices and decision matrices, the team had some difficulty explaining these items to the Panel. Though the team knew how the matrices worked based on inferred, innate reasoning, the workforce a generation from now may not understand the matrices’ logic and heritage. Capturing and articulating this logic for the future is important.

The Orion team understands that they need to communicate more clearly the integrated analysis being used, which is currently very complex. This includes giving examples if exact numbers are not available.

Rigorous discussion also arose regarding the probability of small risks building up and becoming a larger risk. Specifically, will current practices and approaches be able to detect this cumulative risk over time?

Another question, “How safe is safe enough?” was raised during presentations. This question is answered in the Constellation program as completion of a multi-tiered process of review, comment, update and approval.

The briefings conveyed enthusiasm about interactions between different disciplines in addressing designs and other factors. This indicates that the program teams feel the systems and processes

are growing, improving, and working increasingly well, and that the products emerging are much better as a result.

Another item that emerged during the briefings was discussion about risk characterization in general. This is normally expressed as a combination of 'Knowns', 'Known Unknowns', and 'Unknown Unknowns'. Knowns are handled with standards. Known Unknowns are handled with fault tolerance. Unknown Unknowns are handled with margin. The Panel noted that a robust approach, which includes all components (standards, fault tolerance, and margins), is necessary to operate in the hazardous environment of space.

Designing for minimum risk has not been fully completed yet, but is in progress and needs to be completed. Since there is no way of knowing all the risk factors of any mission, NASA has to count on the robustness of the design to allow for the mitigation of the Unknown Unknowns.

In discussing the concept of design robustness, ASAP used the example of weight control in aircraft and the difference between conventional takeoff and landing airplanes, and Vertical Short Take-Off and Land (V/STOL) airplanes. Both take good design and weight mitigation, but the weight requirements for V/STOL cause tradeoffs that by necessity lower margins. The subsequent results are very different, and show that while weight control is important to both, fundamental requirements set the process for reaching the desired conclusion. Overall there was consensus that the Constellation Program is in its early stages, but at the same time has overcome important challenges evident earlier in the design development.

KNOWLEDGE MANAGEMENT

A Panel research question: Is NASA capturing, preserving and communicating knowledge generated over the last 50 years of spaceflight? The newly appointed JSC Chief Knowledge Officer, Jean E. Engle, is adapting her knowledge management system to the existing knowledge capture model and practices already in place, as opposed to pursuing a new system. This approach has produced a great deal of cooperation as opposed to organizational resistance. ASAP determined that this speaks well of the program, constituting a powerful approach, and believes that a best practice ought to be adopted along these lines across NASA.

At the same time, while the Knowledge Management program is the catalyst to standardizing knowledge capture practices across the agency, the resources and staffing required to complete the pertinent tasks may be insufficient across the Agency at large.

ARES

Thrust oscillation was discussed as it had been on many prior occasions. The Ares team indicated they would prefer to use passive as opposed to active counter-measures to address thrust oscillation. The sooner they can finalize this assessment and decision, the better, so they can continue with the design process. The Ares team seems to be moving well along this path and making good decisions, in addition to keeping ASAP informed.

ASAP RECOMMENDATIONS, SECOND QUARTER, 2009

2009-02-01: ASAP recommends that in maintaining the Constellation Program's technical baseline, NASA must develop, use and report in-process and outcome metrics to assure risk management processes are being followed and that progress is being measured.

Though design integration has progressed substantially, ASAP believes NASA's work process would be enhanced by adding quantitative measures that can be introduced, tracked and reviewed periodically, thus serving as indicators of a successful work process.

2009-02-02: ASAP recommends that NASA be more aggressive and transparent in communicating changes—and the rationale for changes—relating to some areas of the Constellation design and development process. This would prevent NASA's detractors from resorting to using incorrect or incomplete information that puts NASA in a weakened or defensive posture for no technical reason. For example, a significant media miscommunication occurred following NASA's release of information about a change in the number of crew seats on the Orion (a design decision). Media outlets subsequently took this information out of context, resulting in incorrect conclusions being relayed to the public.

2009-02-03: ASAP recommends that Hazard and Risk Matrix definitions be more quantitative in nature. Risk definitions must be improved and made more precise. Since approving the risk and accepting the risk are not the same, these terms must be made more clear and differentiated, particularly in any information that is released. The ASAP also recommends that NASA train all its new engineers and managers in its hazard and risk management processes, so that everyone can better appreciate and understand how this relates to their work.

2009-02-04: ASAP recommends that NASA exercise appropriate diligence with respect to insuring the acceptable safety for aircraft employed in all host countries. If the existing safety level is insufficient or documentation is incomplete, actions need to be taken that will result in improvements to the existing providers' operations, or instituting new resources to provide this transportation.

2009-02-05: ASAP recommends the Industrial Safety team more openly communicate the results of Skip-Level Assessments of supervisors to senior leadership. This will allow leadership to become increasingly involved in, and more knowledgeable of, the Industrial Safety Program.

2009-02-06: ASAP recommends NASA acquire a means to continually identify workforce and management issues before they grow into even larger problems. Using a workforce survey is an accepted practice and can be integrated within normal HR and program activities. Properly employed, this will serve as a proactive leading indicator of organizational effectiveness.

2009-02-07: NASA (in all locations) needs a strong quantitative and qualitative measurement of culture changes, done with rigor and frequency. ASAP subsequently recommends that NASA reinstitute a periodic culture assessment.

2009-02-08: ASAP recommends that NASA adopt a best practice to standardize knowledge capture and management practices across all centers.

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

August 17, 2009

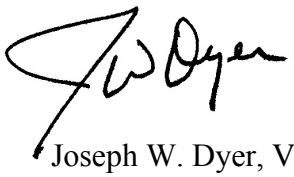
Major General Charles F. Bolden, Jr.
Administrator
National Aeronautics and Space Administration
Washington, DC 20546

Dear Gen. Bolden:

The Aerospace Safety Advisory Panel held its 2009 Third Quarterly Meeting at the Jet Propulsion Laboratory (JPL) on July 22-23, 2009. We greatly appreciate the support received from JPL subject matter experts as well as the NASA Headquarters staff who attended the meeting and provided requested information.

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

Sincerely,



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

Enclosure

Aerospace Safety Advisory Panel
2009 Third Quarterly Report
Minutes and Recommendations

Aerospace Safety Advisory Panel (ASAP)
Public Meeting
July 23, 2009
Jet Propulsion Laboratory
Pasadena, CA

ASAP Members Present

Vice Admiral Joseph W. Dyer, USN (Retired), Chair
Dr. James P. Bagian
Mr. John C. Marshall
Ms. Joyce A. McDevitt, P.E.
Mr. John C. Frost
Ms. Deborah Grubbe, P.E.

ASAP Staff and Support Personnel Present

Ms. Katherine Dakon, ASAP Executive Director
Ms. Susan Burch, ASAP Administrative Officer
Ms. Paula Burnett Frankel, Reports Editor

Attendees, Public Session

Mr. Matthew Landano, JPL Office of Safety and Mission Success
Mr. Frank Mortelliti, JPL Office of Environmental Health and Safety
Mr. Peter Robles, Jr., JPL NASA Management Office
Mr. Robert Democh, JPL NASA Management Office
Mr. Helmut Partma, JPL Office of Safety and Mission Success
Mr. Rod Zieger, JPL Project Support Office

OPENING REMARKS

The Aerospace Safety Advisory Panel (ASAP) held the public session of its 2009 third quarterly meeting at the Jet Propulsion Laboratory (JPL) in Pasadena, CA. Admiral Joseph Dyer opened the session by noting several absent panel members, including General Charles Bolden, who has been with the Panel for the past two and a half years. General Bolden is leaving the Panel to take up his responsibilities as the new Administrator of NASA. He comes with tremendous experience and background: an astronaut with close personal experience with the Hubble Space Telescope, a friend to human spaceflight as well as science and applications, and a retired Marine Corps General. Admiral Dyer also noted that Mr. Christopher Scolese has been husbanding the organization as acting Administrator after Dr. Michael Griffin's departure and prior to the appointment of General Bolden. He is a technical expert and an outstanding

communicator. Mr. Scolese has done an excellent job of ensuring continuity for the next Administrator, and the Panel owes him a special debt of gratitude.

Admiral Dyer commented that this is an interesting time for NASA. There is a desire on behalf of many inside and outside of the agency to both understand and influence future vectors as well as a desire to revisit policies of the past. Some policies that will be challenged will be ones with which this Panel has strong feelings, such as the concept of Technical Authority and the role of Center Directors, organizational structure and checks and balances, budgets, and a view of NASA as a confederation of ten independent Centers vis-à-vis a strong and integrated union. All of these will be topics of import with the new Administration, and they all directly relate to safety. Admiral Dyer stressed that the Panel's spectrum of interest remains broad and includes all of these topics.

OVERVIEW OF JPL

The Panel spent the previous day in fact-finding discussions with JPL and NASA Headquarters representatives. Admiral Dyer reported on the discussions with the Director of JPL, Dr. Charles Elachi, who provided a broad overview of the institution. Dr. Elachi opened his talk with the Panel by making an important point with regard to safety—he was a bit late for the meeting, but was careful not to speed for many reasons. He emphasized that the leadership must set the tenor with respect to safety.

JPL was established in the 1940's, born out of the California Institute of Technology (CalTech). It was moved out of town because of concerns with its explosive activities. JPL is a Federally Funded Research and Development Center (FFRDC), which gives it more flexibility in terms of salaries, competition, and operating situations than other NASA institutions, such as the Ames Research Center in the San Francisco area. JPL has about 5000 people, all of whom are CalTech employees, and a business base of $1.7 billion. Seventy-two percent of its base is in science, and it probably houses the most impressive knowledge of Mars anywhere. Currently, JPL has some nineteen spacecraft flying, a record that is representative of more activity in space and longer survivability. The benchmark for survivability would be Voyager, currently in its twenty-fourth year. JPL is organized in a matrix form, both in terms of programs as well as competencies. This organization demonstrates a great answer to the question of how to maintain balance in both perspectives, relying heavily on the rotation of people. Today, there is very little propulsion work at JPL, but there is a considerable amount of robotics work, perhaps the most impressive the Panel has seen. Admiral Dyer noted that the ASAP has had an outspoken history of concern about the compartmentalization of robotics to science, separate and apart from human spaceflight. A significant contribution to safety can be made by a better integration of human spaceflight and robotics.

