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

August 7, 2014

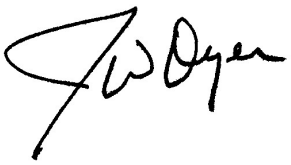
Mr. Charles F. Bolden, Jr.
Administrator
National Aeronautics and Space Administration
Washington, DC 20546

Dear Mr. Bolden:

The Aerospace Safety Advisory Panel (ASAP) held its 2014 Third Quarterly Meeting at NASA Headquarters, Washington, DC, on July 22-24, 2014. We greatly appreciate the participation and support that was received from the subject matter experts and support staff.

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

Sincerely,



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

Enclosure

AEROSPACE SAFETY ADVISORY PANEL
Public Meeting
July 24, 2014
NASA Headquarters
Washington, DC

2014 Third Quarterly Meeting Report

Aerospace Safety Advisory Panel (ASAP) Attendees
VADM (Ret.) Joseph Dyer (Chair)
Dr. Patricia Sanders
The Hon. Claude Bolton
CAPT (Ret.) Robert Conway
Mr. John Frost
Dr. George Nield
Dr. James Bagian (via telecon)
Dr. Donald McErlean

ASAP Staff and Support Personnel Attendees
Ms. Harmony Myers, ASAP Executive Director
Ms. Marian Norris, ASAP Administrative Officer
Ms. Paula Burnett Frankel, Technical Writer/Editor

NASA Attendees:
Grey Hautaluoma
Evette Whatley

Other Attendees:

Caryn Schenewerk	SpaceX
Stephanie Bednarek	SpaceX

Telecon Attendees:

Melanie Chan	NASA
James Dean	*Florida Today*
Dan Leone	*SpaceNews*
Lynne Loewy	NASA OSMA

Opening Remarks
The ASAP Chair, VADM Joseph Dyer, called the meeting to order at 2:00 p.m. After introducing Panel members and support staff, he reviewed the agenda topics. He noted that Dr. Donald McErlean had participated in the fact-finding sessions over the three days, but was unable to stay for the public meeting.

International Space Station (ISS) Update – reported by Dr. Patricia Sanders
The ASAP discussed ISS schedules, anomalies, and challenges with the ISS Program Manager, Mr. Mike Suffredini. He covered the Orbital flight engine fire and how the recent Orb-2 flight decision was made in light of this incident. The ASAP noted that the commercial resupply program has succeeded reasonable well, but the vehicles remain immature and attention must still be paid to the issues that arise in each flight. Based on the update provided by Mr. Suffredini, it does appear that the commercial providers are being open and transparent as they work to resolve the anomalies. However, the ASAP noted with some concern that despite the successful resupply missions, the commercial providers continue to have schedule slips that are eroding onboard supply margins.

Mr. Suffredini provided information on the upcoming extravehicular activities (EVAs) and the ongoing and planned scientific investigations that average about 300 per increment pair. The near-term initiation of investigations with rodents and the associated management challenges were intriguing. The Panel appreciated a thorough discussion of the ISS Top Program Risk Matrix. While Micrometeoroid and Orbital Debris (MMOD) remains an area of concern, the ASAP noted that the highest risk area is now lack of assured access to ISS. As NASA moves to a future commercial crew provider, there is a question whether there will be a backup capability—either domestic or through the Russian partner—to safely take U.S. astronauts to and from the Station.

The ASAP was impressed with the aggressiveness with which Mr. Suffredini's team addressed anomalies, as exemplified by the Extravehicular Mobility Unit (EMU) incident. The Panel also appreciated the Agency's positive embrace of steps to avoid the "normalization of deviance."

Two topics of consistent interest to the ASAP continue to be ISS life extension and deorbit planning. The Panel is pleased to see the progress being made both in the assessments to support certification for life extension and in the planning for deorbit under both planned and unplanned circumstances. Panel members especially welcomed the news that the ISS partners are on board with the deorbit planning and that a detailed schedule to support that planning should be completed soon. The ASAP also appreciated the role of the Automated Transfer Vehicle (ATV)-5 in learning about shallow angle reentry.

