

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

November 4, 2011

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

Dear Mr. Bolden:

The Aerospace Safety Advisory Panel (ASAP) held its Fourth 2011 Quarterly Meeting at Johnson Space Center on October 20-21, 2011. We greatly appreciate the participation and support received from the subject matter experts and support staff.

The Panel submits the enclosed Recommendation with Minutes resulting from this meeting for your consideration. We request that NASA provide a Point of Contact (POC) and the expected completion or implementation date as part of its response.

Sincerely,

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

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

Enclosure

**ASAP RECOMMENDATION, FOURTH QUARTER 2011**

**2011-04-01 Chief Knowledge Officer Positions**

Finding: Johnson Space Center (JSC) has done an excellent job with lessons-learned capture and documentation on the Constellation Program; likewise, a good effort is underway to capture knowledge and lessons-learned on the Shuttle Program. As noted in ASAP's Third Quarter Report, the Goddard Space Flight Center (GSFC) also has a good knowledge management model. Both JSC and GSFC have Chief Knowledge Officers.

Recommendation: To ensure the identification and capture of critical NASA implicit and explicit knowledge, the ASAP recommends 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 recommends 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.

Rationale: 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.

**AEROSPACE SAFETY ADVISORY PANEL  
Public Meeting  
October 21, 2011  
Johnson Space Center  
Houston, TX**

**2011 Fourth Quarterly Report  
Minutes**

**Aerospace Safety Advisory Panel (ASAP) Attendees**

VADM (Ret.) Joseph Dyer (Chair)  
Dr. James Bagian  
Ms. Deborah Grubbe, P.E.  
Mr. John Frost  
Mr. John Marshall  
Dr. Donald McErlean  
Ms. Joyce McDevitt (via telecom)  
Dr. George Nield

**ASAP Staff and Support Personnel Attendees**

Ms. Diane Rausch, ASAP Acting Executive Director  
Ms. Susan Burch, ASAP Administrative Officer  
Ms. Paula Burnett Frankel, Reports Editor

**Public Attendees**

Ken Gidlon, FAA-AST at JSC  
Mark Carreau, *Aviation Week & Space Technology*

Dr. Donald McErlean, who chaired this meeting at VADM (Ret.) Joseph Dyer's request, called the ASAP's Fourth Quarterly Public Meeting of 2011 to order at 12:35 pm. After introductions, Dr. McErlean asked VADM to proceed with his report on robotics.

**UPDATE ON INTEGRATION OF ROBOTICS**

VADM Dyer noted that the ASAP's history with robotics, and more specifically, the integration of robotics and human spaceflight, goes back a number of years. It was crystallized two years ago when, during an extravehicular activity (EVA), an astronaut chafed a glove while doing work on Space Station. This was around the same time that the Constellation Program was considering heavy manual astronaut labor activity on the lunar and Mars surfaces. The Panel was struck with the dichotomy between the fragile nature of spacesuits and human equipment and the potential robustness of robotics; it was inspired by the vision of cooperative robotic and human undertakings. The Panel noted, however, that robotics has been primarily in NASA's science missions and has been little used by human spaceflight. Believing that robotics could make a significant contribution to safety in a human/robotic team in future exploration, the ASAP made a recommendation in 2009 (updated in February 2010), and during this meeting's fact-finding session, NASA's Chief Engineer, Mr. Michael Ryschkewitsch, gave a report on the status of NASA's response. The Panel agreed that progress has been made. The NASA Chief Technologist has published a roadmap that addresses tele-operated robotics and autonomous systems and provides a vision for future missions and future endeavors. It represents good progress; it speaks to the technical challenges of autonomy and "smarter" robots. The Office of the Chief Technologist (OCT) is also conducting an inventory on current robotics activities across NASA. The Panel agrees that this is necessary, and is pleased that NASA is on course and there is improvement; however, the ASAP proposes to keep the recommendation (2009-03-04) open to verify the bona fides of implementation, e.g.: Is budget following the rhetoric? Are the Centers integrated in their execution of that budget? Is there a real and funded future in the integration of human and robotic exploration? The ASAP is looking forward to future status reports on this topic.