With respect to JPL's physical infrastructure, the Panel felt that while not perfect, it is in far better condition than at most Centers. Overall, JPL is an impressive facility.

Dr. Elachi told the panel that he would like to see a change in the NASA governance model as it applies to centers that manage smaller projects that do not involve multiple

center responsibilities. He believes that both Project responsibility and Technical Authority for such projects should reside at the Center Director level. He felt that this would clarify lines of responsibility. The Panel has previously supported the existing NASA concept of Technical Authority not being blended with Project responsibility at the Center level. This is one way to ensure that Technical Authority decisions are not unduly influenced by the schedule and cost pressures that a Project naturally faces. The Panel has not been presented evidence altering this position.

OVERVIEW OF THE OFFICE OF SAFETY AND MISSION SUCCESS AND THE STATUS OF ENVIRONMENTAL HEALTH AND SAFETY

Ms. Deborah Grubbe reported on the Panel's observations on the presentations from and discussions with Mr. Matthew Landano from JPL's Office of Safety and Mission Success. She noted that her comments pertained to this topic as well as the Panel's discussion with Mr. Frank Mortelliti on the status of JPL's Environmental Health and Safety.

JPL continues to have a good safety performance. Based on the Panel's last visit in 2004 and observations and discussions the previous day, JPL has maintained a good safety record. However, the Panel believes that the challenge for JPL going forward is a question of how good it really wants to be in safety, because it possesses the capability to be much better. The JPL safety culture can be improved, and it must start with a renewed commitment from JPL's leadership—it should clearly express the challenge and its commitment to it to the workforce. (Recommendation 2009-03-01a cites some specific actions.)

There have been some very good conversations with regard to hazards, but they can be better—they can be more certain and definitive for people. There have been warning signals, one of which the Panel observed during its tour: employees wearing open-toe shoes when there might be a possibility of their venture into a potentially hazardous area. With a good safety performance, more attention can be placed on issues associated with making aging workers more productive. Some excellent work has been done in this area on a volunteer basis—volunteer, because it requires the human individual to make changes to lifestyle. A good initiative to start with would be one that focuses on specific issues inside JPL. Ms. Grubbe indicated that the Panel would be happy to provide more details to JPL privately if desired. The question Ms. Grubbe posed was: You can be great—do you want to be?

Mr. John Marshall noted that another issue is better integration with the new NASA Safety Center (NSC) at the Glenn Research Center. It is a resource that can be of great use to JPL and vice versa. He encouraged and recommended that JPL establish a better working relationship with this organization and capitalize on the NSC's strengths and experience.

Mr. John Frost commented that the JPL safety representatives are top notch and seem to have exceptional credibility with the programs that they support. One of the reasons that

this is true is because of the encouragement of personnel exchange between the project side and the support side of the matrix. This exchange is working and is something the Panel would like to see more of at the other Centers. Also, JPL has a good closed loop system for taking lessons learned from flight or ground anomalies and ensuring that they are tracked and put into a system. There are two areas that the Panel has commented upon previously: the risk acceptance process and lessons-learned/golden rules standardization. Mr. Frost noted that Panel has seen some weakness in these areas at many NASA Centers and again sees it here. He recommended that JPL strengthen its risk acceptance process by clearly identifying the individuals who accept the various risks. The Panel continues to recommend better coordination Agency-wide on lessons-learned and the sharing/standardization of golden rules.

METRICS AND REPORTING

Ms. Joyce McDevitt summarized the Panel's review of Metrics and Reporting and the discussion with Ms. Faith Chandler, the NASA Headquarters Mishap Investigation Program Manager. All of the discussion dealt with responding to recommendations made by the Panel at previous meetings: to improve on the quality of the accident investigation; to ensure more timely investigation results and more timely final authorization of the Mishap Investigation Board Report by NASA Headquarters for a broader release across the Agency; and to improve the capture of lessons learned. There was a discussion addressing the various initiatives in the area of mishap investigations. One of the key things that has improved the strategy for dealing with mishaps and reporting on investigation results is that Ms. Chandler now reports monthly to the Baseline Performance Review (BPR), which is a senior management committee; the reporting to senior management is the result of a previous ASAP recommendation. The BPR is directed by the Associate Administrator, and includes the Associate Administrators for the various Mission Directorates and Center Directors or their representatives, and focuses on addressing institutional issues. The BPR has resulted in more emphasis being given to the area of mishaps and reporting as well as the flow of the process down through the Centers. The Panel looks forward to continued progress in this area.

Some of the initiatives underway are: the Incident Reporting Information System (IRIS) and the use of that system by all Centers; the Interim Response Team activities to ensure that evidence is impounded, debris collected, etc., prior to establishment of the Mishap Investigation Board (MIB); and root cause analysis. The Panel was pleased to hear of the March 2009 beta release of the root cause analysis software to NASA civil servants. The full roll out is expected to occur in October 2009 to all contractors and Agency representatives. This tool is helpful in looking across all of the analysis performed in conducting the investigation. Recognizing the requirement within the Agency to use trained investigators, there is a continuing effort to train people both in the safety community and those in specific discipline areas. To facilitate the mishap investigation process, three Mission Support Specialists from the NSC are available to assist in the Type A and Type B mishaps. When the MIB convenes, they now have a trained facilitator and are able to step out promptly to perform their investigative activities.

In completing the MIB activity in a timely fashion, a couple of noteworthy things have been accomplished. A Mishap Warning Action Response (WAR) has been developed. This provides early findings and recommendations, with results posted on a web site. In the past, the ASAP has been concerned that mishap information was not getting out across the Agency as quickly as possible. The Mishap WAR process addresses that concern, but still is solely dependent upon the accident board to determine if agency-wide information is necessary instead of NASA's SM&A leadership making that determination. There was also concern about the quality of the mishap reports, and the NSC is now taking on an initiative to perform a peer review of this area. Also, the additional resources provided by the NSC are freeing up some of the backlog activities. With respect to this backlog, a prioritization has been established for tracking corrective action closure. Those mishaps that affect programmatic missions and multiple injuries are worked on first, followed by the rest of the backlog of corrective action reports. This was one area that the Panel had previously expressed concern about—the timeliness for getting the final authorization of the report through the various offices at NASA Headquarters. The ASAP did not receive any particular metrics or statistics in this area. The Panel requested Ms. Chandler and her staff to pull the data in this area together and provide it to the Panel to determine whether the trending is in the right direction.

Admiral Dyer added that the tracking and trending of administrative turnaround of reports at NASA Headquarters was fundamentally conspicuous in its absence and needs to be fixed. Another concern was capturing in-flight anomalies. This area has not been addressed with regard to gathering the metrics, but there is an effort underway to utilize the root cause analysis tool to improve on the investigation of in-flight failures and anomalies that lead to mission failure.

Mr. Frost noted that it is NASA policy to fully track to closure the recommendations stemming from investigation of unmanned system flight anomalies that meet the criteria of mishap (i.e. mission failure). This is a good closed loop system for these safety investigations; however, it is not clear if such a system is being utilized to identify and track to closure the programmatic and systemic root causes of less severe flight anomalies that are investigated by technical boards that are not part of the mishap investigation process. The panel has noted several excellent flight anomaly investigations in the past whose recommendations seem not to have been fully implemented as new standards or procedures. The Panel would like to be briefed at a future session by the Chief Engineer's Office on how programmatic or systemic root causes are identified and recommendations tracked to closure for technical boards of investigations that are not part of the mishap investigation process.

The Panel was presented with several charts depicting the current results of data analysis efforts. This area is evolving. The Panel specifically asked that this report be presented quarterly because there is a continuing, overriding question of how to make the safety program better. The ASAP is committed to help NASA identify leading indicators and having this data analysis supports that initiative.

Ms. Grubbe commented on Dr. Elachi's statement that he worries most about human error and loss of experienced people. Considering the leading indicators, the data base should grow to include the "people aspects" at some point in the future.

Ms. McDevitt indicated that one of the areas NASA Headquarters is going to be examining is mishaps with cost as the common denominator to see what information that might convey. The Panel was shown more than merely a number count—there was a normalization of data based on the number of work hours per Center, for example, and this showed results in a more meaningful way. Telling messages can be derived from this data. The Panel encouraged NASA to continue its work in this area, and expects reviews periodically. Dr. Jim Bagian added that one of the important aspects is how NASA looks at the data and understands the true underlying causes as well as the more generalized learning that can be achieved throughout the Agency.

Admiral Dyer reiterated Ms. McDevitt's laudatory comments. He noted a follow up action: a chart based on the Panel's previous recommendation regarding administrative approval time.

OBSERVATIONS ON JPL TOUR

Before Mr. Marshall gave his report on the JPL tour, Admiral Dyer thanked him for his representation of the Panel in testifying to the Science Committee on the Hill a few weeks ago.

Mr. Marshall shared some feedback from the ASAP's tour at JPL. He noted that the Panel has taken on the issue of utilization and integration of robotics in support of both science and exploration. The very impressive field demonstration was more confirmation of JPL's great skill in robotics. This happens because of good leadership and enthusiastic performance of people. The Panel was given a demonstration of the Axel Rover robotic concept and received a briefing about its capabilities for utilization in exploration. On behalf of the Panel, Mr. Marshal gave compliments to all involved. After the Axel field demonstration, the Panel had a conversation with JPL about the Spirit and Opportunity rovers on Mars. Their success has been tremendous. A rover designed for a three month lifetime has gone five years. This is a credit to leadership and the people involved in the program.

Regarding the integration of robotics in NASA in general, Mr. Marshall noted that the Panel continues to be disappointed—it continues to see a lack of integration both among Centers developing robot capability and across the full spectrum of manned and unmanned exploration. Most Centers have some robotic activity because they want to be "in the game." Accordingly, the Panel concludes that this contributes to a loss of momentum and loss of opportunity and recommends that NASA pursue robotics research in a coordinated, consolidated fashion to capitalize on the strengths that have been developed and more fully exploit robotics utilization throughout all missions.

Ms. Grubbe added that one of the positive steps with regard to integration is the people-sharing going on between JPL and the Constellation program. Currently, seventy-nine people are involved. This is positive progress, but what is needed is something that is overarching and can accelerate the collaboration.

