Aerospace Safety Advisory Panel

Vice Admiral Joseph W. Dyer, USN (Ret.), Chair
Dr. James P. Bagian
John C. Frost
Deborah L. Grubbe, P.E.
John C. Marshall
Joyce A. McDevitt, P.E.
Dr. Donald P. McErlean
Dr. George C. Nield

Aerospace Safety Advisory Panel

Annual Report for 2011

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

January 25, 2012

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

Dear Mr. 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 2011 to the U.S. Congress and to the Administrator of the National Aeronautics and Space Administration (NASA).

This report is based on the Panel's 2011 fact-finding and quarterly public meetings; "insight" visits and meetings; direct observations of NASA operations and decision-making; discussions with NASA management, employees, and contractors; and the Panel members' past experiences.

In our report we highlight issues on cost, schedule, resources, requirements and acquisition strategy that impact safety. Further, we again note the uncertainty regarding goals and objectives and the need for clarity and constancy of purpose. Importantly, we also acknowledge several of NASA's many accomplishments during calendar year 2011. We observe that transparency, the evolution of a safe and open culture, and key process advances have all significantly improved under your leadership.

A key and honest question that we pose is: "How safe is safe enough?" The pursuit of great reward often comes hand in hand with great risk—so it has always been with explorers. The answer to the question must come from a balance between risk and reward and should reflect a consensus among the American people, the White House, the Congress, and NASA. It is not our intent or purpose to answer the question; however, we point to areas where we believe the stated requirement may not produce the requisite safety. We especially invite your attention to the section "Reassessment of Space Shuttle Risks" and the historical gap between anticipated and deployed systems risk.

In this report, we have assumed that the purpose of the commercial crew initiative is to facilitate the near-term development of a U.S. commercial space transportation capability to achieve safe, reliable, and cost-effective access to and from low-Earth orbit (LEO). However, some among the stakeholders believe human transport to LEO is not the primary intent of the commercial crew initiative. They believe the intent is, instead, to foster a domestic U.S. space industry over a longer time horizon. We note that attention to and investment in safety are critical in developing near-term transport to LEO but may not be as significant in seeding a future industry. Some of the funding decisions and the resultant shifts in acquisition strategy give credence to those who believe the objective has indeed changed. We believe clarity is needed, and constancy of purpose must follow in either regard. We strongly believe those setting national strategy, providing resources, and planning for execution must all share in acknowledging and shouldering the risk. To speak more plainly, if NASA attempts to execute an underfunded program to an unrealistic schedule, the accountability for accepting the associated risk must be shared.

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 2011 with respect and appreciation.

Sincerely,

VADM Joseph W. Dyer, 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 25, 2012

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 2011 to the U.S. Congress and to the Administrator of the National Aeronautics and Space Administration (NASA).

This report is based on the Panel's 2011 fact-finding and quarterly public meetings; "insight" visits and meetings; direct observations of NASA operations and decision-making; discussions with NASA management, employees, and contractors; and the Panel members' past experiences.

In our report we highlight issues on cost, schedule, resources, requirements and acquisition strategy that impact safety. Further, we again note the uncertainty regarding goals and objectives and the need for clarity and constancy of purpose. Importantly, we also acknowledge several of NASA's many accomplishments during calendar year 2011. We observe that transparency, the evolution of a safe and open culture, and key process advances have all significantly improved under NASA Administrator Charles F. Bolden, Jr.'s leadership.

A key and honest question that we pose is: "How safe is safe enough?" The pursuit of great reward often comes hand in hand with great risk—so it has always been with explorers. The answer to the question must come from a balance between risk and reward and should reflect a consensus among the American people, the White House, the Congress, and NASA. It is not our intent or purpose to answer the question; however, we point to areas where we believe the stated requirement may not produce the requisite safety. We especially invite your attention to the section "Reassessment of Space Shuttle Risks" and the historical gap between anticipated and deployed systems risk.

In this report, we have assumed that the purpose of the commercial crew initiative is to facilitate the near-term development of a U.S. commercial space transportation capability to achieve safe, reliable, and cost-effective access to and from low-Earth orbit (LEO). However, some among the stakeholders believe human transport to LEO is not the primary intent of the commercial crew initiative. They believe the intent is, instead, to foster a domestic U.S. space industry over a longer time horizon. We note that attention to and investment in safety are critical in developing near-term transport to LEO but may not be as significant in seeding a future industry. Some of the funding decisions and the resultant shifts in acquisition strategy give credence to those who believe the objective has indeed changed. We believe clarity is needed, and constancy of purpose must follow in either regard. We strongly believe those setting national strategy, providing resources, and planning for execution must all share in acknowledging and shouldering the risk. To speak more plainly, if NASA attempts to execute an underfunded program to an unrealistic schedule, the accountability for accepting the associated risk must be shared.

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 2011 with respect and appreciation.

Sincerely,

VADM Joseph W. Dyer, 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 25, 2012

The Honorable John A. Boehner
Speaker of the House of Representatives
Washington, DC 20510

Dear Mr. 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 2011 to the U.S. Congress and to the Administrator of the National Aeronautics and Space Administration (NASA).

This report is based on the Panel's 2011 fact-finding and quarterly public meetings; "insight" visits and meetings; direct observations of NASA operations and decision-making; discussions with NASA management, employees, and contractors; and the Panel members' past experiences.

In our report we highlight issues on cost, schedule, resources, requirements and acquisition strategy that impact safety. Further, we again note the uncertainty regarding goals and objectives and the need for clarity and constancy of purpose. Importantly, we also acknowledge several of NASA's many accomplishments during calendar year 2011. We observe that transparency, the evolution of a safe and open culture, and key process advances have all significantly improved under NASA Administrator Charles F. Bolden, Jr.'s leadership.

A key and honest question that we pose is: "How safe is safe enough?" The pursuit of great reward often comes hand in hand with great risk—so it has always been with explorers. The answer to the question must come from a balance between risk and reward and should reflect a consensus among the American people, the White House, the Congress, and NASA. It is not our intent or purpose to answer the question; however, we point to areas where we believe the stated requirement may not produce the requisite safety. We especially invite your attention to the section "Reassessment of Space Shuttle Risks" and the historical gap between anticipated and deployed systems risk.

In this report, we have assumed that the purpose of the commercial crew initiative is to facilitate the near-term development of a U.S. commercial space transportation capability to achieve safe, reliable, and cost-effective access to and from low-Earth orbit (LEO). However, some among the stakeholders believe human transport to LEO is not the primary intent of the commercial crew initiative. They believe the intent is, instead, to foster a domestic U.S. space industry over a longer time horizon. We note that attention to and investment in safety are critical in developing near-term transport to LEO but may not be as significant in seeding a future industry. Some of the funding decisions and the resultant shifts in acquisition strategy give credence to those who believe the objective has indeed changed. We believe clarity is needed, and constancy of purpose must follow in either regard. We strongly believe those setting national strategy, providing resources, and planning for execution must all share in acknowledging and shouldering the risk. To speak more plainly, if NASA attempts to execute an underfunded program to an unrealistic schedule, the accountability for accepting the associated risk must be shared.

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 2011 with respect and appreciation.