**COMMERCIAL CREW UPDATE**

Dr. McErlan reported on the commercial crew discussion. He noted that during the previous day's fact-finding session, Mr. Brent Jett, the Deputy Program Manager of the Commercial Crew Program (CCP), provided a very comprehensive review of the Program status. The Program is in a transition phase; it is currently executing CCDEV 2, which is a continuation of the Commercial Crew Development Program that began in FY10 under Space Act Agreements (SAAs). It now contains six entities: Blue Origins, Boeing, Sierra Nevada, SpaceX, and two unfunded programs with Alliant Techsystems (ATK) and United Launch Alliance (ULA). That Program will run through the end of FY12; then the Integrated Design Phase (CCIDC) will commence. CCIDC will be conducted under a more traditional contract arrangement. The draft Request for Proposal (RFP) is currently out for comment and can be found in *FedBizOpps*. That Program has 2 phases: Phase A, which is design and early development, and runs through almost the end of FY14; then another competition and down-selection for Phase B based on participants' level of maturity and progress in Phase A. Phase B is the development, test, evaluation, and certification against NASA's human crew capability design specification. They are anticipating a transition to a services-type contract at the beginning of FY17. It appears to be a well-organized program that is moving forward.

The current focus is the transition from the CCDEV approach under SAA to the more contract-oriented requirements approach for the design phase of the program, and NASA is well on the way to achieving that. The first phase will be firm-fixed-price (FFP) with flexibility and options. It is a traditional approach, utilizing Critical Design Review (CDR) and Preliminary Design Review (PDR), and a NASA-approved certification plan wherein NASA puts out the requirements, then negotiates a certification program and validation plan with each participant. The company then executes the validation plan, leading to certification. The second phase completes the certification program and allows for the company to compete for NASA Crew Transportation business. There are a number of objectives. From the ASAP perspective, it is important that the number one objective is to secure a safe, reliable, and cost-effective system for crew transportation; the other top two objective are to provide a certified system for NASA-crewed mission to the ISS and to enable a commercial use of the system so that it can be utilized for other things than just transportation of NASA personnel.

The ASAP believes the movement from the SAA to the contract arena with NASA being able to specify requirements and achieve verification does improve the potential for creating a safer system and the Panel supports that; however, there is a concern for what may be a serious budget issue. At the moment, the House and Senate marks are considerably below the President's budget request, which had already been cut to the minimum. The concern is that the current CCP program is based around the idea that cost effectiveness will result from competition between providers. The difficulty is that if the budget is cut too far, one is left without sufficient funding to continue with two providers and is faced with the potential dilemma of an early down-selection to a single provider. This would not result in the hoped for cost effectiveness. NASA has adjusted the requirements document—they are trying to create a performance-based requirements document that tells the companies the requirement objective, presents a process or approach that meets it, but provides the option for a company to show that its approach achieves the same objective, leaving it available for approval. It appears to be a good approach. NASA has put in place Technical Integration Leads (TILs) with each of the current CCD-2 entities, and if those same companies are selected for the CCIDC, the TILs will stay there. Their job is to ensure that at critical meetings and milestones, the proper oversight people, such as subject matter experts, are present and participate in engineering discussions. This will ensure that the company knows NASA's view as quickly as possible to take the necessary action—either try to convince them to change their mind or modify their course, if required, or receive acknowledgment that their approach is acceptable. The idea is to improve the speed of decision-making, which is one of the differences between the SAA and a traditional contract. The companies have said that they need to get the speed of the SAA approach into the contracting approach. NASA is well aware of this and is trying to move in that direction.

All in all, it was an excellent discussion. The path forward is to maintain the CCIDC procurement timeline to award a contract in FY12, incorporate lessons learned from other programs into that execution, and examine how NASA's internal management structure might have to change as it moves from a SAA environment to a contracting environment that ensures flexibility in the program to adjust to budget changes and lessons learned. NASA is working very hard to keep the public and all of the necessary stakeholders informed on the CCP progress.