STATUS OF COMMERCIAL ORBITAL TRANSPORTATION SERVICES (COTS)

Mr. Frost reviewed the Panel's discussion with Mr. Alan Lindenmoyer, the Manager of the Commercial Crew and Cargo Program Office, who came to JPL to talk about the COTS Program. It is emerging as one of the critical programs for NASA. The Panel had assumed that Constellation would be the immediate path to the future of Human flight for the Agency; however, there may or may not be a widening of the gap between the end of Shuttle flights and the beginning of Constellation services. If there is a widening gap, COTS could play a key role and could be a critical program for flight safety of the astronauts. This warrants greatly increased attention on the processes of ensuring the safety of COTS systems.

There are two phases to the current COTS ISS cargo program: a demonstration phase of $500 million, followed by a competitive procurement planned to proceed only after a successful capability demonstration. For reasons not completely clear to the Panel, the timeline for the two phases has been compressed, and both are now proceeding simultaneously. Orbital Sciences Corporation (OSC) and SpaceX have both been funded to perform both phases 1 and 2. Although Phase 1 is not complete, Phase 2 contracts have been awarded for about $3.5 billion. The two organizations have distinctly different ways of approaching the complex job of getting mass to orbit. The compression of the program (to do Phase 2 before Phase 1 is complete) entails programmatic risk and is of concern to the Panel. Adding to this concern, one of the contractors will demonstrate all of its capability in a single test flight, in effect "putting all of its eggs in one basket".

As far as the safety issues, they basically boil down to expanding the cargo capability to include crew. If that is done, the traditional method would be to apply full human rating criteria initially at the beginning of the program's development. However, thus far NASA has consciously chosen to not use a traditional approach, and there yet have been any performance requirements identified to put crews on board a COTS vehicle. The Panel previously had made a recommendation regarding this issue and continues to be perplexed as to why NASA has delayed this important action. Mr. Frost noted that the Panel has a meeting with SpaceX at its facility later in the day and has a lot to learn about the entire process. Nevertheless, the Panel continues to recommend that the Agency quickly establish fundamental safety requirements for today's COTS programs that may in the future be used to get NASA's astronauts to Low Earth Orbit (LEO), or beyond.

Admiral Dyer indicated that the Panel was looking forward to the SpaceX visit. The Panel has addressed its concern in its previous quarterly and annual reports. The issue is becoming more focused and more urgent. The prospect of a COTS delivery of cargo to space is organizationally and politically simpler than crew transport. The issue of human rating with COTS and the delivery of NASA astronauts into space is the primary concern.

Admiral Dyer noted that the Panel remains concerned that in the probing of this question, NASA looks to the FAA, which doesn't have the institutional history and people to speak clearly to the topic. This issue represents an opportunity for improved interagency performance.

REPORT ON JPL ROBOTICS SUPPORT OF HUMAN SPACEFLIGHT

Dr. Bagian reported on the Panel's review and discussion of JPL Robotics Support. It is clear that JPL has been integrated and is working collaboratively with other NASA Centers and the Exploration Program. This is a good thing. As JPL is organized, the matrix approach is a way to make good use of appropriate resources. JPL leads two exploration programs--Advanced Environmental Monitoring and Control, and testing for Autonomous Landing and Hazard Avoidance. These are in keeping with their past experience on the Mars program and other remote probes. For robotics in support of human spaceflight, there are three basic areas: stand-alone, precursor for human activities, and systems embedded in the human infrastructure. This categorization of functions makes sense to the Panel. A specific example that was given was lunar and Mars experiences with ATHLETE and tri-ATHLETE. The Panel was impressed with models on how to deploy the habitat without man-suited activity. There was some discussion with Mr. Wilcox about designing this system to be teleoperated on for the Moon mission rather than being autonomous as will be required on an eventual Mars mission. The Panel found this somewhat curious. If the Moon mission is meant to be in preparation for a Mars mission, shouldn't we be practicing the technology and procedures that we will need for that ultimate mission. Mr. Frost mentioned that in the military that is known as "training like you will fight". Admiral Dyer emphasized that this was not a criticism, but rather is a programmatic question.

Mr. Frost pointed out that this question illustrates the theme that the Panel has iterated repeatedly. It is critical to know the mission in order to design the hardware. If we don't know why we are going to the moon, we won't know how to design the hardware properly for whatever the mission is. Teleoperation on the moon makes sense if we are trying to do the lunar operations in the simplest way; however, if we are practicing on the moon for a future Mars mission, we should be demonstrating and improving the autonomous operations that will be needed in the next phase.

Admiral Dyer noted that this is also the issue with COTS. If the vehicle is being designed to be a cargo hauler, that is a different mission and a different set of designs than a crew transporter.

Mr. Frost added that the human rating requirements for the Agency are built around the design process and those processes are ongoing now at the COTS contractors. It would be problematic to come back later to put these requirements into a process that is already complete.

CONCLUDING REMARKS

After stating that the ASAP public hearing was complete at this point, Admiral Dyer commented on an interesting discussion on risk that the Panel had earlier that morning. He asked everyone at the meeting to think about the time of innovation in the aviation business in the 1930's. It was the era of Reno Air Races and Air Mail Delivery. It was a risky business with associated loss, but it was a great leap forward. Anchor one end of the risk continuum with this 'Air Mail' era, and anchor the other end with the Shuttle era, where perfection is not only expected but demanded in what is essentially a zero failure tolerant business. In terms of the attitude on risk management, there is a lot of space between the two ends of that continuum, and probably neither end is where NASA really should be operating.

One of the things the panel discussed extensively is that in going forward with exploration, the shouldering of risk needs to be undertaken not only by NASA but by the Congress and the White House and communicated to the public. For NASA to go into the future with the Agency alone shouldering the risk does the nation a disservice and is disingenuous to the public. Admiral Dyer commented on U.S. naval aviation and operations from aircraft carriers. Each year, we lose about a dozen people, but because it is important business, we shoulder that risk and move forward. Space exploration is just as dangerous, and we are fortunate to have courageous people willing to accept the risk.

With respect to this aspect, Dr. Bagian noted that the issue also is NASA's ability to be candid with the public, and that the public fully understands what risk is involved. There is no shortage of well-qualified people that are willing to take the risk. There can never be a zero level of risk. The rate of progress can be limited by the amount of risk one is willing to take. He opined that the pendulum may have swung very far to one side in assuming that there should be no risk. Most importantly, the "risk conversation" should be more transparent to everyone. The human rating requirement is in process, but it doesn't say "how safe is safe" or what that number should be, and it needs to. The longer NASA delays the decision on the safety requirements for COTS, the more the eventual system will suffer in safety, cost or schedule.

With regard to communication from the lower ranks to the upper ranks within the Agency, Admiral Dyer noted that the Panel has seen a very positive shift in the culture of NASA. People are not only allowed and encouraged to voice concerns, but are appreciated for doing so. There has been tremendous progress in this regard. Flight readiness reviews have shown that voices get heard and NASA has been doing a much better job. This progress contrasts with something that hasn't changed—how NASA communicates to the public and perhaps to Congress. This communication doesn't reflect the same positive evolution. The plainspoken nature of the in-house technical NASA is out of harmony with the Agency's communications to the public and its congressional relations. Admiral Dyer tied this back to what had been stated earlier regarding the shouldering of risk among NASA, Congress, and the White House. He recommended an evolution in external communications. Ms. Grubbe added that NASA has a role to educate and help society with technical learning and development. So much of this is in the context of what is going on at the moment when the decision is made. It

is sometimes difficult to extricate out of the present and make a good decision for the future, and even more difficult to stick to that decision year after year.

With respect to communications, Dr. Bagian commented that one of his concerns is the lack of the same candor and openness to the extramural community as is seen in NASA's intramural community. There is an obvious dissonance between the external and internal message, and what is said externally inhibits people from speaking up internally. This dissonant message has an impact, although it is hard to document or quantify.

Ms. Grubbe opined that the lack of "proactiveness" on the part of NASA's communications office has allowed detractors to define NASA in the public domain, and this is worrisome. Mr. Frost noted that one of the serious consequences of a failure under these circumstances could result in a stand-down for several years. This would be tragic for the exploration program. One cannot undertake great enterprises of great risk and be surprised when there are issues en route.

Before adjourning the meeting, Admiral Dyer thanked JPL again for its hospitality and reiterated how impressed the Panel was with what it had heard and seen.

ASAP RECOMMENDATIONS, THIRD QUARTER, 2009

2009-03-01: JPL Safety Performance

2009-03-01a: In order for JPL's leadership to improve their current excellent safety record even further, we recommend that:

1. The leadership express that challenge and their commitment to this to their workforce
2. Working with middle management and others – develop an action plan that implements improvements using an approach similar to the "continuous improvement process" used in manufacturing (often called the "lean" process or the DMAIC process)
3. Track progress using explicit metrics that are periodically published to the workforce and implement further corrective actions as needed.

2009-03-01b: The new NASA Safety Center (NSC) at the Glenn Research Center is a resource that can be of great use to JPL and vice versa. The ASAP recommends JPL establish a closer working relationship with this organization and capitalize on its strengths and experience.

2009-03-02: JPL Risk Assessment Process

2009-03-02: JPL appears to have a well organized process for tracking potential safety risks and eventually making informed decisions about their acceptability based on wide coordination and reviews by various committees. A further improvement to that process would be the clarification of the individuals who in fact make the final formal decisions. Recommend that the process be expanded to include a formal risk acceptance document signed by the authority designated with that responsibility in accordance with the risk level presented by the risk.

2009-03-03: Metrics on MIB Report Authorization and Release from NASA HQ

2009-03-03: There is continuing concern about the tracking and trending of administrative turnaround of reports at NASA Headquarters—specifically, the timeliness of getting the final authorization of the MIB report through the various offices at NASA Headquarters. The ASAP did not receive any particular metrics or statistics in this area. The Panel recommends that the NASA Headquarters Mishap Investigation Office continue to pull the data in this area together to determine whether the trend is in the right direction. A chart should be presented to the ASAP at the next meeting. A quarterly report on this topic is requested.

2009-03-04: Integration of Robotics

2009-03-04: The Panel continues to be disappointed in what it sees as a lack of integration of robotics across NASA. Most Centers have some robotic activity because they want to be "in the game." There appears to be a loss of momentum and opportunity in this area. The Agency needs examine the benefits of developing a consolidated and integrated robotics research program to capitalize on the numerous independent programs that have been developed and more fully exploit robotics utilization throughout all missions.