Sincerely,

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

Enclosure

CD Table of Contents

I. Introductory Remarks

A. The Aerospace Safety Advisory Panel (ASAP)

The ASAP was established by Congress in 1968 to provide advice and make recommendations to the NASA Administrator on safety matters.[1] The Panel holds quarterly fact-finding and public meetings and makes one or more "insight" visits per year to NASA Field Centers or other related sites. It reviews safety studies and operations plans and advises the NASA Administrator and Congress on hazards related to proposed or existing facilities and operations, safety standards and reporting, safety and mission assurance aspects on ongoing or proposed programs, and NASA management and culture related to safety. Although the Panel may perform other duties and tasks as requested by either the NASA Administrator or Congress, the ASAP members normally do not engage in specialized studies or detailed technical analyses.

This report highlights the issues and concerns that were identified or raised by the Panel during its activities over the past year. The Panel recommendations submitted to the Administrator during 2011 are summarized in the Appendix at the end of this report.[2] They are based upon the ASAP fact-finding and quarterly public meetings; "insight" visits and meetings; direct observations of NASA operations and decision-making; discussions with NASA management, employees, and contractors; and the Panel members' expertise.

B. ASAP Observations on NASA Accomplishments in 2011

1. Shuttle Program Completion

NASA safely concluded the Space Shuttle Program with the landing of the orbiter Atlantis on July 21. This historic program and its vehicles have inspired people around the world and flown more people to space than any other spacecraft. The five vehicles have been workhorses for NASA and the international community for the past 30 years. They spent a combined total of 1,332 days in space and completed 21,152 Earth orbits covering 548.2 million miles. All five orbiters deployed a total of 66 satellites and rendezvoused with the International Space Station (ISS) 37 times. They carried a total of 355 individual astronauts and cosmonauts into space, many of whom flew multiple times, bringing the total number of "crewmember transports" to 833. Although the Shuttle Program came to an end in 2011, its legacy and the experience of those who worked on it will benefit future human exploration programs for years to come.

2. International Space Station (ISS) Assembly Complete

With the installation of the Alpha Magnetic Spectrometer II in May, the assembly and outfitting of the U.S. On-orbit Segment of the ISS was completed, allowing the opportunity for full utilization of its research capabilities. The ISS represents an unparalleled engineering feat—construction of a highly complex spacecraft with components built in many nations, launched from four different space centers, and assembled on orbit by over 160 astronaut spacewalks. It has been visited by more than 200 people and has been continuously crewed for over 11 years. The ISS provides a valuable laboratory for research related to exploration requirements and human space exploration.

---

1. The ASAP Charter is included as Attachment 1 on the enclosed CD.
2. The full text of all the 2011 recommendations is included as Attachment 2 on the enclosed CD.

3. Noteworthy Launches

NASA safely and successfully launched several important robotic missions in 2011:

- Aquarius was launched on June 9 from Vandenberg Air Force Base (AFB) on a Delta II. The joint U.S.-Argentine mission will map ocean surface salinity, which is critical to understanding the water cycle and ocean circulation—two major components of Earth's climate system.
- The Juno probe to Jupiter, the second mission in NASA's New Frontiers Program, was launched on August 5 from Cape Canaveral on an Atlas V. Juno will take 5 years to reach the planet and will be the first spacecraft to orbit Jupiter since the Galileo probe was de-orbited in 2003.
- The Gravity Recovery and Interior Laboratory (GRAIL), a two-spacecraft Discovery mission, was launched on September 10 from Cape Canaveral on a Delta II. GRAIL will be used to study the Moon's gravitational field and learn more about its internal structure and thermal evolution.
- The National Polar-orbiting Operational Environmental Satellite System (NPOESS) Preparatory Project (NPP) was launched on October 28 from Vandenberg AFB on a Delta II. NPP is the first of a new generation of satellites that will observe many facets of our changing Earth.
- The Mars Science Laboratory, with the Curiosity Rover, was launched on November 26 from Cape Canaveral on an Atlas V on its quest to determine if Mars is, or ever was, capable of supporting microbial life. Curiosity is scheduled to arrive at Mars in August 2012.

4. Public Communications

Public communications on two potentially negative events were handled very well. In March, the Glory spacecraft failed to reach orbit after launch on a Taurus XL from Vandenberg AFB. NASA's Office of Communications released a thorough message very quickly; several NASA personnel were on television and radio discussing the mishap scenario and presenting the information that was available at that time. There were frequent updates throughout the day. In September, 6 years after the end of its productive scientific life, the Upper Atmosphere Research Satellite (UARS) broke into pieces during reentry, and most of it burned up in the atmosphere. NASA's chief scientist for orbital debris discussed the reentry process and status on NASA's website, and NASA's Office of Communications was in close contact with the media. From the time that it appeared that UARS would be de-orbiting, NASA did an outstanding job of keeping the public informed on the satellite's status and associated risks in an exemplary manner that has not always been the case with other programs. This was done by not only supplying very technical numerical analyses, but also by providing comparative real-life analogies to other risks to which people are exposed in their everyday life; thus, people could make meaningful comparisons.

5. Progress on ASAP Recommendations

NASA has continued to show good progress responding to ASAP recommendations. For 2010, 27 recommendations were closed out during the year, resulting in 30 recommendations open at the end of the year. For 2011, 25 recommendations were closed out during the year, resulting in 18 open at the end of the year. In 2011, the ASAP generated 13 recommendations (9 fewer than in 2010), of which 7 have already been closed. There are still 12 open recommendations from years prior to 2011.

II. Issues and Concerns

Note on color bars: ■ Red highlights what the ASAP considers to be a long-standing concern or an issue that is not being adequately addressed by NASA. ▲ Yellow highlights an important ASAP concern or issue, but one that is currently being addressed by NASA. ● Green indicates a positive aspect or a concern that is being adequately addressed by NASA but continues to be followed by the Panel. A heading with no color bar represents an issue or concern that is relatively new and that the ASAP will be addressing in the upcoming year.

▲ A. Human Spaceflight

Calendar year 2011 saw the Space Shuttle era draw to a close with the successful completion of the STS-135 mission. The human spaceflight safety issues that were related to the Space Shuttle Program are now no longer NASA's most pressing concerns; however, there still are a number of areas related to the ISS, Soyuz, the Commercial Crew Program (CCP), and potentially the Space Launch System (SLS) that require continuing attention. The areas of particular interest include Micro-Meteoroid and Orbital Debris (MMOD) risk to the ISS, plans regarding ground impact risks after de-orbit at the end of the ISS's useful life, and the risks of inadequate resources for programs under development. Risk is an unavoidable component of any program. A critical characteristic of a successful program is the ability to identify hazards and their risk of causing harm; comparing that to the level of risk allowable by the program, the Agency, and the Congress; and prioritizing the work to mitigate the known risks to an acceptable level.

In this Report, the ASAP provides specific comments on the ISS, Soyuz, the CCP, and the SLS/Multi-Purpose Crew Vehicle (MPCV).

■ *1. International Space Station*

NASA had great success in completing the ISS construction. The technical and organizational challenges that had to be overcome to achieve this result are often not appreciated and can lead to a perception that this success was easily achieved. Such a misperception can cause complacency in regard to the hazards and associated risks that are always present, such as MMOD. Failing to realize the hostile environment in which the ISS must operate and not giving adequate attention to these hazards can result in an unintended compromise to crew safety. Constant vigilance and a continual attention to detail are essential to the safe sustainment of crew operations on the ISS.