The Panel applauded Mr. Suffredini's successful management of the ISS. He was asked to what that could be attributed and how that effectiveness could be shared with other NASA programs. With his typical modesty, Mr. Suffredini began by attributing success to luck, but the ASAP clearly recognized his team's critical role in attention to detail, constant alertness to risk areas, and responsiveness to emerging challenges. Mr. Suffredini noted the value of multilateral operations and discussed the initiation of system maturation teams—a concept that the Panel appreciated as having the potential to build on ISS lessons learned.

Mr. Claude Bolton commented that the communication among the various programs is very good, and Mr. Suffredini provided excellent insight into the ISS program. With regard to transparency, VADM Dyer added that more detail was provided in the Panel's discussions with Mr. William Gerstenmaier, NASA's Associate Administrator for the Human Exploration and Operations Mission Directorate (HEOMD). Mr. Gerstenmaier noted that a typical space alliance flight will return 13 to 14 small things or "gripes" of relatively little import and somewhere between 1 and 3 anomalies, which are items that are noted for further investigation and are worthy of better understanding. Reflecting the early evolution of their systems, the new providers, SpaceX and Orbital, are experiencing somewhere between 15 to 20 gripes and 3 to 5 anomalies. Mr. Gerstenmaier was very complimentary about both companies regarding their openness and sharing with NASA and the transparency with which they communicate.

Mr. John Frost commented on one success story—the result from a recent MMOD impact on the radiator. This type of MMOD is a known hazard in low Earth orbit (LEO). The impact left a five-inch gap in the radiator. The good news is that that hazard was foreseen by the designers, and the ammonia tubes that run through that radiator were armored. When debris struck the tube, the armor apparently worked—there was no leakage whatsoever. What could have been a major problem turned out to be a minor event.

National Research Council (NRC) Human Spaceflight Committee – reported by Mr. Claude Bolton

Mr. Bolton noted that former Panel member Mr. Bryan O'Connor was part of this study, and he briefed the Panel on this report. The title of the study was *"Pathways to Exploration – Rationales and Approaches for a U.S. Program of Human Space Exploration."* The study has been released and can be found on the National Academies' website.

This study was requested by Congress in the NASA 2010 Authorization Act. The Committee met six times from December 2012 to January 2014. The members visited the NASA human spaceflight Centers, which included Johnson Space Center (JSC), Kennedy Space Center (KSC), and Marshall Space Flight Center (MSFC). They also called for public input; a number of white papers and surveys were done; and representatives of past and current NASA and foreign programs, as well as experts from academia and industry, provided briefings to the Committee. The study was co-chaired by Dr. Mitchell Daniels, Jr. from Purdue University and Dr. Jonathan Lunine from Cornell University. There were about 15 participants on the primary Committee, and many of the members were not the typical members one would normally see on a study of this nature. Most did not have direct experience in human spaceflight. The Committee was asked to consider the goals for human spaceflight; solicit broadly-based, but directed, public and stakeholder input; describe the expected value and value proposition; identify a set of high-priority enduring questions; consider prior studies; examine the relationship of national goals; and provide findings, rationale, prioritized recommendations, and decision rules that could enable and guide future planning for U.S. human space exploration. The report had four chapters: (1) an overview of analyses and findings; (2) why

do we go there? (3) public and stakeholder attitudes; and (4) technical analysis and affordability assessment of human exploration pathways—a topic that is not normally addressed in this type of study. Many studies that are done by the federal government are assessments and rarely do in-depth technical analysis. Some of the findings at the top level were: the rationale for human spaceflight is a mix of the aspirational and the pragmatic; the level of public interest in space exploration is modest relative to other public policy issues; the horizon goal for human space exploration is Mars; a program of human space exploration beyond LEO that satisfies the "pathway principles" is not sustainable with a human spaceflight budget that increases only enough to keep pace with inflation; and with regard to international collaboration, it is evident that U.S. near-term goals for human exploration are not aligned with those of traditional international partners.