2009-03-05: Human Rated Requirements (HRR) Technical Standards

2009-03-05: The Panel reiterates its previous recommendation 2009-01-01-- "ASAP recommends that NASA formally establish and stipulate the direct link between the HRR and the applicable NASA standards, such as the NASA-STD-5000 series of engineering directives as well as relevant technical standards," and 2009-01-02--"The ASAP recommends that NASA stipulate directly the HRR acceptable risk levels including confidence intervals for the various categories of activities (e.g., cargo flights, human flights) to guide managers and engineers in evaluating 'how safe is safe enough.' These risk values should then be shared with other organizations [COTS] that might be considering the creation of human-rated transport systems so that they are aware of the criteria to be applied when transporting NASA personnel in space."

2009-03-06: Human Rated Requirements (HRR) for COTS

2009-03-06: Recent events make it likely that use of commercial vehicles to transport NASA crews to LEO will occur much sooner than most had planned. While the Panel recognizes that authority and direction to proceed in this direction has not yet been formally given to NASA, it also recognizes that systems to meet this need are already under development by COTS vendors. If these systems are ever to provide the level of safety expected for NASA crews, it is imperative that NASA's criteria for safe design of such systems be agreed upon and provided to such COTS enterprises. This issue is becoming more focused and more urgent. Human rating of COTS for the delivery of NASA astronauts into space is now one of the Panel's primary concerns. Recommend that COTS HR requirements be established as soon as possible and promulgated to those that seek to design systems for this future mission.

2009-03-07: NASA External Communications

2009-03-07: With respect to internal NASA communications, the Panel has seen a very positive shift in the culture of NASA. People are not only allowed and encouraged to voice concerns, but are appreciated for doing so. There has been tremendous progress in this regard. Flight readiness reviews have shown that voices get heard and NASA has

been doing a much better job. This progress contrasts with something that hasn't changed—how NASA communicates to the public and perhaps to Congress. This communication doesn't reflect the same positive evolution. The plainspoken nature of the in-house technical NASA is out of harmony with its communications to the public and its congressional relations. The Panel recommends an evolution in external communications commensurate with that achieved in its internal communications.

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

November 13, 2009

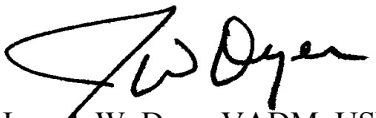
Major General Charles F. Bolden, Jr.
Administrator
National Aeronautics and Space Administration
Washington, DC 20546

Dear Gen. Bolden:

The Aerospace Safety Advisory Panel held its 2009 Fourth Quarterly Meeting at the Kennedy Space Center (KSC) on October 21-22, 2009. We greatly appreciate the participation and support received from KSC subject matter experts and support staff.

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

Sincerely,



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

Enclosure

Aerospace Safety Advisory Panel
2009 Fourth Quarterly Report
Minutes and Recommendations

Aerospace Safety Advisory Panel (ASAP)
Public Meeting
October 22, 2009
Kennedy Space Center Visitor Complex
Cape Canaveral, Florida

ASAP Members Present

Vice Admiral Joseph W. Dyer, USN (Retired), Chair
Dr. James P. Bagian
Mr. John C. Marshall
Ms. Joyce A. McDevitt, P.E.
Ms. Deborah Grubbe, P.E.

ASAP Staff and Support Personnel Present

Ms. Katherine Dakon, ASAP Executive Director
Ms. Susan Burch, ASAP Administrative Officer
Ms. Paula Burnett Frankel, Reports Editor

Attendees, Public Session

James Dean, Florida Today
Tiffany Alexander, KSC
Jessica Williams, KSC
Chris Torres, KSC
David Frankel, self

OPENING REMARKS

The Aerospace Safety Advisory Panel (ASAP) held the public session of its 2009 fourth quarterly meeting at the Kennedy Space Center (KSC) Visitor Complex at Cape Canaveral, Florida. Admiral Joseph Dyer opened the session by noting that the ASAP has lost two members recently: Mr. Brock Stone, who has retired, and Gen. Charles Bolden, who has left the Panel to become Administrator of NASA. In the near future, two new members will be replacing them.

Immediately prior to this meeting, the Panel had an opportunity to visit the Ares 1-X launch site at KSC, Pad 39A. The NASA workforce exhibited obvious pride and excitement with this first new rocket in over three decades.

The ASAP had a successful meeting over the past two days with the KSC leadership. The first discussions were with KSC Director Robert Cabana. The prime topic on the

minds of the KSC management as well as most of the people on the Space Coast concerns jobs and the transition from the Shuttle Program to the Constellation Program. In this regard, the Panel shares their concerns and commends the Center's leadership and its contractors in working diligently to ease the transition. There has been considerable attention to detail, and Mr. Cabana and his team are working with state and federal authorities to be able to place as many as individuals as possible. Admiral Dyer noted that there are currently some 2200 to 2300 civil servants and some 13,000 contractor employees working at KSC. The contractor workforce will bear the brunt of the downsizing, but both NASA and the companies involved are working hand in hand to do the best possible job on the transition.

The series of discussions focused on the remaining flights in the Shuttle Program. Some contingency work is being done on the potential of doing one additional flight if necessary, but the preponderance of effort is concentrated on flying out the program safely. The Ares 1-X activity is ongoing and the planning that has gone into that program is evident. The first launch of the Ares 1-X booster is scheduled for 8:00 a.m. on October 27. The workforce is confident of a good launch, as well as launch of STS-129 on November 16.

Other discussions centered on KSC's organizational structure, which is providing appropriate checks and balances during this transitional period. While achieving the right workforce skill mix is probably the biggest worry—the demographics of age are supportive of a transition to a lay off, but the issue in this case has to do with the economy and probability of people desiring to work longer. Recognizing that, NASA is working with several agencies that are looking into building an exploration park and technology center. There is great interest and some uncertainty associated with the Augustine panel's report which has been out in summary fashion but is scheduled for official release shortly. Many have been awaiting the report as well as NASA and White House leadership on the direction and consensus on space exploration.

Mr. John Marshall commented on the challenges facing KSC in the transition. There is no bigger challenge from a safety perspective than to have distractions from concentration, attention, and focus. At KSC, there is a keen effort to provide alternatives and positive reinforcement to keep the management and workforce focused. The leadership is very "hands on" and understands the need to focus on the basics and safety. They merit high marks for commitment and empathy. Admiral Dyer noted that over a year ago, the ASAP had significant worry about the workforce staying together to support the Shuttle Program until its end; however, the workforce has proved its dedication and people are staying. The civil servant workforce fares very well during the transition. It is the contractor resources that will have challenges. The ASAP has been very impressed by the commitment, proactive nature, and supportability that they have shown thus far.

SAFETY AND MISSION ASSURANCE (S&MA) UPDATE

Ms. Deborah Grubbe shared her observations from the S&MA discussion. Ms. Shannon Bartell, Director of S&MA, briefed the Panel on the work of her organization. Currently,

it includes 240 civil servants and 100 contractor employees. The briefing focused on how the workload balance is being achieved with the necessary skill set during transition as the workload changes. S&MA works with the Shuttle Program, the International Space Station (ISS) Program, the Launch Services Program, the Constellation Program, and other projects and organizations. The important piece of their work is to evaluate and maintain the skill sets and transition from the Shuttle type of work to the Constellation type of work. Some great work is going on by the S&MA leadership team to evaluate and maintain the skill sets. The "independent voice" is not only allowed but encouraged. From a safety culture standpoint, this is extremely important. Progress is being made in the right direction. The governance process and interface with the Independent Technical Authority is good. One can ask the question: What else can be helpful? What they could put in place and would serve them well would be an internal governance process for their own operation. There will be some important questions: Are we replacing our skill sets in kind? How do we know that we are replacing our skill sets? How are we measuring our skills? What are the benchmarks? A formal governance process for S&MA would be very helpful. Therefore, the ASAP recommends that the KSC S&MA organization put into place an internal management process that includes clear and transparent metrics with respect to skill sets required for current shuttle and future Constellation, ISS, COTS and "other program" support. Additionally, there needs to be established a "quick feedback" process that reaches into each of the current near misses and mishaps to examines the role that "lack of right skill at the right time and right place" has on each incident.

Dr. James Bagian mentioned that Commercial Orbital Transportation Services (COTS) was also discussed. The KSC S&MA organization recognizes that there are some challenges and that there is not an Agency-wide system on how to deal with COTS. This is still a task that needs to be addressed. Admiral Dyer added his compliments to Ms. Bartell—she is not only working hard but also very effectively.

SAFETY METRICS AND TRENDS

Safety Metric and Trends is of special interest to the ASAP. Mr. Marshall reported on the Panel's discussion with Mr. Dave Barker, Chief of Institutional S&MA. Mr. Barker provided an excellent briefing on safety trends and metrics. Measurement is the key—if there are no measureable metrics that provide hard data, it is a subjective world. KSC trends three OSHA rates: lost time injury rate (LTIR); days away, restricted or transferred rate (DART); and total case incident rate (TCIR). They also look at vehicular damage and property damage in general. Although the data goes back eight years, the ASAP was primarily looking at recent trends that have changed the workplace environment. The last three years have seen no appreciable changes in LTIR, with most incidents associated with slips, trips, and falls. In the last year, the rate has been steady. The DART rate (primarily from lifting and twisting injuries) has shown a slight decrease, which is to be acknowledged. TCIR shows a noticeable trend downward, which the ASAP applauds. In terms of vehicular or property damage, there was one substantial incident in 2009—a contractor vehicle fell into the river and was declared a total loss. The investigation has been completed and corrective actions have been put into place. In

comparing rates with others, KSC rates are favorable although not overwhelmingly better. The Panel was pleased with KSC's metrics.

In terms of the Executive Safety Forum, one of the issues discussed is how senior management is involved in investigations and what is being done about closing open cases. The KSC investigation processes are mature, comprehensive, and serve what needs to be done. Leadership involvement in terms of recognizing the problems that need to be solved is right on.

Despite this positive trend, the ASAP continues to be disappointed by the continued slow response with regard to the reporting and closeout of reports from NASA Headquarters. The ASAP has made recommendations in the past to review the processes used to accelerate dissemination of information and implementation of corrective actions yet the Panel universally agrees that this requires further attention and action to get the word out more quickly for ALL centers, not just uniquely at KSC. Admiral Dyer added that a recurring theme of ASAP has been to observe many "best practices" at individual centers, but be disappointed with the homogeneous distribution of those practices across the Agency. This is where NASA could and should do better.