Analyses presented to the ASAP on several occasions, most recently in May 2011, stated that the probabilistic risk assessment (PRA) related to ISS Loss of Mission (LOM) was 1 in 55 for a 180-day mission. Since there are approximately 20 180-day missions in the currently projected ISS Program, this means that there is a greater-than-30-percent chance that the ISS could sustain a LOM sometime during its projected operating life. Even though PRA numbers have uncertainties associated with them, one cannot escape the conclusion that the risk of an ISS LOM is more than an outside possibility. Should such an event occur, the result could arise that the ISS would have to be abandoned—potentially without the possibility of a return to nominal operation. Thus, a premature ISS de-orbit is one potential outcome. This can occur in either a controlled or an uncontrolled manner, with the latter clearly the more dangerous. While this possibility has been known for some time, NASA has not yet shared with the Panel an explicit plan to deal with this situation. ISS End of Life (EOL) is inevitable, and the ISS will ultimately de-orbit; therefore, it is not too soon for EOL planning to begin in earnest and its consequences to be understood by all stakeholders. Action plans, contingent on various circumstances, should be created and shared with all agencies responsible for executing some part of that plan. This would especially be true should resources (such as Soyuz) be required to complete the action plan.

The lack of advanced planning was illustrated by the activities surrounding the Russian Progress failure that is described more fully in the next section of this report. This failure necessitated major schedule changes due to the delay of Soyuz launches to the ISS. While NASA had always recognized a possible interruption of scheduled Soyuz availability and, from a safety perspective, there was no immediate impact on the crew, the subsequent flurry of activity showed a lack of maturity in the planning to handle this eventuality. The potential loss of Soyuz availability—to bring new crew to the ISS as well as to provide vehicles to be available 24/7 as potential "lifeboats"—raised the very real potential that the ISS may have had to be abandoned. Fortunately, in this instance, time was available to create the required plan; however, had this been an MMOD hit or other more immediate hazard, there may not have been this luxury of time.

It is a foregone conclusion that at some time in the future, the ISS will have to be de-orbited. This fact strongly supports the argument that NASA should have detailed plans already worked out with the international partners on how this de-orbit will be accomplished. The hazards and risk implications for those on the ground must be analyzed, and the resulting conclusions and plans must be available to mitigate those risks.

● *2. Soyuz Return to Flight*

On August 24, the third-stage engine of a Russian Progress cargo vehicle failed to operate properly, and the vehicle and its supplies were destroyed. The Progress cargo vehicle, which carried no crew, is closely related to the Soyuz and is used to resupply the ISS with dry cargo, propellant, water, and oxygen. It is also used to boost the ISS orbit and control Station orientation. The launch vehicle involved is used for both Progress and Soyuz spacecraft and is a time-tested design that has been flying for many decades.

Since the launch vehicle is used for both Progress and Soyuz, a detailed failure investigation was ordered to be completed prior to any crew being transported on Soyuz flights. Our Russian partners formed a commission to investigate the anomaly and, as has been the case with previous investigations, kept NASA well informed about the progress and the review results.

In September, the ISS partners baselined a new Progress and Soyuz flight plan based on the results of the Russian Accident Board (called a State Commission) that was chartered to investigate the root cause of the Progress failure and to recommend recovery and remediation activities. The report on the accident investigation was fully presented to members of the ASAP (among other participants) in a daylong briefing by Marshall Space Flight Center (MSFC) and a discussion session held at Johnson Space Center

(JSC). Following the detailed discussion on the Russian investigation and its conclusions, the MSFC team then explained its independent Risk/Failure Tree analysis and computer modeling. This was very thorough, especially considering the fact that the team's knowledge of the system and its history is not as detailed as the Russian Commission's. However, regardless of some obvious differences in background on the system, they were able to replicate all of the critical Russian results.

Both teams concluded that the most likely event was a "quality escape" resulting in debris entering and clogging the fuel system. This result was based on the investigation and considerable history of this engine (some 2,000 engine runs) without ever seeing this failure before. This conclusion was also supported by audits on the assembly, build, and test process. In short, the MSFC team agreed with the conclusions of the Russian team and felt that the failure scenario was plausible. MSFC was able to reach its conclusions independently and also felt that a quality escape was the most probable cause. The MSFC team concluded that the Russians were on track to put into place measures to mitigate any recurrence.

In the ASAP's view, the two teams did an exemplary job examining the cause of the Progress accident. The Russians treated this incident very seriously and put the kind of expertise on the team that had technical knowledge and background as well as the seniority in the Russian system to act and speak independently. The MSFC team's work was very impressive, both its analysis of the Russian work and its independent work.

While no absolutely definitive physical evidence is available to prove the failure cause, the completeness and competence with which this investigation took place gave the confidence in the subsequent return to flight decision. The successful Soyuz mission commencing November 14, 2011, took place without incident. NASA should continue to closely examine Soyuz operations so as to be alert to any information that might bear on future operational decisions.

It is well to remember that the Soyuz spacecraft, an evolutionary vehicle that has been flying since 1967, currently provides the sole transportation to and from the ISS for the Expedition crews. Equally important to know is that since Soyuz has the capability to remain docked to the Station for 6-month periods, it provides a "lifeboat" function. This supports the crew by providing an on-orbit rescue capability in the event of a contingency aboard the ISS. It has been long-standing ISS policy that the Station can host six crewmembers on long-duration missions only with the availability of immediate de-orbit capability for the entire on-board crew. Therefore, two Soyuz spacecraft are required to be docked at Station for the six-person ISS crew. In September of this year, when one of the docked Soyuz vehicles reached the end of its on-orbit certified life, NASA and Russia made the decision to return three crewmembers to Earth on Soyuz 26. It must be recognized that there could be circumstances where the Soyuz 6-month on-orbit limit could result in a de-crewing of the ISS. In addition, recently projected slippages in the Commercial Crew Program will require renegotiation with the Russians to provide Soyuz transportation beyond the currently agreed 2016 deadline. Such renegotiations could be problematic. Failure to renegotiate the agreement could result in a period of time without U.S. access to the Station. The ASAP will continue its focus on these issues and NASA's plans over the next year.

3. Commercial Crew

We believe the objective of the commercial crew initiative is to facilitate the development of a U.S. commercial space transportation capability with the goal of achieving safe, reliable, and cost-effective astronaut access to and from low-Earth orbit (LEO) and the ISS. (We do not believe the objective is just to fund and develop a commercial space industry; however, we note that some stakeholders would debate this.) Once that capability has matured, NASA plans to purchase commercial services to meet the ISS crew transportation needs. To take maximum advantage of the limited funding available, and in recognition of the urgent need for this capability, NASA is using nontraditional acquisition and partnering approaches during the early phases of the program and had planned to switch to a more standard acquisition process during later (post–critical design review) program phases. Competition is considered to be a fundamental aspect of the strategy in order to incentivize performance, support cost effectiveness, and eliminate dependence on a single provider.