As the Committee members went through their deliberations, they looked for an overarching rationale for human spaceflight. They settled on two "enduring questions"—those questions that not only stand the test of time, but also continue to drive the endeavor forward in the face of technological, societal, and economic constraints. The enduring questions motivating human spaceflight are: (1) How far from Earth can human beings go? and (2) What can humans discover and achieve when they get there? The Committee found no single rationale alone that seemed to justify the value of pursuing human spaceflight; however, it cited several pragmatic and aspirational rationales. One of the things that the Committee was tasked to do by Congress concerned value and value proposition. The Committee had some difficulty with this, because those are terms that are used in business endeavors but normally not in government programs. This type of assessment has been attempted over the years, but usually encounters problems because the federal government is not run like a business. That said, the Committee did present in Chapter 2 a novel and detailed analysis of how value propositions might be developed for the publicly-funded U.S. space program by looking at how stakeholders derived benefits and what opportunities would no longer be available if human spaceflight were discontinued.

Approaches to human space exploration were discussed, and the Committee felt that it could not recommend either a capabilities-based or a flexible-path approach, which are approaches where no specific sequence of destinations is specified. Instead, the Committee recommended a "pathways approach" to human space exploration—a specific sequence of intermediate accomplishments and destinations normally of increasing difficulty and complexity leading to an ultimate (horizon) goal with technology fed-forward from one mission to subsequent missions.

Recommendations were broken into the highest priority recommendations and other recommendations. The highest priority recommendations were: (1) the cost, scope, and challenges of human spaceflight beyond LEO demand that a set of a carefully thought-out principles be applied before any pathway is initiated; and (2) NASA should adopt a number of pathway principles, two of which were: commit to design, maintain, and pursue the execution of an exploration pathway beyond LEO toward a clear horizon goal that addresses the enduring questions; and establish exploration pathway characteristics that maximize the overall scientific, cultural, economic, political, and inspirational benefits without sacrificing progress toward the long-term goal. When one reads the list of those characteristics, one is reading systems engineering and the way NASA does business. This validated the way NASA has been operating for years and came from a group that is not steeped in this way of doing business. The Committee put forth some decision rules, which are the rules that should be applied by the Administration, NASA, and Congress when technical, cost, or schedule problems arise.

Other prioritized recommendations include: commit to design, maintain, and pursue the extension of human presence beyond LEO; maintain long-term focus on Mars as a horizon goal; establish and implement the pathway approach versus the capabilities approach; vigorously pursue opportunities for international and commercial collaboration; engage in planning that includes mission requirements and systems architecture. For the latter, the target areas should be entry, descent, and landing for Mars; advanced in-space propulsion and power; and radiation safety.

Mr. Bolton noted that the report is online, and briefings to Congress have already started.

Capabilities Management – reported by Dr. James Bagian

Ms. Lesa Roe, NASA Deputy Associate Administrator and former Langley Research Center Director, updated the ASAP on the Technology Capability Assessment. The purpose of the Assessment is to establish a more efficient operating model that maintains critical capabilities and meets current and future mission needs. One of the challenges is to integrate the critical capabilities in a way that avoids unnecessary duplication and takes advantages of the synergies that already exist. NASA has looked at business skills—program planning, contracting, human resources—as well as technical skills; however, the Panel heard primarily about technical aspects of the process, specifically, how to make best use of skill sets across the Agency for current and future needs.

Competition issues usually arise in large organizations. Competition is healthy, but NASA does not want some Centers or groups working to the disadvantage of others. The focus should be on the goal that the Agency is trying to achieve. Ms. Roe described how they looked at the technical requirements. At this point, the budgeting process has not been refined to allow the infrastructure to be healthy as well as to be flexible. The key question is: How does NASA get the best use from the resources that are available? Ms. Roe discussed how NASA is looking at matching capabilities to Agency goals. This assessment has already had some impact on Aircraft Operations. One of the biggest issues is how to communicate with people. Transparency is very important. All sides need to understand the various capabilities at the different Centers across NASA and how resources can be utilized most effectively and efficiently. It is important that people do not inaccurately and inappropriately perceive capabilities management. NASA is an archetypical matrix-management organization. The intent is to have better alignment with roadmaps and identify gaps and needs. To date, they have formed a Capability Steering Committee, chaired by Ms. Roe, to work through the issues and queue up decisions for the NASA Council. There is an internal employee website for transparency of process and decisions. NASA Council decisions have already been made on Aircraft Operations, as well as Microgravity Flight Services, Balloon Services, and Life Sciences. The ASAP recognized that there will be considerable learning that goes along with this assessment. Dr. Bagian complimented Ms. Roe and her team on this approach.