Mr. John Marshall agreed that the presentation was very helpful and useful; however, he noted that there appears to be a risk of insufficient funding to facilitate this program as envisioned by NASA. While missing an official NASA program estimate and considering Mr. Jett's requirements, he opined that the current Congressional budget proposal

that is still under review appears to be significantly short of what NASA assesses to be necessary. Acknowledging that a budget is not yet finalized, this raises concern about how this program can be implemented safely with such a funding delta. Whether one tries to slip the program to the right or eliminate the number of participants, it puts NASA in a very difficult position. Mr. Marshall further noted that he believes that the current funding appears to put the CCP at risk.

Mr. John Frost commented that the ASAP has for some time pointed out the need for clear requirements on the commercial program. NASA is getting very close to that end goal; more importantly, the change in procurement strategy to move more towards a traditional contract arrangement with firm requirements and verification techniques is very good for safety. The Agency has moved to a good, middle-ground that will buy safety as long as the necessary funding is provided. Mr. Frost opined that this is the type of case where you either build it or you don't. He encouraged proper funding and using the proper contract vehicles.

Mr. George Nield added that the ASAP has had some good discussions on some of these issues. The Panel wants to make sure that the requirements are clear and the programs are properly funded, looking at the different mechanisms that NASA has available to take the program forward. Both SAA and Federal Acquisition Regulation (FAR)-based contracts have been used in the past, and there has been debate on what the appropriate mechanism should be. The FAR contracts allow clear requirements and good NASA insight and oversight, but there are many other factors involved in how a program can be run successfully. The SAA proponents view that mechanism as potentially allowing more flexibility and speedy response, such that companies would be able to deliver on their planned capabilities. NASA is ultimately able to make a decision on whether a particular provider is meeting the requirements that NASA wants. There are advantages and disadvantages to each approach; however, the ASAP is pleased that NASA is trying to take the best of both worlds--the speed and flexibility of the SAA and the requirements and program management tools found in a traditional contract.

**UPDATE ON INTEGRATION OF CREW REQUIREMENTS INTO DESIGN AND SPACE SHUTTLE LAUNCH AND RE-ENTRY RISK STUDY**

Mr. Frost noted that both of these updates were in response to recommendations from the Panel. They represent some good work by NASA in responding to ASAP's concerns. The first recommendation came out of an observation that the ASAP made during the Constellation Program's development. One of the issues is how a requirement is suggested and how, as the development progresses, one ensures that a system is not "gold plated." As new needs arise, they can become very cumbersome. The ASAP observed the interaction of crew needs as expressed to the project. Clearly, the crew must have sufficient input; on the other hand, the Program must ensure that they are not "over-considered" and weighted in a way that drives the overall system to less than an optimum level. One example revolved around the thrust oscillation issue on the solid rocket booster. The crew identified a vibration concern, relating to their safety and ability to operate switches and functions during ascent. What worried the ASAP was that this took so long to resolve. Much effort was spent on eliminating the vibration due to the crew's concern; even more worrisome, there was a much consideration given to adding considerable additional mass to damp out the vibration without the analysis that indicated whether the risk was real or not. In the end, it turned out positive, and NASA developed some super technologies for handling vibration; however, the process didn't go as quickly and sharply as the ASAP would have liked. The lesson learned here was the need to resolve issues quickly. Just because one proponent--whether crew or program--has a proposed requirement doesn't mean that it must be accepted. The ASAP believes that NASA has changed its processes to resolve issues more quickly, but the management needs to keep eye on this in the future.