Because the 2010 NASA Authorization Act stated that commercially provided services should be used as the means for ISS crew transportation to the maximum extent practicable, the ASAP has been closely following NASA's progress on this program and has requested status updates at each quarterly meeting. Some program challenges that have been identified to date include making sure that the available funds are appropriate to the objectives, working toward a realistic schedule, developing the safety certification processes that will be used, and selecting the proper design targets for safety and reliability.

NASA has recently baselined and published the design requirements in its 1100-series documents. It has also defined a streamlined control board process that should contribute to expedited decision-making. To increase its insight into the commercial development efforts, NASA has put in place Partner Integration Teams that will have the ability to work side by side with the various partners to understand their approaches and progress. Although such an approach can certainly be beneficial, it will be important to ensure that the tendency to "over-identify" with the contractor does not result in a lack of objectivity by the NASA representatives.

According to NASA program managers, the top program risk is inadequate budget; however, without an accurate NASA estimate of how much it will cost to develop and test a system, it is not possible to precisely know the program's budgetary requirements or if there is a risk of underfunding. In this case, the difficulty is compounded by the fact that the vehicles are being developed by commercial entities, using nontraditional procurement strategies. It is not surprising that when NASA asked proposers on the second phase of the Commercial Crew Development (CCDev) Program for rough estimates of the funds needed to complete the development of a commercial crew system, it received a wide range of figures from the various companies. NASA is understandably reluctant to publicize the details of those estimates due to the proprietary nature of the figures in the ongoing competition. Nevertheless, it appears to the ASAP that the fiscal year (FY) 2012 funding level approved by Congress, which was less than half of what was requested by the Administration, will not allow commercial crew transportation to the ISS by 2016. In fact, if the new funding level continues into the future, it is the ASAP's belief that the program is in jeopardy, thus extending the current lack of a U.S. human spaceflight capability and resulting in no alternative to reliance on Russia to obtain access to the ISS.

The ASAP considers the lack of a credible and appropriately funded plan to develop a U.S. capability to launch its astronauts to the ISS to be an issue with significant safety implications. If the development program is continued without adequate funding, it will increase the likelihood that safety-related testing and modifications to correct any design deficiencies would not be made. Alternatively, terminating the development program would result in continued reliance on the Russian Soyuz, a system with an uncertain long-term future.

In mid-December, however, just before this report went to publication, NASA announced plans to change its acquisition strategy for the integrated design phase of the CCP from a fixed-price, Federal Acquisition Regulation (FAR)-based contracting approach to one utilizing Space Act Agreements (SAAs). Previously, NASA had made a strong safety case for using conventional contracting on the next phase of the CCDev Program, an approach that was viewed as well reasoned and appropriate by the ASAP. The ASAP acknowledges NASA's assertion that the change is primarily driven by funding uncertainties and the need to maintain more than one provider for commercial crew transportation services. However, we believe that the sudden change in acquisition strategy in an effort to salvage the CCP may have significantly increased the risk to safety that the previous plan had begun to address. The lack of the ability to incorporate firm safety requirements using an SAA procurement exposes NASA to new risks if, at the conclusion of the developmental phase, the proposed designs do not meet minimum safety requirements. In that event, NASA will have to either (1) expend additional time and money having the designs modified and retested or (2) accept the risk associated with flying its astronauts on systems that do not meet the currently articulated minimum safety requirements. If NASA is deciding to take on more risk because the cost is otherwise prohibitive, then the Agency should be clear about that increased level of risk acceptance and develop approaches to manage that risk. While it is possible that NASA can find a way to accomplish the assigned mission with the available budget, at this point in time the Panel has serious concerns about the likelihood of such an outcome. The ASAP plans to closely examine the SAA approach in 2012 and will be most interested in the plan for transitioning the designs into certified systems before their use as crew transport.

4. Space Launch System (SLS)/Multi-Purpose Crew Vehicle (MPCV)

To provide the capability for human exploration beyond Earth orbit, NASA plans to develop the SLS and the Orion MPCV. The SLS is an advanced, heavy-lift launch vehicle that will incorporate technological investments from the Space Shuttle Program and the Constellation Program. It will have an initial 70-metric-ton lift capability and will be evolvable to a 130-metric-ton capability. The first test flight is targeted for the end of 2017. The Orion MPCV will serve as the primary crew vehicle for missions beyond LEO and as a backup system for ISS cargo and crew delivery.

Because the SLS and Orion MPCV will be NASA's primary vehicles for carrying out its exploration mission over the next several decades, it will be important that they initially be designed to be as safe and reliable as possible and that they take advantage of the lessons learned during the Space Shuttle and Constellation Programs. The ASAP plans to review the SLS and Orion MPCV programs during the coming year.

A key question involves the selection of an appropriate mission. For the purposes of determining risk, should NASA assume the vehicles will be used in a mission to the Moon, to an asteroid, to a Lagrange point, or to some other destination? Or should the vehicles be designed for all of those missions? Other areas of interest include reexamining the design targets and thresholds for LOM and Loss of Crew (LOC), the plan for program control boards, the appropriate magnitude of needed budget margins, and the potential impacts of a decline in the U.S. aerospace industrial base on long-term logistics and support. NASA will need to give each of these questions due consideration in 2012. This is not a new challenge. Prior ASAP reports have highlighted the requirement for clarity and constancy of purpose regarding goals and objectives for NASA.