Mr. Bolton noted that they also talked about change management, and the ASAP offered some thoughts that have been used in the Department of Defense. The elements of change management include a vision, a plan, resources, skills, and most importantly, incentives. All of that must be communicated constantly to be successful. This is important work and will yield large dividends for NASA in the future.

VADM Dyer added that one of the telltale indicators of success is when people talk about being members of the large enterprise rather than their individual Centers or disciplines. This is a dramatic shift, and if successfully accomplished, leads to increased effectiveness and efficiencies.

Exploration Systems Development (ESD) Update and ESD Risk Acceptance – reported by Mr. John Frost

The ASAP congratulated Mr. Bill Hill on his recent permanent appointment as Associate Administrator for Exploration Systems Development in HEOMD. Currently, everything is focused on Exploration Flight Test (EFT)-1, presently scheduled for November/December 2014. This flight will give us the first flight and reentry data for Orion. It will be uncrewed and will have a different launch vehicle than the Space Launch System (SLS); however, it will answer many questions about Orion, especially those concerning the heat shield and the reentry characteristics. The flight will be a key engineering test. The real learning mission is the nearly flight-like Exploration Mission (EM)-1, currently scheduled for December 2017. It is budget limited, but the Program will do the best they can with the budget that is available. The ASAP examined the top risks for the overall Program. None of the top risks are safety related; the primary program risks are budget related. One of the top risks has been Orion mass, and the team has worked hard on that issue and has brought the mass down as much as is economically feasible. They are still about 2900 pounds overweight. The good news is that a change to the upper stage engine will provide some extra thrust that will handle the extra weight. The ASAP reviewed a number of Program accomplishments. They have recently mated the crew module to the service module for EFT-1. They have completed a subscale testing of launch acoustic effects. The testing found some coupling that had not been expected that could have caused a problem, but it is fixable. This finding points out the importance of a robust test program to reveal problems early and fix them.

Mr. Paul McConnaughy discussed the systems integration issues. In the past, the ASAP has raised questions about the difficulty in integrating such a complex program at the NASA Headquarters level without a prime contractor. There have been a number of organizational and personnel changes to address the issue. The good news is that they brought in the NASA Engineering and Safety Center (NESC) to review what has been done, and the NESC had positive comments. In addition, the Program has briefed the systems integration processes to a senior advisory group that also had positive feedback. The Panel is pleased to see the attention to this issue, but believes that this is still an area that needs to be watched very carefully.

The Panel looked at some examples of system level requirements. One of them was the probability of being able to launch in a given launch window. Currently, they have a 120-day requirement between launches, which is driven by the need to support a far-horizon goal of a Mars campaign. The Panel raised the issue of how slow they can go. Everyone recognizes that safety issues can be induced with a fast launch rate; however, if the launch rate is too slow, people skills, processes, and equipment can degrade. Generally, there is an optimum launch rate with some limits on "too fast" or "too slow." The Program has considered this conceptually and has some ideas on how slow is too slow. The ASAP encouraged the Program to pursue this question and determine what the boundaries are. Budget limits will put pressure on launch rates. One thing that may help the launch rate is the growing interest by the science community in using the SLS for science missions. One possibility that has arisen is the Europa mission. Missions like this can help fill the gaps and provide a safe and cost-efficient launch rate beyond a human mission to Mars.

There was a healthy discussion about the current plans to fly the first crewed mission, EM-2, with some portion of the life support system on that mission as a first flight. Ideally, this is not how one would want to do the mission, but this approach is driven by the budget. The Program has clearly recognized the potential risks and has developed a concept for ground testing, ISS testing, and other extensive testing. All eyes are on this, and if it does not work as planned, they are prepared to take action to correct it. This is another area that needs to be watched very carefully. A similar issue is the current plan to fly the first crewed mission with the first flight of the newly designed upper stage. The upper stage contains heritage hardware that has been around a long time. It will utilize four RL-10C engines, which have been flying since 1962. However, a number of tests and analyses need to be completed to gain confidence for a first crewed flight. They have a rigorous schedule ahead of them, and the Panel looks forward to watching the Program implement these plans.