The Space Shuttle Launch and Re-entry Risk Study is a real success story. The ASAP asked that an analysis be made of the longest-running human spaceflight system in existence--the Space Shuttle. Significant funds were spent on this program, and we should learn much from the results about the risk side of a vehicle that was in service for such an extended period. Ms. Teri Hamlin did an outstanding job of looking back over the many years of Shuttle flights. She took snapshots of all the various Shuttle versions that existed. Knowing what we know now about the failures and the mechanisms that were there all along, but had not manifested themselves, she calculated what the true risk was on each flight. Many things were learned. One very important one was that the risk on a new system that has not been flown before and has not been through the rigors of real life flight is probably much higher than what the risk assessments show. That is because the failure mechanisms are not fully known--what we call the "unknown unknowns." In Shuttle's case, the first flight risk was 1 in 12 of losing the crew, yet the one analysis that we know that existed at that time estimated the risk to be 1 in 1000 or less. This is a huge difference, even considering that the analysis at that time was not done with the rigor that today's probabilistic risk assessments (PRAs) are done.

Everyone should remember that kind of difference when targets for reliability and loss of crew numbers are chosen—to include margin for error and allow for the unknown unknowns.

In terms of the actual level of risk, there are some numbers that need to be clearly articulated in the lessons learned from Shuttle. In case of Shuttle, based on this later analysis and the historical data, we now know that there was a 92 percent chance that a crew would be lost in the first 25 missions. Mr. Frost noted that NASA was lucky to make it as far as it did. In a separate item report out, Ms. Hamlin performed an analysis of risk to the public and those on the ground during launch and re-entry. It was a rigorous analysis and was very enlightening. There are risks to the public at both ends of the trajectory, and Ms. Hamlin computed those statistics. Those kinds of numbers must be kept in mind as re-entry and landing points and types of systems are chosen. NASA not only needs to protect its astronauts, but everybody exposed to these vehicles.

Dr. McErlean added that one thing that has always been said in the design business is that design standards take care of the knowns; factors of safety take care of the known unknowns, but margin is what takes care of the unknown unknowns. Margin should be built into the design to create a robust design activity. The reason the ASAP was interested in the Shuttle analysis is because, as the longest-running human spaceflight program, it will become the basis of everything else we do in the future. Whatever program proceeds forward, it is inevitable that people will ask: What did the Shuttle do? It is very important to capture that database. The ASAP is very pleased with NASA's work in this area.

#### **KNOWLEDGE CAPTURE AND MANAGEMENT, UPDATE ON CONSTELLATION PROGRAM AND SHUTTLE PROGRAM**

Mr. Marshall noted that a lot of the discussions today were related to capturing lessons learned. At its fact-finding session, the ASAP received two briefings—one from Mr. Charles Stegemoeller, Director of the Performance Management and Integration Office at JSC, on the Constellation Program and one from Ms. Peggy Wooten, Program Analyst at JSC, on the Shuttle Program. Mr. Stegemoeller gave the ASAP an outstanding review of efforts taken to closeout the Constellation Program and, where appropriate, establish lessons learned. He established the successful strategy that was used to complete the Program closeout in FY11, save dollars to move exploration forward, use existing Agency transition management and lessons-learned, and work closely with project, programs, and Centers to ensure that stakeholders' issues and impacts were brought to light. The ASAP recognizes that he has done an excellent job. The Constellation Program has been closed out and no additional expenses have been incurred. The processes and records have been migrated to the National Archives and Records Administration (NARA). Lessons Learned Volume 1 has been presented to senior management, and the second volume should be released at end of this month. Records disposition and archiving are underway; EVA, Orion, and Ares operations are all being documented, either in a holistic perspective or at JSC. The Program has progressed very well and ASAP commends it for the lessons learned documentation.