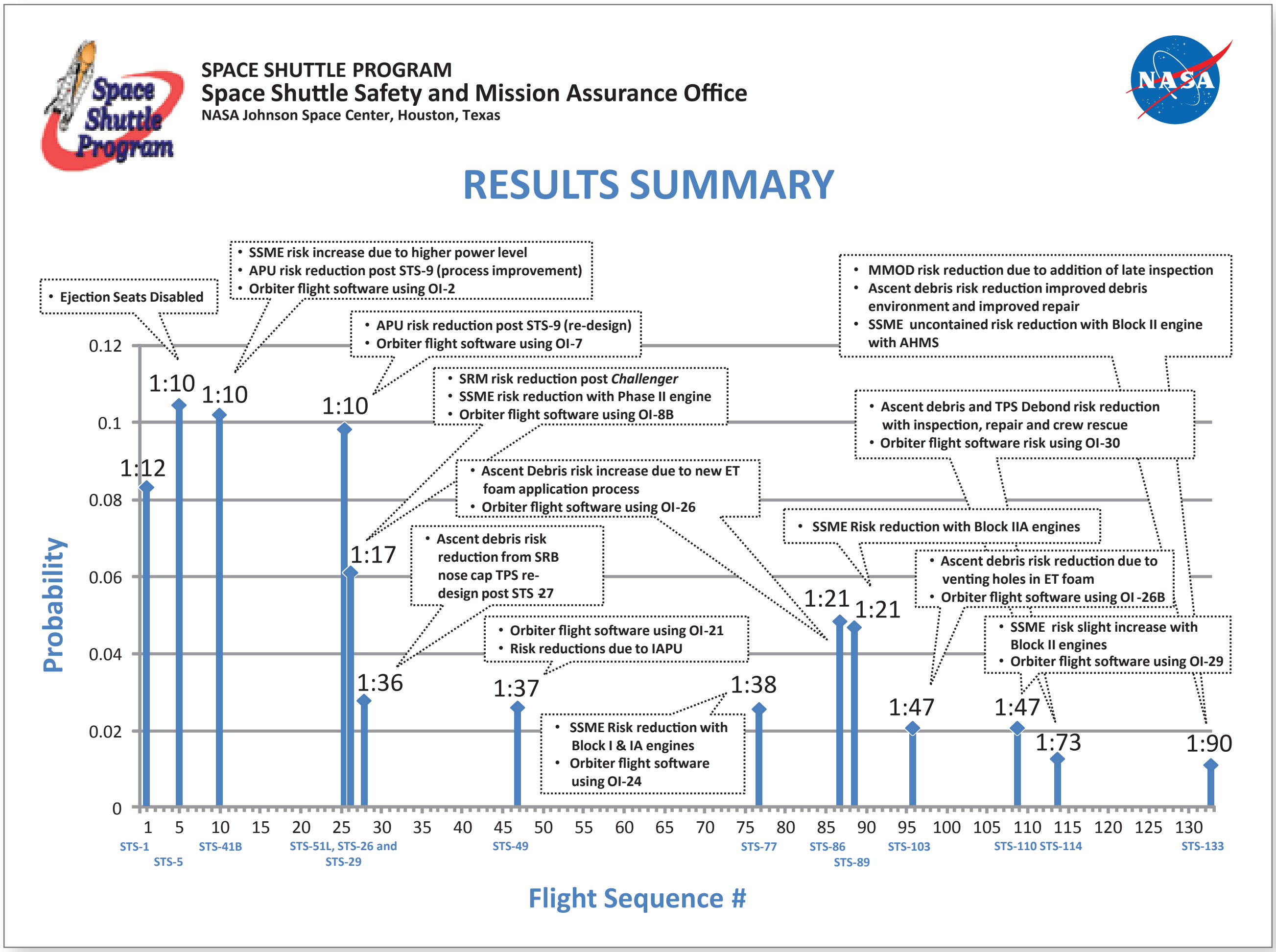
▲ B. Risk Management

At least in our lifetime, travel by humans to orbital velocity and beyond and returning to Earth through our atmosphere will always entail significant risks. The sheer amount of energy required to reach these velocities and the space environment's unforgiving nature dictate that extraordinary efforts must be expended to identify potential hazards and either design them out or provide positive measures to minimize the probability of their occurrence and control the results if they do occur. The residual risk that remains is measured by the probability of the various failure scenarios and the severity of their outcomes. The most serious of these outcomes is known as LOC (loss of crew). In using a variety of analytical tools to identify, assess, and manage these risks, NASA remains at the forefront of organizations conducting high-consequence operations. The ASAP feels that the risk targets must be prudently selected, based on past experience, and explicitly articulated. The foundation upon which the ultimate assessment must be made is the acceptable level of risk. In other words—how safe is safe enough?

● *1. Reassessment of Space Shuttle Risks*

By the end of the longest-running human spaceflight program in U.S. history, the Space Shuttle PRA grew to be a highly refined tool for predicting flight risk. The ASAP asked that an analysis be made of the lessons learned in predicting risk in a complex space vehicle. The reason the ASAP requested this analysis is because, as the longest-running human spaceflight program, the Shuttle Program will become the basis of everything we do in the future. Whatever human spaceflight program proceeds forward, it is inevitable that people will ask: What did the Shuttle do? It is very important to capture that database.

NASA responded with an outstanding "Space Shuttle Launch and Re-entry Risk Study." This study analyzed the many years of Shuttle flights by taking "snapshots" of the various Shuttle configurations that existed over time and what the flight risk was thought to be for each at the time. Then, based on what is now known about actual failures and the failure mechanisms that were there all along but had not yet manifested themselves, a revised assessment of the true risk on each flight was calculated. The results of this analysis are depicted on the following page.



The ASAP is very pleased with NASA's work in this area. Many things were learned through this analysis. One key finding was that the risk on a new system that has not been flown before and thus has not been through the rigors of real-life flight is probably much higher than what the initial risk assessments show. The reason for this difference is that at the beginning of operations, all the failure mechanisms are not fully known. In the language of risk analysis, such unknown failure mechanisms are often called "unknown-unknowns." In the Shuttle's case, the first flight risk as now retrospectively calculated was in actuality 1 in 12 for LOC, yet at least one analysis that existed at the time of the initial launch estimated the risk to be 1 in 1,000 or better. In other words, the system was almost 100 times more dangerous than the early analysis indicated. This type of disparity must be remembered when future targets for reliability and LOC numbers are chosen for new programs. One thing that has always been said in the design business is that engineering design standards take care of the "knowns"; factors of safety take care of the "known-unknowns"; and margin is what takes care of the "unknown-unknowns." A significant margin for error should be allowed for the unknown-unknowns as well as to create a robust design.

In any discussion of spaceflight risk, the perceived versus actual risks experienced by the Space Shuttle clearly should be taken into account. As already mentioned, the Space Shuttle, unbeknownst to the team at the time, started at a LOC risk level of 1 in 12, and there was a 92-percent chance that a crew would be lost in the first 25 missions. By constant improvements, that risk was lowered to 1 in 90 by the last flight, which is still a high number compared to many endeavors.

▲ 2.How Safe Is Safe Enough?

The ASAP applauds the overall review undertaken by NASA to establish a new methodology to set safety risk tolerances for human spaceflight. The acceptable mission risk for LOC is now to be expressed in terms of three levels: (1) the Agency acquisition threshold, which is the highest risk level to be tolerated by the Agency; breaching this level would normally result in program cancellation; (2) the Program Design/Mission Requirement risk level, which is the "build to" level and is somewhat more conservative than the Agency threshold to allow a margin of buffer; and (3) the Agency long-term maturity goal, which includes continuous-improvement upgrades and represents the long-term mission goal.

While the Panel applauds the effort to establish safety thresholds, we are concerned that the specific levels chosen by NASA for these criteria unfortunately are significantly less conservative than those that were being used for the now-cancelled Constellation Program. For example, the Exploration Program requirement for probability of LOC on an ISS mission has changed from 1 in 1,000 to 1 in 270. This new Agency criterion for future human spaceflight missions is less than one-third as safe as the old criterion. This is especially worrisome considering the fact that the criterion only considers the risks that are already known, not the always-present hazards that have not yet been discovered. This observation is compounded by the fact that recent detailed analysis on Shuttle, as noted above, revealed that the *initial* flights were not nearly as safe as predicted. Thankfully, those flights did not result in crew loss, but the risk they posed illustrates a profound problem. When estimating probabilities of failure in areas where there is no history, limited experience, and only a partial understanding of what can go wrong, analysts tend to produce optimistic numbers. If a design process is initiated using a high value of acceptable loss criteria, this tendency is exacerbated by setting goals too low and hence creates a larger potential for failure than might be anticipated. The ASAP continues to recommend that NASA reconsider its criteria for future human spaceflight.

▲ 3. Preparing for Future Low-Probability Events

While NASA has historically focused great attention on meticulous preparation for upcoming events such as launches, Space Station assembly, and exploration on other planets, the Panel has noted a less aggressive preparation effort for some low-probability events that can be postulated to occur at some future time. One example is the present lack of a fully vetted, detailed procedure for emergency ISS de-crewing as noted in the Human Spaceflight section of this report. The eventual safe de-orbiting of the ISS at EOL or a potential catastrophic failure are future events that the ASAP believes have not been given sufficient consideration and planning. The Panel continues to encourage NASA to expend the effort required now to prepare for such future events.