MISHAP STATUS AND IMPROVEMENTS & OSHA COMPLIANCE AND ANALYSIS

Ms. Joyce McDevitt reported on the discussions on Mishap Investigation Board (MIB) status and improvements. The discussion was directed to the efforts at KSC, although this has been recognized as an Agency-wide and Headquarters-level problem. The ASAP first highlighted the need to correct this problem about two years ago. It further followed up at other centers and elevated its concerns about the need for correcting all of the different phases of the process to shorten the timeline for accomplishing the investigation, the development of the investigation report, the NASA Headquarters endorsements, the center approval, the development of the corrective action plan and implementation thereof, and verification so that the case can be closed. KSC is involved in the investigation and development of the report and providing approval after Headquarters endorsement. NASA Headquarters has been a problem in terms of the number of endorsements required before the Center can follow through with the latter phases of the process. The current process resulted from a NPR change in 2000, which strived to improve the quality and consistency of reports and identify true root causes as well as improve recommendations. In doing so, it resulted in a significant increase in the number of required formal mishap investigations. This, in turn, required increases in the level of effort required to complete the investigation as well as increases in the supporting efforts required to close out the reports. The KSC improvements have been in response to Headquarters actions, and they have reduced some of the timelines, e.g., the investigation timeline from 75 days to 30 days. KSC has accomplished this by providing a readiness for kicking off the preliminary aspects of investigations. They also have a secure and dedicated mishap investigation room, so that when the Board convenes, it can move out quickly. Additional dedicated resources have been provided, e.g. technical writers, video support, etc. Also, a NASA Safety Center mishap representative is actively involved. To improve communication, KSC has implemented a Mishap

Warning-Action-Response (WAR) process which provides preliminary notification to other centers with as much information about the event as possible so they can be alerted.

There have been fourteen completed MIB investigations, with four active investigations at present. The Center Director conducts a monthly review of the status report. In reviewing the status, the ASAP observed that the overall progress that was described is not yet evident—e.g., the corrective action plan for the fatality that occurred in 2006 has just now been completed, and it still has two more steps to go before closeout can occur. There are similar instances like that. The centers are doing what they can under their areas of control, but it will take more effort before an overall improvement is seen in this area. Recommendations made at the last ASAP quarterly requested the Agency to put together the data so that the Panel can see evidence of when improvements take place. This has not yet been done.

The other subject discussed with Mr. Barker was OSHA compliance and analysis. One very specific area concerned a ladder that was involved in a mishap. Although the ladder was not a contributor to the mishap, KSC used this incident as an impetus for looking across the board at fixed ladders at Launch Complex 39. Investigation revealed that over 50 percent of the fixed ladders were not in compliance with OSHA requirements. This led to a subsequent effort to do a center-wide inspection to document OSHA non-compliances. The finding was about 20 percent of systems were non-compliant, although only a small percentage were classified "high risk." When it came to correcting and resolving the non-compliances, a risk-based analysis was used. In the case of ladders, those things that were high risk (red) were tagged out (i.e., not to be used, or not to be used without fall protection), as well as actions assigned to correct the design wherever KSC could. Low risk compliances will be candidates for additional funding. This is an example of something that should be asked of other centers: When was their last OSHA compliance survey? These types of surveys were thought to have been done in the past, but there is no record if it at the Center. The ASAP recommended that NASA pose the question to other centers on where they stand on inspections in this area.

Admiral Dyer observed that if you can't measure something, you can't manage it. At the Agency-wide level, NASA is struggling with having a passing grade. In January 2008, the ASAP recommended that NASA reevaluate the mishap investigation process. This was reemphasized again in February 2008—that not only senor leadership be briefed, but a closed-loop tracking system be implemented. When there is a serious incident, it is important to understand it and evaluate it, but it is also important to communicate about it. The ASAP is confident that critical information is getting shared, but it seems to be via workarounds on behalf of good people who are trying to make the system work. NASA and the S&MA Office should be more responsive to the ASAP recommendation. It should be able to answer the following questions: How many investigations are open? How long have they been open? One can see this at each individual center, but not NASA-wide.

Ms. Grubbe noted that the trend around mishap investigation also bleeds over into collection of data around incidents. The ASAP has asked for additional information and

there has been difficulty getting that information. Admiral Dyer emphasized the importance of highlighting this problem. He noted that things like the Columbia Accident Investigation Board (CAIB) report get a lot of attention and are driven to resolution. However, it is the tier below that, e.g., where the conduct of test and evaluation is done, where the industrial work is done, etc., where NASA needs attention. One good proactive example was the work at KSC in improving lab safety.

LAB SAFETY IMPROVEMENTS

Dr. Bagian reported on the briefing by Mr. Greg Clements about lab safety improvements. One of KSC labs was performing pressure testing of a composite tank and the vessel unexpectedly burst. No one was seriously injured, but this alerted everyone to a problem regarding non-routine, hazardous lab testing. A number of actions came out of that investigation: enhanced management awareness of hazardous operations and an education on what constitutes hazardous testing and approval; assignment of someone from S&MA to each lab to help with hazardous operations; implementation of a working group to deal with issues like this on a routine basis; and a basic, consistent plan for how non-routine hazardous testing is done across the center. KSC took exemplary action, but the sharing of this across NASA is non-existent. This illustrates the issue regarding dissemination of information.

SHUTTLE WORKFORCE MANAGEMENT

The Shuttle workforce topic deserved deeper discussion, and the ASAP received an excellent update from Ms. Rita Willcoxon, Director of Launch Vehicle Processing. Ms. Grubbe reported on the briefing and the discussion. The ASAP learned about how wonderful the KSC workforce truly is. They are committed to bringing safe closure through to the very last Shuttle flight. Ms. Willcoxon reviewed in great detail the workforce composition and the skill retention that is needed to do the work. She discussed workforce development, how KSC is helping people who are leaving, employee morale initiatives, and how KSC is working with its major contractor partners. Ms. Grubbe noted that while the internal KSC effort is very good, there is some external work that could be pursued with other industries that are looking for the skills that are present here at the Center. She encouraged KSC management to pursue any and all kinds of options for their workforce, and is confident that they will be doing that. Ms. Willcoxon and her team continue to look for early warning signals that they are not doing the right thing. One such approach would be to look at the incidents and mishaps that occur and dissect the "people" aspects of those incidents. Ms. Grubbe encouraged KSC to inquire into the "softer side" of incident investigations for warning signals in order to make course adjustments. At this point in time, KSC is doing an excellent job in managing the shuttle workforce. It is important to the local area, the Agency, and the Nation. Admiral Dyer added that the ASAP is very impressed with Ms. Willcoxon, who appears to be a very capable and caring manager.

CONSTELLATION GROUND PROJECTS UPDATE

Mr. Marshall reported on the ASAP tour of the Ares 1 rocket pad and ground facilities. Ms. Ruth Gardner provided the ASAP with a status report on the facilities that are being modified or constructed to accommodate the Constellation Program. She was enthusiastic and took great pride in the efforts thus far. It has been a tremendous undertaking, and everyone should have an appreciation for the aggressive action that is being taken to get Ares operational as quickly as possible. Design has been completed. The fabrication Request for Proposal (RFP) has been out on the street and is getting ready to be awarded. Ares 1 requires a new mobile launcher to erect the vehicle, and construction is about 60 percent complete. The critical design review should be completed by June next year, on track and on target. The lightening protection system affords much better protection than was previously available. The towers are very impressive. Ground support equipment is about 60 to 70 percent complete. On its previous visit, the ASAP visited the launch communications facility. It is about 92 percent complete and will be used for the October 27 launch. The Orion recovery and retrieval system reviews have been completed. There is good, solid work and continued progress.

The ASAP has been following the debate underway regarding the ultimate vehicle for the follow-on to the Shuttle. The proactive thinking and effort on the Constellation Program is impressive, and several ASAP members commented that it is hard to understand how anyone could walk away from this. The Panel was very impressed with the effort to transition from Shuttle to Constellation.

Admiral Dyer noted that in the future, the Panel intends to take a look at the letter and spirit of funding for safety personnel working on NASA programs. The CAIB recommended independent funding. That was established, but the organization has regressed to the point where now only about 10 percent of the total safety personnel are independently funded; the rest are funded by programs. This issue is worthy of more research and discussion going forward.

MITIGATING COMPOSITE OVERWRAPPED PRESSURE VESSEL (COPV) RISK

Ms. Grubbe reported on the status briefing about the ongoing work on COPV risk. The effort is being led by the KSC engineering and S&MA organizations. COPVs are rather light, metal pressure vessels encased (overwrapped) with high strength epoxy. Currently, there are ongoing studies to fully understand the failure modes of the vessel. Ms. Grubbe noted that even in the industry, there is not a lot of understanding about COPVs. The ASAP may want to follow up on this topic in the future. It may become more important as the world moves to alternative energy sources in more common applications, e.g., cars. The progress of the initiative and the questions being asked are all in the right direction. Ms. McDevitt added that this area was an example of the types of analysis that the KSC S&MA office has to perform in order to define the risk associated with the systems that it has to certify. In this case, there are COPVs on the Shuttle and COPVs are planned for Orion, which has a number of vessels that are specified for the higher pressures. Dr. Bagian noted that one of the issues is that KSC really doesn't have good data on COPV's.

Even in auto applications with natural gas, there have been tank explosions. COPV risk is another issue for COTS. There is the possibility that something could be missed.

LAUNCH SERVICES PROGRAM OVERVIEW

Ms. McDevitt reported on the Launch Services Program briefing and discussion. The ASAP received an excellent overview from Mr. Bill Wrobel. The ASAP had asked for this type of discussion because of concern over NASA losing its medium-class launch service provider. The Panel was also interested in finding out about the technical management approach for launch services. The Launch Services Program has enjoyed an excellent reputation as a very competent team. Since 1998, the Program has achieved a launch success rate of 98.3 percent. The technical management approach is built around the Space Commercialization Act of 1996—it provides for each fleet to be directly owned, managed, and operated by a commercial operator. The Program maintains a robust review process to positively confirm flight readiness, and has contract clauses that enable NASA to have full technical insight. The Program retains the "go/no go" authority for the launch.

The briefing provided valuable information that puts these things into perspective vis-à-vis COTS. NASA has a contract for launch services that expires in 2010. Under that contract, ULA, Orbital, and SpaceX are the current providers and compete through a task order process for specific missions. NASA plans to extend the contract through 2020, and has a "ramp-on" provision for other launch services providers to be considered. In order to take advantage of the efforts on-going under the COTS and Commercial Resupply Service (CRS) activities, the Launch Services Program has been providing requested support on how the Program might be able to assist the COTS and CRS. Program members have also been assigned to workgroups to develop human-rating requirements for COTS. The ASAP agreed that the Launch Services Program people have a decade of experience that should be put to good use.