The ASAP also learned from Ms. Wooten that the lessons learned from the Shuttle Program are underway. This is a much larger, more complex issue because of the long-running Program and the multiple parties involved. The JSC Knowledge Management Office has played a key role in this effort. The Chief Engineer's council has been involved, and it is directly contributing, as well as the various Centers. Mr. Marshall did not discuss all of the databases, integrations, and lessons learned, but he stated that it is a very large effort. This said, the Panel noted that there is no dedicated funding and no integrated process that has been established or is being followed. Mr. Marshall offered the following recommendation:

*To ensure the identification and capture of critical NASA implicit and explicit knowledge, the ASAP recommends 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 recommends 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.*

#### **BUDGET AUTHORITY FOR FACILITY MAINTENANCE, INFRASTRUCTURE DEVELOPMENT, AND SAFETY UPGRADES FOR NASA AIRCRAFT**

Ms. Deb Grubbe reported on the briefing from NASA's Associate Administrator for Mission Support, Dr. Woodrow Whitlow. Dr. Whitlow discussed the facility maintenance and repair budget, which is an area of continuing interest to ASAP because there is a relationship between safety and mission success and infrastructure. Ms. Grubbe noted some

of the facts shared by Dr. Whitlow. In FY11, about \$280M was spent on facility maintenance and repairs. As one looks forward, that budget needs to increase and is planned to increase, first to \$450M and then looking further—in FY14 and FY15—another \$200M. Everyone recognizes that in the out-years, nothing is assured, but at least looking forward to next year, the budget for maintenance and repair has increased. There has been reinvestment at the Centers, e.g., at Langley Research Center, Glenn Research Center, and Ames Research Center; however, Dr. Whitlow also pointed out that 80 percent of the facilities in NASA's infrastructure are beyond their design life. This is not uncommon for the U.S. today. Facilities often last longer than their design life, but it is important to monitor and be vigilant on infrastructure. The repair backlog has also dropped from last year, but this is no guarantee of continuing decline. It is important that NASA continues to monitor this. NASA is working on a demolition program to take old, unneeded infrastructure off the books. This is also positive because it reduces the infrastructure that needs to be maintained. Dr. Whitlow noted that there is a prioritized list for repair backlog projects, and they are in a format that shows relative safety priority. The ASAP has asked for a copy of this list and is gratified to hear that NASA Headquarters is taking a holistic view on the facilities effort. The ASAP encourages NASA to continue an overarching management review. This helps in budget forecasting; it also helps Centers obtain funding for a large amount of older infrastructure that is still needed.

#### ***NASA SAFETY METRICS OVERVIEW, 5-YEAR STRATEGIC PLAN FOR CONTINUOUS IMPROVEMENT, NSC UPDATE, STEP UPDATE***

Ms. Grubbe noted that Mr. Alan Phillips, Director of the NASA Safety Center (NSC), gave an update on metrics at the fact-finding session the previous day. The ASAP sees good progress in this area. There appear to be reductions in injuries and incident performance across the Agency as a whole; however, when ASAP tried to penetrate why that is happening, it concluded that the appropriate analysis to answer that question has not yet been performed. ASAP applauds NASA for the improvements and asks NASA to continue to look underneath the numbers to see what more can be gleaned. Mr. Phillips shared some examples of internal programs in ergonomics and electrical safety that have been done as a result of looking at where people are getting hurt on NASA facilities. He also reviewed the status of the mishap investigation process. ASAP was pleased to see continued progress in reducing the time required to complete mishap investigations. This appears to be on course and the ASAP looks forward to continue progress in this area. Mr. Phillips also shared the current status of the NSC organization and an update on the STEP program. STEP stand for the "Safety and Mission Assurance (SMA) Technical Excellence Program." In the two years since STEP launched, 73 percent of the civil service workforce has graduated from STEP Level 1. There has been 550 percent increase in safety training activities within NASA as result of STEP. One person has graduated from STEP Level 3 and 31 have graduated from STEP Level 2. Most of the upper level STEP sequences have been developed, but there are a few gaps. ASAP encourages NASA to see this through, possibly with the use of a variety of external partnerships to fill in some of the skill gaps that they may not have at the upper levels of the requirements.