In order for risk to be managed appropriately at any level, but especially at a programmatic level, the various component risks and their overall impact must be clearly communicated. A critical question involves not only what technical information should be communicated, but also what entities need to receive this communication and the manner in which the information is communicated. If this clear communication of risk is not accomplished, then safety, appropriate use of resources, and overall confidence and support of programs and NASA can be negatively impacted.

Examples— ● UARS *and* ▲ ISS

There are examples where this has been done in productive and less than productive ways. As noted in Section I of this Report, NASA communicated the UARS reentry hazard in a multipronged manner and did a very good job in communicating the level of risk and explaining that real damage or injury could result. The proactive, well-thought-out and -executed communication of risk was accomplished well in advance of the actual reentry event and ultimately resulted in an appropriate public response rather than an emotional alarmist response.

In the case of the ISS, however, ASAP feels this level of proactive, clear communication of risk has not been accomplished. As noted earlier, NASA provided information to ASAP regarding the risk of LOM for ISS at a level of 1 in 55 for a single, 180-day mission. The ASAP thinks that it would be more informative to state the risk as a greater-than-30-percent chance that the ISS could sustain a LOM sometime during its projected operating life. LOM is not an inconsequential risk, and it has not been openly communicated either inside or outside of NASA. The point here is not the 1 in 55 number, but that it may not be understood in the same manner as expressing it as an approximately 30-percent chance of LOM during the ISS's currently projected life. Failure to clearly communicate this level of risk in a manner that the various stakeholders conceptually understand can result in an inappropriate loss of support and confidence in NASA in the event that an ISS LOM occurs. For example, it could be argued that in the case of the Challenger mishap, the failure to communicate openly and effectively about risk undercut the confidence and support for NASA that might otherwise have been present.

Attempting to execute programs with insufficient funding often leads to compromise detrimental to safety. Therefore, we believe transparency is essential if NASA, the Congress, and the White House are to collectively shoulder the risk and the responsibility.

▲ *4. Knowledge Management*

Knowledge management is the collection of processes that govern the creation, dissemination, and utilization of knowledge. In this discussion, the ASAP is using the following definition of "knowledge": the ability, capability, and willingness to assemble information in such a way as to advance learning, improve on current mechanisms, and advance civilization. Knowledge management takes time, effort, expertise, and the willingness to be curious, search, think, and experiment. It is a nontrivial, critical task that must be undertaken by serious personnel who are competent in the process. The ASAP has observed such personnel within the NASA Centers and compliments the personnel and the programs at JSC and Goddard Space Flight Center, for example. In these locations (and perhaps others), competent and enthusiastic personnel are making excellent progress at both cataloging and managing NASA critical knowledge. We have also seen excellent examples in regard to specific programs; for example, the Constellation Program just published a two-volume report on lessons learned, and the Shuttle Program has an equivalent program in process.

These examples, while excellent and laudable, do not constitute an approach that ensures the identification and capture of critical NASA implicit and explicit knowledge Agency-wide in a manner that would allow any NASA employee (or, under some circumstances, NASA partners and contractors) a single process or tool to locate and then access all of the information resources.

The ASAP has recommended that NASA establish a single focal point—a "Chief Knowledge Officer"—within the Agency to develop the policy and requirements necessary to integrate knowledge capture across programs, projects, and Centers. Additionally, the ASAP has recommended that NASA consider establishing Chief Knowledge Officer positions at all NASA Centers and in all Mission Directorates to ensure standardization of programs and lessons learned as we move forward. A single focal point within the Agency provides clear responsibility and authority to ensure an integrated Agency-wide process and archive for knowledge capture. A similar focal point at each NASA Center and each Mission Directorate would facilitate this function at the local level.

The ASAP believes that one overarching and fundamental purpose of NASA is to create knowledge. The Agency remains the sole repository within the U.S. for a rich history of knowledge on human spaceflight. Its Centers contain much of the world's information on planetary science, knowledge of the cosmos, and many related scientific fields. Ensuring that this knowledge is captured and available to future generations is more than an obligation; it is a sacred trust.

■ *5. Facilities*

For the past 3 years, the ASAP has been monitoring the condition of NASA facilities and infrastructure with an eye toward safety and mission accomplishment. In this regard, during each Center or installation visit, a facilities tour is performed to derive a sense of the changes that have occurred since the last visit and to gain an appreciation of the general condition of the facilities' components. This is not a detailed engineering inspection or assessment, nor is it a comprehensive review, covering every facility or all areas of the Center; rather, it is an overall impression of the facilities' condition, including pressure vessels, boilers, hoists and lifts, hangars, test stands, electrical systems, etc.

The Panel has noted in past annual reports and continues today to believe that, considering their age, most NASA facilities are in relatively acceptable condition. However, during each visit we have observed firsthand or have identified areas where the infrastructure or a particular condition could have an undesirable mission effect. Worse yet, it could present a safety hazard that, if not addressed, could result in NASA or contractor personnel injury. Regretfully, but not surprisingly, the number of such conditions or infrastructures is on the rise, and the overall facility condition-index trend is downward.

In light of this downward trend, for the past 2 years, the ASAP has asked NASA to identify the process used Agency-wide to identify, characterize, and prioritize facilities or infrastructure requiring critical repair or replacement. The response thus far is that the burden of such characterization and repairs is the responsibility of each Center's engineering organizations, using standardized codes to identify the most critical repair or replacement. Funding to address these needs routinely is provided by project funds, if available. For those Centers well endowed with an abundance of projects, this approach has been, for the short term, satisfactory; however, for Centers not so fortunate, this methodology has been less than successful. In some cases, instead of repairs, the Agency has earmarked facilities for replacement. This approach has resulted in a significant near-term request for construction that even under the best of circumstances is not likely to be funded.

Considering the current and anticipated budget environment, the ASAP believes that NASA must develop and implement a process that compares risk at each Center, then integrates, prioritizes, and allocates dollars for facility repairs Agency-wide for the most critical areas. To do otherwise will allow further deterioration of critical facilities at some Centers while possibly over-improving facilities or infrastructure at other Centers. Both results are undesirable. In other words, these decisions need to be made from the perspective of what is best for NASA overall rather than what is best for an individual NASA Center.

▲ C. Transparency/Culture

The ASAP continues to believe that it is critical for the Agency to constantly evaluate its transparency and culture. In this context, "transparency" means open access to information, participation, and decision-making, which ultimately creates a higher level of trust among stakeholders; "culture" is a collection of values and norms that are shared by people in the organization and that control the way they interact with each other and with stakeholders outside the organization. An open culture makes it easier to identify risk and perform insight and oversight; it will also improve communication within the Agency and with key partners and contractors. The ASAP has addressed culture frequently since the Columbia Accident Investigation Board (CAIB) report and will continue to do so. With respect to transparency and culture, this past year the ASAP made recommendations on insight/oversight, timely and accurate communication, and development of a NASA alcohol use and testing policy.

▲ *1. Insight/Oversight*

As NASA transitions into utilizing commercial services for both cargo and crew transportation to LEO destinations while developing a new SLS for exploration, both insight and oversight will be essential to maintaining the safety of various systems and the crew that occupy them.