INTERNATIONAL SPACE STATION COMMERCIAL RESUPPLY SERVICES

Mr. Marshall summarized the discussion on ISS CRS. CRS is a continuation of the exploitation of a similar, new capability—providing cargo capability to the ISS. While lots of threats impact the safety of the astronauts and safety of ISS in general, one of biggest challenges is resupply and sustainability. Shuttle missions have been incorporated into the manifest. There have been other opportunities such as the Automated Transfer Vehicle (ATV) and the H-II Transfer Vehicle (HTV), which offered some resupply capability. Soyuz also presents some capability.

Because of this important need, a major initiative has involved: to use commercial providers and develop a new capability. The ASAP received an informational briefing from Ms. Kathy Leuders on this program. The Panel was impressed by the innovative structure to which the program is evolving—launch services and cargo delivery services, structured in a two-phase approach: (1) demonstrate a vehicle in orbit; and (2) provide

commercial delivery. Today, NASA has two contracts that were awarded in December 2008: Space X for twelve flights, and Orbital Sciences for eight flights. The process has begun. NASA is working very closely to provide support and oversight, but the transition is left up to contractor to guarantee mission delivery under a firm fixed price contract.

ARES 1 THRUST OSCILLATION UPDATE

Dr. Bagian reported on the last topic: the Ares I thrust isolation issue. He noted that thrust isolation is an issue that has been discussed in the past and is an issue during the final 20 seconds of the first stage. Initially, concern was with crew during this phase as well as the potential after effects when the crew might need to take some actions after engine cut-off. A few months ago, some of the tanks aboard the service module on Orion started to show some issues with thrust isolation. There are several mitigation methods, and the one that is being pursued for Ares I is dual plane isolation, which will "tune" the way the vehicle resonates. The project is very confident that this solution can do what is required for both the service module tank and crew related concerns. There is also a recent innovation to use the Lox tank as a damper, wherein an additional chamber is added to damp out the vibration. This approach is in the early stages of development and it remains to be seen if it can be used successfully. There is high degree of confidence that the thrust oscillations effects can be adequately mitigated. The project has taken a prudent and conservative approach. The ASAP will await the outcome and future reports.

Admiral Dyer summarized the ASAP's working session examining a plan for developing commercial human rating requirements for astronaut transport aboard COTS rockets. He noted that NASA has made a start at achieving the progress that this Panel has been recommending—specifically, to more clearly communicate the standards necessary if astronauts are to be transported on COTS vehicles. However, this is only half of the challenge. After there is an agreed upon a process and criteria for what needs to be accomplished, there must be a process and criteria for how to validate the accomplishment and certify it. In the past, NASA has possessed the knowledge and control. How NASA will accomplish the human rating of commercial vehicles has been advanced in terms of communication, but the certification question is still open.

Ms. Grubbe added that the ASAP has learned a lot about the "what;" however, it still need to know who will decide what, and who will have input into the decision. This aspect is still open. We may become so focused on the 'what' (the products), that we may forget about the essence of who is going to be accountable. Mr. Marshall noted that the issue goes back to much of the political discussion in Washington, DC. The ASAP now has a sense of comfort that the right level of effort and the right approach is being used, although NASA is behind where it should be at this point in time. The ASAP is confident that NASA now has the right priorities and can get this done if it can deliver on what it has told the Panel. For the first time, the ASAP is encouraged by the progress, commitment, and understanding of what is necessary.

Ms. Grubbe cautioned that the job is easier to say than do. Studies have shown that in organizations that were not prepared for role changes, there were lots of missteps, e.g., Human Resources (HR) outsourcing. These lessons need to be learned. Although he is optimistic, Mr. Marshall agreed that a lot of work needs to be done.

CLOSING COMMENTS

Admiral Dyer noted that the ASAP has selected its quarterly meeting dates and sites for 2010:

1) February 4-5 at Marshal Space Flight Center, Huntsville, AL
2) April 29-30 at NASA Headquarters, Washington, DC
3) July 15-16 at Langley Research Center, Hampton, VA
4) October 21-22 at Johnson Space Center, Houston, TX

Admiral Dyer announced that word had just been received that the Review of US Human Spaceflight Plans report (the Augustine report) has been officially released. It will be a topic of discussion around the space community. While the official report will not have a lot of news over the summary report that has already been provided to the Congress, it will enlighten some of the views that are resident within the panel. Admiral Dyer noted that he represented the ASAP, along with Mr. Augustine and Dr. Griffin, in providing testimony to the Science Committee on the report. The ASAP has two prime positions: (1) it is not in support of a further extension of the Shuttle; and (2) it believes that any alternative to the Constellation Program must be both significantly better and demonstrably so.

The ASAP observed two significant changes at KSC: (1) a transition and recognition of Shuttle coming to an end; and (2) the leadership and workforce standing up to support Constellation. Across all centers, the design activities undertaken by NASA are reminiscent of the Apollo Program: excitement, commitment, and intensity. With Ares I, there is a similar high rate of experienced and bright people standing up to be leaders in space for another generation. Mr. Marshall echoed Admiral Dyer's message. He said that he could not overemphasize the thrill of standing on the launch tower and talking with the people about what they envision and the efforts for the future. While they are a small group of people, they are on the threshold of a new program and a new era. The workforce has done superb work over the last decade and they take great pride in seeing the Shuttle Program come to a successful close. They deserve heartfelt thanks for what they have done for the Nation.

ASAP RECOMMENDATIONS, FOURTH QUARTER, 2009

2009-04-01: Formal Governance Process for KSC S&MA and Shuttle Workforce Management

Finding: In the face of transition from Shuttle to Constellation, the KSC S&MA leadership team is doing good work in evaluating and maintaining the skill sets. Progress is being made in the right direction. The governance process and interface with the Independent Technical Authority is working well. What would serve the KSC S&MA organization well would be an internal governance process for their own operation.

Recommendation: The ASAP recommends that the KSC S&MA organization put into place an internal management process that includes clear and transparent metrics with respect to skill sets required for current shuttle and future Constellation, ISS, COTS and "other program" support. Additionally, there needs to be established a "quick feedback" process that reaches into each of the current near misses and mishaps to examines the role that "lack of right skill at the right time and right place" has had on each incident.

Rationale: By putting a formalized process into place, there will be more overall attention paid to inherent skills as the workload changes occur, and corrections can be made in a timely manner. This will hopefully prevent repeat incidents with similar cause, and will highlight skill gaps that need to be quickly closed.

2009-04-02: Center-Wide OSHA Compliance Surveys

Finding: KSC is undertaking a center-wide OSHA compliance survey after finding that 50% of the fixed ladders at Launch Complex 39 were OSHA non-compliant.

Recommendation: The ASAP recommends that NASA Headquarters S&MA assures that other centers are current in performing OSHA compliance inspections and that there is a sharing of results among the Centers.

Rationale: As part of the Federal Government, NASA is a model workplace and needs to provide a safe work environment for all employees and contractors. Knowing where all centers are on maintaining compliance with Federal regulations is an important part of the oversight function. The safety findings can also be helpful to NASA leadership in determining priorities for capital expenditures on infrastructure.

ASAP 2009 RECOMMENDATIONS AND STATUS

Recommendation #	Title	Status
2009-01-01a	Human Rating Requirements (HRR) and Data Mining	Open
2009-01-01b	HRR and Engineering Standards	Closed
2009-01-02a	Constellation Program (CxP) Implementation of HRR and Design Safety	Open
2009-01-02b	CxP Implementation of HRR and Data Mining	Open
2009-01-02c	CxP Implementation of HRR and the Constellation and Engineering Review Panel (CSERP)	Open
2009-01-03a	Risk Management Models and Risk Acceptance	Open
2009-01-03b	Risk Management Models and Risk Definitions	Open
2009-01-04	Safety, Reliability, and Mission Assurance (SR&MA) Technical Fellows	Closed
2009-02-01	CxP Technical Baseline and Metrics	Open
2009-02-02	Communication of Changes on the CxP	Open
2009-02-03	Hazard and Risk Management	Open
2009-02-04	Safety of Aircraft in Host Countries	Open
2009-02-05	Communication of Skip-Level Assessments	Open
2009-02-06	Identification of Workforce and Management Issues	Open
2009-02-07	Culture Assessment	Open
2009-02-08	Standardize Knowledge Capture and Management Practices	Open
2009-03-01	Jet Propulsion Laboratory (JPL) Safety Performance	Open
2009-03-02	JPL Risk Assessment Process	Open
2009-03-03	Metrics on Mishap Investigation Board (MIB) Report Authorization and Release from NASA Headquarters	Open
2009-03-04	Integration of Robotics	Open
2009-03-05	HRR Technical Standards	Open
2009-03-06	HRR for Commercial Orbital Transportation Services (COTS)	Open
2009-03-07	NASA External Communications	Open
2009-04-01	Formal Governance Process for KSC's S&MA and Shuttle Workforce Management	Open
2009-04-02	Center-Wide OSHA Compliance Surveys	Open

ASAP 2009 Recommendations, NASA Responses, and Status

2009-01-01a, Human Rating Requirements (HRR) and Data Mining

The ASAP recommends that NASA rigorously research, compare, and contrast the different human rating approaches used during the Apollo, Shuttle, International Space Station, and other programs. NASA should take advantage of this significant history and body of knowledge not only to assess the validity of the assumptions used in the new hazard analysis (HA) and in failure mode and effects analyses (FMEAs), but also to evaluate the benefits that the various approaches yield in terms of safety and mission assurance, which enhance future HRR modifications.

Status

Open; will status at each quarterly meeting in 2010

NASA Response

NASA Concurs. The teams that developed the various revisions to the NASA HRR (NPR 8705.2) performed exhaustive research into the activities analogous to human rating that were applied to the Apollo, Space Shuttle, ISS, Orbital Space Plane (OSP), as well as other programs. More importantly, the Apollo, Space Shuttle, ISS, and OSP engineers and managers that applied these analogous requirements provided their opinions on the strengths and weaknesses of their respective requirements. NASA incorporated the knowledge gleaned from that research into the various versions of the NASA HRR, culminating in the current NPR 8705.2B. NASA agrees to perform additional research to support development of the HRR implementation handbook (described in NASA's response to ASAP recommendation 2008-04-03) that will include examples from previous programs to assist in effective and consistent application of the HRR. In addition, NASA will factor in the results of the independent assessment (conducted in response to ASAP recommendation 2008-04-02) to augment the implementation handbook. As appropriate, NASA will also make changes to the HRR based on this research.