#### ***ADDRESSING JSC WORKFORCE CHANGES/ISSUES***

Dr. McErlean commented that workforce change is always an issue, because changes have safety overtones—as experience leaves the Center and as people experience increasing stress as they go through the transition process. The ASAP received a good briefing from Ms. Beth Nguyen, JSC Associate Director of Human Resources. She was very enthusiastic and upbeat, and told the ASAP about the broad-based, human resources program that has been in place at JSC to help people through the transition process. Three things have happened since the ASAP was last at JSC. JSC has just completed a series of workshops and meetings with businesses or industry organizations to transition people with aero skills to other industries such as oil and gas. Many of the skill sets utilized at JSC to support Shuttle program were rather easily transportable to oil and gas, and a number of people have made that transition successfully. Next, it was noted that after people are outside of the JSC firewall (into the public sector), they no longer could access much of the workforce transition information that was on the JSC computer system. To address this issue, JSC set up an electronic workforce transition newsletter, published monthly, that takes a segment of the information that is of value to those workers and puts it out in a public forum where even those outside the JSC computer firewall can access information. There have been thousands of hits on that information. Thirdly, JSC has also set up a Shuttle alumni page that allows mentoring and networking among Shuttle populations. This is program-wide, not just at JSC, and is another way that JSC is trying to keep the former and current workforce informed and help people make a successful transition from the Shuttle program.

In terms of civil servants, JSC has redeployed people under the aegis of "highly-impacted." All those employees have now been placed in appropriate new positions that take advantage of their skill sets. Despite public perception, hiring is not zero—the organization is still looking to bring people aboard in specialized areas. In addition, students, co-ops

and “fresh outs” from college are being recruited. JSC is currently under a hiring freeze, but once the headcount falls below the allocation for next year (which is projected to occur at the end of this year), JSC will be able to hire back to the authorized head count level. Major layoffs are most likely over, at least with regard to the Shuttle program. Clearly, however, the federal budget is undergoing transition and there could be further effects from generalized budget reductions. In FY11, almost 2700 people were released from the contractor workforce; so far this year, the number is 67. JSC has performed some best case/worst case analyses, and even in the worst case, Ms. Nguyen indicated that she does not anticipate the number would be more than 900 and most likely much lower. This would be driven by the overall state of the federal budget, not just Shuttle closeout. She observed that the workforce is very mobile and adaptable. Fifty percent of the civil service workforce of three years ago is working on new programs and assignments. The process continues, and JSC is staying in contact with their alumni. As new programs flow back into JSC, many people are still in the commuting area and it is possible they will return.

#### **JSC SAFETY PROGRAM OVERVIEW**

Mr. Frost noted that this discussion centered around the manpower and budget impacts on the SMA program. As others have noted, budget cuts can have adverse impacts, e.g., reduction of oversight and safety assistance programs. The SMA has had a major reduction in its support contractors—from 500 to 267. With Shuttle and other changes, the missions have reduced, but JSC still needs to be very cognizant of this large reduction in capability. There has been a slight increase in the civil service workforce, and in the current environment, it is difficult to fill those positions. Some of the impacts revolve around funding. Specifically, JSC is concerned about funding shortfalls impacting the pressure vessel inspection program, the ability to conduct PRAs, and the fire protection program. One interesting example was the recent grass fire caused by a vehicle propulsion test. Normally, three fire protection personnel would have been on the scene, but because of the budget cuts they only had two. One had to leave for another fire call, leaving only one to fight the grass fire. Luckily, no one was hurt, but there is a penalty when there are budget reductions, and everyone needs to be aware of that. JSC has one of the strongest safety programs in the Agency; it does a good job in both flight safety and industrial safety, but it is facing challenges. The Center appears to be well aware of the challenges, and things are being handled as best as they can be.