The ASAP has been monitoring the transition to commercially based programs for the delivery of cargo and eventually crew to the ISS and other LEO destinations and has discussed the type of information that is needed to provide additional insight. In accordance with our recommendations from prior reports, we are pleased to note that NASA has recently baselined and published technical requirements for any provider interested in offering transportation for NASA astronauts to LEO. This publication is fundamental to establishing transparency in the relationship between the Agency and its suppliers. The ASAP believes it will be equally helpful for NASA to provide oversight to a validation and verification matrix that outlines how each provider will provide assurance that the design meets those requirements.

Establishing requirements to guide the design and then overseeing the process that validates that the intent is being met is fundamental to being able to certify these systems upon entering into follow-on development phases after the SAA design phase.

The ASAP feels that oversight must continue to be provided in order to ensure that the vehicle is manufactured, is assembled, and will be operated in accordance with the requirements and the design constraints. Any manufacturer that is involved in producing or providing systems where human safety is a critical concern should expect that a level of oversight is a necessary requirement and take the appropriate steps to integrate this oversight into the program plans.

Even though the SAA prevents NASA from issuing requirements directly under a contract-type arrangement, there should be no restriction on NASA seeking assurance information to make certain that the provider designs to meet the human rating requirements, validates the design, builds to the design, operates the build within the design limits, and maintains it to ensure that no degradation takes place.

Another related area where insight must be provided is risk. Technical risk represents perhaps the most controllable risk. NASA is providing a set of requirements that list the objectives that must be achieved as well as any known approach for achieving them; in addition, all of NASA's engineering standards are being provided. While technical risk can never be fully eliminated, this approach mitigates such risk to the extent possible. We believe that NASA should seek the maximum opportunity to closely oversee what the contractors are developing during the SAA phase of the CCP. Schedule risk is a more difficult risk to mitigate because, like cost, it tends to be a "victim" of whatever else goes wrong. The ASAP believes that the best approach to handling this risk is to develop an agreed-to integrated plan and schedule that calls out specific, measurable events that are easily discernable by all parties so that progress is clearly measurable and evident. Financial risk is, without a doubt, the most contentious risk category, from both the funder's perspective and the performer's perspective. The funding uncertainty makes this risk more difficult to manage. The tendency to "promise beyond ability" and to "expect beyond capability" is strong in the program culture. Under the recently announced change from traditional contracts to SAAs, the ASAP continues to stress that insight and oversight into program execution are essential to ensuring that the SAA phase of the program yields designs that can be ultimately certified as meeting safety criteria.

Several things can ease the ASAP's concerns regarding the programmatic and thus the safety risk associated with developing the commercial space transportation system and any future space launch system for NASA astronauts:

1. An independent and credible cost estimate;
2. A realistic schedule based on the resources made available;
3. Sufficient resources to fund the acquisition approach, with historically realistic management reserve;
4. Completion of NASA's safety certification requirements and process; and
5. Provisions in the SAAs negotiated with suppliers that provide NASA access to and insight into the design and validation of the vehicles under development.

Transparent communication, constructive feedback, professional trust, and flexibility will be necessary to assure all stakeholders that these programs are on a path to success. The insight/oversight process must revolve around the development of a long-standing, mutually trusting relationship between all stakeholders. It is essential to the safe and efficient execution of any programs or partnerships. When issues arise, they need to be openly and thoroughly discussed. Withholding information, hiding concerns, and keeping secrets are clearly signs of trouble in any relationship, but especially one in which the end product is designed for human transport to space, which is a very hazardous endeavor. The ASAP believes this must be worked on by both sides until an open and transparent relationship is established. While the SAAs pose the potential for increased risk, this can be partially overcome by making sure that both sides of the process are fully knowledgeable about the ability of the design to meet NASA's human rating requirements.

▲ *2. Timely and Accurate Communications*

Given the 24/7 news cycle, the 15-second sound bite, and the social media of Facebook and Twitter, NASA needs to work even harder to communicate more complex scientific information, relative risk, and test results. When working through and with commercial entities, it becomes more critical for NASA to effectively communicate all events of interest to external stakeholders. This involves very close coordination between NASA leadership, the broader NASA organization, NASA's Office of Communications, NASA's program offices, and external providers. Timely and accurate information needs to flow seamlessly and rapidly. Clear, timely, and effective communication is essential, as poor performance in this area leads to loss of reputation, distrust, and perhaps even contractual issues. Accuracy in communicating NASA's activities involves structuring the information to meet the needs of several different levels of understanding in the target audience. The general public needs to be aware of the benefits and the risks involved in the endeavor, expressed in terms that can be understood by a nonscientific audience. At the same time, NASA must keep its scientific audience satisfied with much more detailed technical information. This challenge makes the communication job more complex but in no way makes it less critical. NASA and its contractors and partners must work to achieve these multiple levels of understanding if they ever hope to gain a national consensus in favor of their activities.

In the past year, the Panel believes that there have been communication missteps between the Commercial Cargo and Crew offices and NASA's top leaders. These transparency and communication issues have caused precious time to be wasted and confidence lost as the individuals involved strove for clarity. In one instance, a very public legal action was taken that detracted from the overall program. In another instance, "absolute" versus more "measured" language led to more questions, larger issues, and some loss of credibility.

To NASA's credit, there has been progress in this area within the past year, as a few anomalies were handled quickly and candidly (e.g., the Glory failure and the UARS reentry cited in Section I of this report). While actual performance has indicated a few bright spots, there is more work to be done to build more trust into the accuracy of communications. The ASAP will continue to monitor and assess accuracy and timeliness over the next year.

■ 3. Alcohol Use and Testing Policy

In the early afternoon of March 17, 2006, a fatal fall from a roof occurred at a NASA facility. Subsequent investigation yielded information that pointed to an elevated blood alcohol level in the deceased. Falls like this are tragic and are totally preventable. All stakeholders—the family, the employer, the community, and the Agency—suffer in the aftermath.

The ASAP, after learning the details from the internal mishap investigation, also learned that NASA had no formal alcohol or drug testing policy for employees or contractors. In the spirit of improved safety, the Panel recommended the following in the third quarter of 2006:

> *Random Drug and Alcohol Testing—Recent mishap investigation revelations indicate that there does not seem to be an Agency-wide requirement for random drug and alcohol testing among contractors. ASAP recommends that expanding both random pre-incident and targeted post-incident testing would be well advised for contractors as well as NASA civil servants.*

In the past 5 years, there have been various and periodic discussions on this subject between the ASAP and NASA's Office of Safety and Mission Assurance (OSMA). NASA now has in place a drug testing policy for civil servants and contractor employees that addresses the drug use and testing portion of the recommendation. Unfortunately, NASA has yet to make appreciable progress on a formal policy on alcohol use and testing. Finally, in October 2011, NASA shared with the ASAP that the whole effort had become "lost" with the recent retirements and challenges at the Agency, and the OSMA will now "start over."

The ASAP appreciates NASA's frankness and transparency on the status; however, little to no progress in this area over 5 years continues to be troubling. NASA's work is serious, and any benchmarking with industry indicates that NASA is behind the power curve in this area. The ASAP is looking forward to hearing more from NASA on this subject in 2012.