2009-01-01b, HRR and Engineering Standards

The recently revised HRR standard focuses principally on the process used to reach a human rating certification. Although it does specify some design requirements (such as fault tolerance and some human factors design standards), it does not include a requirement to implement, tailor, or obtain approval to waive NASA's other engineering design requirements for critical systems. These requirements embody the experience of NASA's best designers and the lessons learned throughout the Agency's vast experience in human spaceflight. These lessons might not be properly applied without such a requirement.

To clearly articulate the consistent and comprehensive integration of human safety considerations and mission assurance needs into the integrated design analysis (as required by the HRR), the ASAP recommends that NASA formally establish and stipulate the direct link between the HRR and the applicable NASA standards, such as the NASA-STD-5000 series of engineering directives as well as relevant technical standards.

Status

Closed

NASA Response

NASA concurs. Although the first section of the HRR document states that human rating involves many more requirements and standards than are listed in the document itself, it does not specify (other than four direct references to human system unique standards) what those other requirements are. NASA will address this issue

with a change to the first section of the HRR document that makes it clear that human rating consists of tailoring all NASA requirements contained in Agency directions that are categorized as mandatory for all high-priority space systems. The change will also make it clear that human rating includes tailoring of all "mandatory standards" managed by the Office of the Chief Engineer, the Office of Safety and Mission Assurance, and the Office of the Chief Health and Medical Officer. The current list is attached for reference. Finally, NASA will ensure that the language in the first section of the HRR document makes it clear that the Technical Authority may suggest other NASA, military, voluntary consensus, or industry standards or requirements (beyond the mandatory list) as appropriate to the design concept and mission on a case-by-case basis.

2009-01-02A, Constellation Program (CxP) Implementation of HRR and Design Safety

The recently revised HRR standard represents a fundamental shift from telling developers how to create a safe design (by relying primarily on redundancy) to establishing a process for using a risk-informed design approach to produce a design that is optimally and sufficiently safe. The ASAP applauds switching to such a performance-based approach because it emphasizes early risk identification to guide design, thus enabling creative design approaches that might be more efficient, safer, or both.

However, this approach is viable only if a common understanding of "sufficiently safe" exists, and the current HRR procedures leave that determination to individual programs, which could lead to inconsistent "safe-enough" thresholds among various developers if not carefully managed. This consequence could be especially problematic for development (and possible future use by NASA) of potential future human-rated vehicles produced by organizations external to NASA, such as Commercial Orbital Transportation System (COTS) firms or the programs of other nations.

The ASAP recommends that NASA stipulate directly the HRR acceptable risk levels—including confidence intervals for the various categories of activities (e.g., cargo flights, human flights)—to guide managers and engineers in evaluating "how safe is safe enough." These risk values should then be shared with other organizations that might be considering the creation of human-rated transport systems so that they are aware of the criteria to be applied when transporting NASA personnel in space. Existing thresholds that the Constellation Program has established for various types of missions might serve as a starting point for such criteria.

Status

Open

NASA Response

[In concurrence for signature]

2009-01-02B, CxP Implementation of HRR and Data Mining

To strengthen the risk analysis processes that the CxP uses, the ASAP strongly recommends that the program apply a data mining methodology that captures failures, near misses, and other anomalies in hardware and software from other NASA programs (i.e., Mercury through the Space Shuttle and the International Space Station, including expendable launch vehicles). In addition, this methodology should identify personnel issues that positively or negatively affected these previous problems.

Status

Open

NASA Response

[In concurrence for signature]

2009-01-02C, CxP Implementation of HRR and the Constellation and Engineering Review Panel (CSERP)

According to Constellation Program Management (CxPM) Directive No. 013, the CSERP is chartered to provide CxP with an independent review of technical activities and products associated with safety technical risk. Implicit in this directive is a charge to the CSERP to ensure the completion of integrated risk analysis processes, which is a program-level function. The ASAP recommends making one of two modifications to the CSERP organization and review process, specifically (1) elevate the CSERP to a program-level panel or board with the responsibility and authority to review and approve all integrated risks or (2) direct that all hazard reports approved by the CSERP must be forwarded to the Constellation Program Control Board for additional integrated risk analysis and approval.

Status

Open

NASA Response

[In concurrence for signature]

2009-01-03A, Risk Management Models and Risk Acceptance

In the current Office of Safety and Mission Assurance (OSMA) model, as illustrated in the Constellation Program, the project manager is the responsible authority for accepting all risks except for the most likely and most catastrophic risk (i.e., in the risk likelihood-consequence matrix, the project manager is responsible for accepting 24 of the 25 categories of risk). Given the integrated nature of this program and other comparably large endeavors, the reasonable conclusion is that the program manager should have a stronger voice in the acceptance of risk at the project level. Moreover, the currently decentralized risk assessment approach offers no ready visibility into the overall risk accumulated by these various projects, which must be integrated at the program level.

The ASAP recommends that the OSMA analyze and emulate the risk management model used by the Exploration Systems Mission Directorate, with a particular emphasis on matching the level of risk to be accepted with the level of manager (i.e., project versus program) who must decide whether to accept that risk.

The Panel also recommends that NASA review authority levels in Agency-level policy documents to ensure that authority for medium-level and high-level risk decisions is consistent with the levels of risk involved.

Status

Open

NASA Response

[In concurrence for signature]

2009-01-03B, Risk Management Models and Risk Definitions

The Panel has been pleased to learn in previous reviews that the Constellation Program has established a Top Risk Review risk management matrix that exhibits the characteristics of a modern effective risk management system. This matrix established clearly defined risk levels (carefully specifying both the probability and severity components of risk) and allocated those risks by category, commensurate with overall risk level. Despite these

definitions and processes, however, the Panel is concerned that no quality assurance process is in place to assess, and generate data on, whether the matrix actually makes a difference in achieving consistency.

Building on the experience of other agencies, NASA should evaluate whether project and program managers Agency-wide consistently and reliably assign the level of risk for a specified set of examples to the same categories in the risk matrix (e.g., minor, moderate, likely, and so on). This determination then would form .the basis for standardizing the definition of these categories so that risk assessments conducted in various NASA Centers can be better incorporated into the risk calculation for the integrated program.

The ASAP therefore suggests that NASA measure consistency of performance by devising technical risk examples, supplying them to a cross-section of those personnel who are responsible for deciding where a problem falls on the risk matrix, and evaluating the consistency of their risk matrix category decisions. Without conducting this type of exercise (or some comparable process to demonstrate consistent risk matrix category assignments), NASA will find it difficult to contend that its system for evaluating risk level assignments and decision-making is achieving its performance goal. Furthermore, if the Agency documents inconsistency in risk matrix category decisions, NASA should offer (and develop as necessary) appropriate training materials and tools for the relevant Constellation Program personnel. In addition, if warranted by the evaluation, NASA might need to expand the safety hazard risk matrix to include clear guidance on risk probability and severity definitions, enabling consistent application by all practitioners. The ASAP requests that NASA update the Panel at each 2009 quarterly meeting and complete these actions within a year so that the window of opportunity to enhance Constellation Program risk assessments does not close.

Status

Open

NASA Response

[In concurrence for signature]

2009-01-04, Safety, Reliability & Mission Assurance (SR&MA) Technical Fellows

To raise the level of technical expertise available to the Agency to solve challenging SR&MA technical and programmatic issues, NASA has worked diligently to establish Technical Fellow positions for the primary SR&MA technical disciplines. The Panel is pleased that NASA allocated appropriate grades to these positions to attract highly qualified candidates, demonstrating the Agency's level of commitment to the SR&MA effort. The Panel was disappointed to learn at this review that NASA currently is not filling these positions because of budgetary constraints. The ASAP recommends that funding be provided to complete this important step in the process of raising the capability and credibility of the SR&MA discipline at NASA.

Status

Closed

NASA Response

NASA concurs with this recommendation. The Agency has approved four Safety and Mission Assurance Technical Discipline Fellows Positions: Systems Safety, Reliability and Maintainability, Quality Engineering, and Software Assurance. The NASA Safety Center will advertise for, screen applicants (along with the Office of Safety and Mission Assurance Safety and Assurance Requirements Division Director), and recommend candidates for approval to the Chief, Safety and Mission Assurance. The initial term of the temporary promotion will be for three years, with two additional one-year options. The successful candidates will be allowed to serve as Technical Discipline Fellows from their host Centers and will not be required to relocate. The NASA Safety Center has developed a split funding arrangement with the Centers to cover these Scientific and Technical

positions, has polled the Safety and Mission Assurance Directors for their concurrence, and is working with Human Resources to fill the four Safety and Mission Assurance Technical Fellow positions.

We are hopeful that we can have the Safety and Mission Assurance Technical Discipline Fellow positions filled by August 1, 2009.

2009-02-01, CxP Technical Baseline and Metrics

ASAP recommends that in maintaining the Constellation Program's technical baseline, NASA must develop, use and report in-process and outcome metrics to assure risk management processes are being followed and that progress is being measured.

Though design integration has progressed substantially, ASAP believes NASA's work process would be enhanced by adding quantitative measures that can be introduced, tracked and reviewed periodically, thus serving as indicators of a successful work process.

Status

Open

NASA Response

[In concurrence for signature]

2009-02-02, Communications of Changes on the CxP

ASAP recommends that NASA be more aggressive and transparent in communicating changes—and the rationale for changes—relating to some areas of the Constellation design and development process. This would prevent NASA's detractors from resorting to using incorrect or incomplete information that puts NASA in a weakened or defensive posture for no technical reason. For example, a significant media miscommunication occurred following NASA's release of information about a change in the number of crew seats on the Orion (a design decision). Media outlets subsequently took this information out of context, resulting in incorrect conclusions being relayed to the public.

Status

Open

NASA Response

[Response in work]

2009-02-03, Hazard and Risk Management

ASAP recommends that Hazard and Risk Matrix definitions be more quantitative in nature. Risk definitions must be improved and made more precise. Since approving the risk and accepting the risk are not the same, these terms must be made more clear and differentiated, particularly in any information that is released. The ASAP also recommends that NASA train all its new engineers and managers in its hazard and risk management processes, so that everyone can better appreciate and understand how this relates to their work.