#### **NASA LESSONS LEARNED PROGRAM**

Mr. Frost noted that this presentation was in response to an ASAP recommendation concerning use of lessons learned and mishaps. Lessons learned and how to use knowledge is a huge topic. In fact, NASA's primary function is to develop knowledge, e.g., knowledge about the solar system and exploration; however, the ASAP focus is not on this kind of knowledge. There is another kind of knowledge—systems engineering and management knowledge gained on programs that can be used in follow-on programs and by others, including commercial space and even non-space entities. The ASAP interest is in how to capture the lessons learned that support development of safe systems. The Panel tried to carve out a small piece of that and ask targeted questions regarding what is done with what is learned after a major accident happens and with the results of investigations that might take a year or more. The ASAP has strongly complemented NASA on its excellent accident investigation process. The Panel sees good investigations and recommendations; however, when ASAP has checked on these in the past (over a six-year period), it has found that in many cases, nothing formal was done with the recommendation. The ASAP question is: how is the young engineer going to learn from this when he/she gets the job of designing the next spacecraft? The ASAP targeted another mishap that had a good, detailed investigation—the Orbiting Carbon Observatory (OCO). It had a dozen recommendations, many of which looked like the kind of thing that should be codified—put into a standard, a database, or a handbook—so that future designers would know about it. That triggered a good discussion on the broader lessons learned question. Mr. Ryschkewitsch pointed out that NASA's program is based on the 1990's technology, and his office is launching several efforts to bring this up to modern technology that will incorporate things like Google Search, not require key words, and be much more intelligent. NASA is planning a seminar where experts in the field will discuss a good way to do this. The ASAP would like to follow-up on the results of that seminar and what was learned there. On the specific OCO recommendations, there is not much evidence that the recommendations have been implemented in any specific way. At this meeting, NASA took an action item/task to go back and look at several of the recent Class A mishaps and determine which of the recommendations truly are of the type that should be implemented through a standard. NASA will respond to the ASAP with its assessment on how widespread this problem is, and if it is widespread, develop countermeasures to improve the system. The ASAP believes that there is a target-rich environment and is gratified that NASA is working it.

Mr. Marshall added that when looking at an accident, it is not an easy task to simply identify issues and concerns, particularly if it involves contractual agreements and contractor performance. There are things that can be inhibiting,



e.g., proprietary data, the Privacy Act, the International Traffic in Arms Regulation (ITAR), etc. It is a more complex issue that simply doing a fault analysis or lessons learned and putting the findings into a data base. It must accommodate all these issues in a manner such that the young engineer can have accessibility to lessons learned to avoid repeats in the future. This is an effort that is still underway and is making progress.

Dr. McErlean thanked JSC for hosting meeting and the presenters for their time and effort to put the briefings together that led to excellent discussions.

VADM Dyer offered some additional comments. He thanked Dr. McErlean for chairing this meeting. He stated that it was interesting to listen to the Panel, and he continued to be impressed with their knowledge and dedication. He expressed his appreciation to each member of the Panel for his or her service.

VADM Dyer observed that over the last several meetings, he has been struck by the fact that progress is being made both in terms of programs and process. He has known the Administrator, Mr. Charles Bolden, for many years. The Panel is starting to see the effects of good leadership, constancy of purpose, and steady pull. He said that he was also encouraged by the Panel's working visits to both Space X and Orbital within last month, and there is progress there. SpaceX is communicating more openly with greater transparency. Its production facility has greatly matured; its energy and innovation is exciting and infectious. The visit to Orbital was very interesting. Orbital is a company that is both experienced and innovative. It has deep knowledge from having launched over 1000 satellites and vehicles for both commercial entities and the government. As the Panel pointed out during this meeting, the concern is the budget. One might ask: Why is the safety panel concerned about finances and budget? It is because schedule and resources precipitate safety one way or the other. If one is short on the money necessary to do job, one starts to see pressures across the board in the wrong direction. One would like to say more about the shortage of resources, but there is not yet a solid estimate on what it will cost to deliver on America's space future. If one doesn't have a solid cost estimate, then one can't speak with confidence to the Congress on what resources are necessary to succeed. VADM Dyer stated that he feels good about many things, but not about the budget direction. He indicated that he is well aware of the tenor of the times, and he understands the shortfalls and deficits that our government faces; however, if America wants a solid space program, it must be a priority and must be paid for.

There were no further comments. Dr. McErlean thanked everyone and adjourned the meeting at 1:25 pm.