III. Conclusion

NASA is moving forward into 2012 with many challenges, the foremost of which is virtually the same as last year—a lack of clarity and constancy of purpose among the White House, Congress, and NASA. Despite laudable progress on space systems including the ISS, NASA's human exploration mission remains unclear and its budget and schedule uncertain. The ASAP feels it is vital to the national interest that all the principal stakeholders reach a clear and unambiguous understanding of the U.S. human spaceflight program's goals and objectives. The risks to reach the goals must be measured both in resources and in human lives. These risks must be properly estimated by using the most knowledgeable analysts and the most sophisticated and accurate tools. The assessment should be unbiased and accepted by all parties in the endeavor; it must include the risks to both those who make the journey and those who stay behind. Perhaps most importantly, the risks must be made fully transparent to and understood by the American people. The appropriate budget must then be provided to carry out the actions needed to reach that goal.

In regard to human spaceflight, the ASAP has concluded that the following three critical questions must be answered in the near term for any program to any destination:

- **What is the mission?** We must clearly articulate the goals and objectives of the U.S. human spaceflight program, both within and beyond LEO.
- **What will it cost?** We must measure the risk in both resources and human lives to reach the goal. Said another way—Is what we will get worth what it may cost?
- **Whom will you tell?** The risk must be made fully transparent to the stakeholders and the American people.

The time for either unfounded pessimism or unbridled optimism is over. Human space exploration, should we choose to pursue it, is expensive, time-consuming, demanding of the highest levels of technology, and inherently dangerous. If we cannot accept these fundamental facts, then we must consider whether or not we should go. It is a choice, and that choice should not be postponed.

Expanded commercial activities and how best to acquire them remains a topic of importance. The ASAP had previously noted that fixed-price contracting potentially sets up a conflict between cost, schedule, and performance that can affect safety. Significant insight and oversight by NASA will be required to ensure that this inherent conflict is appropriately managed. NASA's very recently announced plan to change the acquisition approach for commercial crew transportation services from FAR-based contracting to SAAs may have negative implications for the safety of NASA crew. The ASAP plans to closely examine this approach and its safety issues in 2012.

In our current media environment, NASA needs to work harder to clearly express more complex scientific information, relative risk, and test results. When working through and with commercial entities, it becomes more critical for NASA to effectively communicate to all external stakeholders.

The ASAP believes that one overarching and fundamental purpose of NASA is to create knowledge. Public information, no matter how skillfully done, does not ensure the identification and capture of critical NASA knowledge. The Agency remains the sole U.S. repository for a rich history of knowledge on human spaceflight, and its Centers contain much of the world's information on space science and related scientific fields. Ensuring that this knowledge is captured, retained, and available to future generations is essential. Therefore, the ASAP has recommended that NASA establish a single focal point—a "Chief Knowledge Officer"—within the Agency to develop the policy and requirements necessary to integrate knowledge capture across programs, projects, and Centers.

NASA has now announced that, to provide the future capability for human exploration beyond Earth orbit, it plans to develop the SLS and the Orion MPCV. Since these systems will be NASA's primary vehicles for carrying out its exploration mission over the next several decades, it is essential that they be designed to be as safe and reliable as possible. The ASAP plans to initiate a more detailed review of these programs during the coming year.




Appendix:

Summary and Status of ASAP 2011 Recommendations

Rec. #	Description of Recommendation	Status
2011-01-01	**NASA Alcohol Use and Testing Policy.** NASA should implement a post-mishap alcohol and drug testing program for all personnel in sensitive positions that are involved in Class A and B mishaps. That includes NASA contractors, civil servants, political appointees, and all affected visitors.	NASA response and updates received; OPEN pending schedule with completion and implementation dates
2011-01-02	**Safety and Mission Assurance Role Descriptions.** NASA should begin to draft a role description as well as some key job requirements, such as educational background and experience, for the personnel who have to specify, manage, and assure the S&MA activities under the new program direction.	NASA response received 6/27/11; OPEN pending briefing on study findings
2011-01-03a	**Safety Metrics.** The NSC should expand mishap analysis to include all types of mishaps. As this process develops and matures, and as the comparisons make the data more meaningful, the NSC should brief the senior leadership of the Centers and the Agency on the results.	NASA response received 6/27/11; CLOSED, with quarterly monitoring
2011-01-03b	**IRIS Support.** NASA should describe how the IRIS supports causal analysis and include the causations in the periodic reports together with their associated mitigation actions and schedules for completion to management. NASA should take steps to have the system do the analysis and reporting automatically.	NASA response received 6/27/11; OPEN, with progress report at 1st qtr. mtg. in 2012
2011-01-04	**Document Title for "Commercial Crew Transportation System Certification Requirements for NASA Low Earth Orbit Missions."** NASA should change the title to one that clearly indicates that the document applies to NASA crew transport to LEO only.	NASA response received 4/22/11; CLOSED
2011-02-01	**Commercial Crew Program.** NASA needs to apply appropriate resources to the CCP to ensure that it meets or beats the 2016 goal while maintaining NASA's high standards for quality and safety. NASA should seek additional resources either within the existing budget or through additional appropriations.	NASA response received 8/24/11; CLOSED

Rec. #	Description of Recommendation	Status
2011-02-02	**Space Shuttle Launch and Re-entry Risk Study.** NASA should perform an analytical study on the Space Shuttle launch and re-entry risk to both crew and public safety. This study should be done using a consistent set of assumptions over the total launch history.	NASA response received 8/8/11; briefing 10/20/11; CLOSED
2011-02-03	**SOMD/ESMD Organizational Merger.** OSMA should review the current reorganizational plans to ensure that no current critical safety and mission assurance (SMA) aspects, particularly programmatic, are inadvertently eliminated or disrupted due to the merger.	NASA response received 8/16/11; CLOSED
2011-02-04	**SMA Software Assurance.** OSMA should do an analysis on what the impact is to NASA's critical programs by not doing 100 percent IV&V for software assurance.	NASA response received 8/16/11; OPEN pending briefing
2011-03-01	**Abort Effectiveness Requirement.** Requirements for abort system effectiveness should be retained as a safety requirement.	NASA response received 10/6/11; CLOSED, with monitoring
2011-03-02	**Partner Integration Team Rotation.** The CCP should develop a written policy specifying team rotation schedules based on tour of duty, milestones, or other appropriate criteria, to ensure a fresh set of eyes are always protecting the government's interest for the insight portion of the acquisition strategy.	NASA response received 10/6/11; OPEN, pending receipt of policy or procedure
2011-03-03	**Responsibility, Authority, and Accountability for System Requirement Approval and Design Risk Acceptance.** NASA's Chief of OSMA, Chief Engineer, and AA for ESMD should clarify who has responsibility, authority, and accountability to approve system requirements and accept design risks associated with the CCP.	NASA response received 10/6/11; CLOSED, with monitoring
2011-04-01	**Chief Knowledge Officer Positions.** NASA should establish a single focal point (a Chief Knowledge Officer) within the Agency to develop the policy and requirements necessary to integrate knowledge capture across programs, projects, and Centers; NASA should consider establishing Chief Knowledge Officer positions at all NASA Centers and in all Mission Directorates to ensure standardization of programs and lessons learned.	OPEN