Status

Open

NASA Response

[In concurrence for signature]

2009-02-04, Safety of Aircraft in Host Countries

ASAP recommends that NASA exercise appropriate diligence with respect to insuring the acceptable safety for aircraft employed in all host countries. If the existing safety level is insufficient or documentation is incomplete, actions need to be taken that will result in improvements to the existing providers' operations, or instituting new resources to provide this transportation.

Status

Open

NASA Response

[Being reworked with action office and JSC]

2009-02-05, Communication of Skip Level Assessments

ASAP recommends the Industrial Safety team more openly communicate the results of Skip-Level Assessments of supervisors to senior leadership. This will allow leadership to become increasingly involved in, and more knowledgeable of, the Industrial Safety Program.

Status

Open

NASA Response

[In concurrence for signature]

2009-02-06, Identification of Workforce and Management Issues

ASAP recommends NASA acquire a means to continually identify workforce and management issues before they grow into even larger problems. Using a workforce survey is an accepted practice and can be integrated within normal HR and program activities. Properly employed, this will serve as a proactive leading indicator of organizational effectiveness.

Status

Open

NASA Response

[In concurrence for signature]

2009-02-07, Culture Assessment

NASA (in all locations) needs a strong quantitative and qualitative measurement of culture changes, done with rigor and frequency. ASAP subsequently recommends that NASA reinstitute a periodic culture assessment.

Status

Open

NASA Response

[In concurrence for signature]

2009-02-08, Standardize Knowledge Capture and Management Practices

ASAP recommends that NASA adopt a best practice to standardize knowledge capture and management practices across all centers.

Status

Open

NASA Response

[In concurrence for signature]

2009-03-01, Jet Propulsion Laboratory (JPL) Safety Performance

2009-03-01a: In order for JPL's leadership to improve their current excellent safety record even further, we recommend that:

1. The leadership express that challenge and their commitment to this to their workforce
2. Working with middle management and others – develop an action plan that implements improvements using an approach similar to the "continuous improvement process" used in manufacturing (often called the "lean" process or the DMAIC process)
3. Track progress using explicit metrics that are periodically published to the workforce and implement further corrective actions as needed.

2009-03-01b: The new NASA Safety Center (NSC) at the Glenn Research Center is a resource that can be of great use to JPL and vice versa. The ASAP recommends JPL establish a closer working relationship with this organization and capitalize on its strengths and experience.

Status

Open

NASA Response

[Response in work]

2009-03-02, JPL Risk Assessment Process

JPL appears to have a well organized process for tracking potential safety risks and eventually making informed decisions about their acceptability based on wide coordination and reviews by various committees. A further

improvement to that process would be the clarification of the individuals who in fact make the final formal decisions. Recommend that the process be expanded to include a formal risk acceptance document signed by the authority designated with that responsibility in accordance with the risk level presented by the risk.

Status

Open

NASA Response

[Response in work]

2009-03-03, Metrics on MIB Report Authorization and Release from NASA Headquarters

There is continuing concern about the tracking and trending of administrative turnaround of reports at NASA Headquarters—specifically, the timeliness of getting the final authorization of the MIB report through the various offices at NASA Headquarters. The ASAP did not receive any particular metrics or statistics in this area. The Panel recommends that the NASA Headquarters Mishap Investigation Office continue to pull the data in this area together to determine whether the trend is in the right direction. A chart should be presented to the ASAP at the next meeting. A quarterly report on this topic is requested.

Status

Open

NASA Response

[Response in work]

2009-03-04, Integration of Robotics

The Panel continues to be disappointed in what it sees as a lack of integration of robotics across NASA. Most Centers have some robotic activity because they want to be "in the game." There appears to be a loss of momentum and opportunity in this area. The Agency needs examine the benefits of developing a consolidated and integrated robotics research program to capitalize on the numerous independent programs that have been developed and more fully exploit robotics utilization throughout all missions.

Status

Open

NASA Response

[Response in work]

2009-03-05, HRR Technical Standards

The Panel reiterates its previous recommendation 2009-01-01-- "ASAP recommends that NASA formally establish and stipulate the direct link between the HRR and the applicable NASA standards, such as the NASA-STD-5000 series of engineering directives as well as relevant technical standards," and 2009-01-02--"The ASAP recommends that NASA stipulate directly the HRR acceptable risk levels including confidence intervals for the various categories of activities (e.g., cargo flights, human flights) to guide managers and engineers in evaluating 'how safe is safe enough.' These risk values should then be shared with other organizations [COTS] that might

be considering the creation of human-rated transport systems so that they are aware of the criteria to be applied when transporting NASA personnel in space."

Status

Open

NASA Response

[Response in work]

2009-03-06, HRR FOR COMMERCIAL ORBITAL TRANSPORTATION SERVICES (COTS)

Recent events make it likely that use of commercial vehicles to transport NASA crews to LEO will occur much sooner than most had planned. While the Panel recognizes that authority and direction to proceed in this direction has not yet been formally given to NASA, it also recognizes that systems to meet this need are already under development by COTS vendors. If these systems are ever to provide the level of safety expected for NASA crews, it is imperative that NASA's criteria for safe design of such systems be agreed upon and provided to such COTS enterprises. This issue is becoming more focused and more urgent. Human rating of COTS for the delivery of NASA astronauts into space is now one of the Panel's primary concerns. Recommend that COTS HR requirements be established as soon as possible and promulgated to those that seek to design systems for this future mission.

Status

Open

NASA Response

[Response in work]

2009-03-07, NASA EXTERNAL COMMUNICATIONS

With respect to internal NASA communications, the Panel has seen a very positive shift in the culture of NASA. People are not only allowed and encouraged to voice concerns, but are appreciated for doing so. There has been tremendous progress in this regard. Flight readiness reviews have shown that voices get heard and NASA has been doing a much better job. This progress contrasts with something that hasn't changed—how NASA communicates to the public and perhaps to Congress. This communication doesn't reflect the same positive evolution. The plainspoken nature of the in-house technical NASA is out of harmony with its communications to the public and its congressional relations. The Panel recommends an evolution in external communications commensurate with that achieved in its internal communications.

Status

Open

NASA Response

[Response in work]

2009-04-01, Formal Governance Process for KSC S&MA and Shuttle Workforce Management

Finding: In the face of transition from Shuttle to Constellation, the KSC S&MA leadership team is doing good work in evaluating and maintaining the skill sets. Progress is being made in the right direction. The governance process and interface with the Independent Technical Authority is working well. What would serve the KSC S&MA organization well would be an internal governance process for their own operation.

Recommendation: The ASAP recommends that the KSC S&MA organization put into place an internal management process that includes clear and transparent metrics with respect to skill sets required for current shuttle and future Constellation, ISS, COTS and "other program" support. Additionally, there needs to be established a "quick feedback" process that reaches into each of the current near misses and mishaps to examines the role that "lack of right skill at the right time and right place" has had on each incident.

Rationale: By putting a formalized process into place, there will be more overall attention paid to inherent skills as the workload changes occur, and corrections can be made in a timely manner. This will hopefully prevent repeat incidents with similar cause, and will highlight skill gaps that need to be quickly closed.

Status

Open

NASA Response

[Response in work]

2009-04-02, Center-Wide OSHA Compliance Surveys

Finding: KSC is undertaking a center-wide OSHA compliance survey after finding that 50% of the fixed ladders at Launch Complex 39 were OSHA non-compliant.

Recommendation: The ASAP recommends that NASA Headquarters S&MA assures that other centers are current in performing OSHA compliance inspections and that there is a sharing of results among the Centers.

Rationale: As part of the Federal Government, NASA is a model workplace and needs to provide a safe work environment for all employees and contractors. Knowing where all centers are on maintaining compliance with Federal regulations is an important part of the oversight function. The safety findings can also be helpful to NASA leadership in determining priorities for capital expenditures on infrastructure.

Status

Open

NASA Response

[Response in work]

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

CHARTER OF THE

AEROSPACE SAFETY ADVISORY PANEL

1. Official Designation: Aerospace Safety Advisory Panel ("The Panel")

2. Authority: 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), as amended, 5 U.S.C. App. §§ 1 et seq.

3. Objectives and Scope of Activities: 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.

4. Description of Duties: 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.

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

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.

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.

5. Official to Whom the Committee Reports: 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.

6. 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.

7. Estimated Annual Operating Costs and Staff Years: NASA Headquarters will provide the budget for operation of the Panel. The estimated annual operating costs total $550,000, including two Full-Time Equivalents (FTEs) for NASA civil servant staff support, technical report writing, travel, and meeting logistics support.

8. Designated Federal Officer: The Designated Federal Officer, appointed from within the Office of External Relations, NASA Headquarters, will be appointed by the NASA Administrator and will serve as the Executive Director of the Panel.

9. Estimated Number and Frequency of Meetings: There will be approximately four full Panel meetings held each year, on a quarterly basis, to perform the duties as described in Section 4. Special meetings of the full Panel may be required and supported as needed. Additional meetings of individual Panelists or small groups of Panelists may be required for fact finding, preparatory, or administrative work and supported as needed.

10. Duration: Since the Panel is a nondiscretionary Federal advisory committee required by statute, it is envisoned to be a continuing entity with charter renewals.

11. Termination: The Panel shall terminate two years from the date of the filing of this Charter unless renewed or terminated earlier by the NASA Administrator.

12. Membership and Designation: 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). In accordance with 42 U.S.C. § 2477 (as reauthorized in 2005), one member shall be designated by the Panel as its Chairman. The Panel will be comprised of recognized safety, management, and engineering experts from industry, academia, and other Government agencies. 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.

13. Committees, Subcommittees, and Task Forces: Subcommittees, task forces, and/or work groups may be established by NASA to conduct studies and/or fact-finding requiring an effort of limited duration. Such subcommittees, task forces, and work groups will report their findings and recommendations directly to the Panel. However, if the Panel is terminated, all subcommittees, task forces, and work groups will also terminate.

14. Recordkeeping: The records of the Panel, formally and informally established subcommittees, or other subgroups of the Committee shall be handled in accordance with General Records Schedule 26, Item 2, or other approved agency records disposition

schedules. These records shall be available for public inspection and copying, subject to the Freedom of Information Act of 1966 (5 U.S.C. § 552, as amended).

15. Filing Date: This Charter shall become effective upon the filing of this Charter with the appropriate U.S. Senate and House of Representatives oversight committees.

11/6/09

Charles F. Bolden, Jr.
NASA Administrator

Date