VADM Dyer agreed with Mr. Hill's observation that the challenges in the upper right corner of the risk matrix are budget, but as already indicated, sometimes safety and technical challenges can be budget driven.

Commercial Crew - Dr. George Nield

Ms. Kathy Lueders, Program Manager for the Commercial Crew Program (CCP), discussed the latest Program status with the Panel. There has been considerable progress recently. The Certification Products Contract (CPC) was closed out at the end of May. They concluded that there has been a huge benefit in articulating exactly what NASA is requesting from the partners and how the Agency will be evaluating the progress that the partners make. They are finishing up phase 2 of the Commercial Crew Integrated Capability (CCiCap) Space Act Agreement (SAA). Boeing has completed its Critical Design Review (CDR) and the phase 2 Safety Review Board. Space X has completed its integrated crew vehicle CDR, and its operations CDR is coming up in August. SpaceX also has a pad abort test and an in-flight abort test that are on the calendar over the next 6 months. Sierra Nevada Corporation (SNC) has finished wind tunnel testing and conducted some main propulsion system and reaction control system tests. SNA has also baselined a new propulsion system design (a pure liquid system design rather than a hybrid) in conjunction with their purchase of ORBITEC. The next major program milestone is award of one or more Commercial Crew Transportation Capability (CCtCap) contracts. This milestone is on track for the August/September 2014 timeframe. Because NASA is in the midst of the source selection process, Ms. Lueders was unable to go into detail about the proposals; however, she did express NASA's desire to continue the partnerships even after the announcement, including with companies not selected. People are recognizing the value of competition and have an appreciation for shared knowledge. NASA has learned from the companies and the companies have learned from NASA. It would be a big plus to continue the relationships.

In terms of activity on the government side, the Program has begun discussions with the FCC and other agencies on spectrum usage from a commercial crew mission. They have also established a Launch and Entry Steering Group, consisting of NASA, the Air Force, and FAA, to develop a consist policy for crew safety, range safety, and public safety issues on human spaceflight missions to LEO.

Ms. Lueders also responded to a recent ASAP question on how dissenting opinions are handled. As she described it, board members have three choices to make on a decision or critical issue: agree, disagree but with a willingness to fully support the decision, or disagree and raise a dissenting opinion. This has been a key interest area for the ASAP. It is very important to understand how dissent is handled and the steps that take place after there is a dissent. In the case of dissent, Ms. Lueders confirmed that the Program would follow up with the members' management and then take that dissenting opinion to the next higher authority. The ASAP believes that it is important to have a good understanding of the process and to document it so that everyone understands what the process is supposed to be. The ASAP is seeing progress in this area, although this is a key issue that people have struggled with on various programs.

The ASAP looks forward to the CCtCap selection announcements in the next few months and will be discussing that at its next quarterly meeting.

Mr. Frost noted that the ASAP has tracked the risk acceptance decision process and Technical Authority implementation for at least the last five years. The situation where there was a non-concurrence but the decision was accepted has been resolved. The deeper issue was when the risk was accepted via a memo from the Contracting Officer that stated that everyone accepted it, but no one actually signed for the risk acceptance. The ASAP members have seen huge benefits to a rigorous, formal process that puts an individual's name on the decision to accept the risk. The paperwork that the ASAP sees indicates that this will happen, but the Panel continues to see risk accepted at committee or board meetings. The Panel has a current open recommendation on this issue, and it needs to be driven to completion.

VADM Dyer added that everyone is eager to see the results of the CCtCap decision. The Panel has emphasized the important of competition and hopes that NASA can maintain it in the next phase.

Aircraft Management – CAPT Robert Conway

The Panel received a very comprehensive overview of aircraft management from Mr. Jamal Abbed, NASA's Aircraft Management Division Aviation Safety Officer, and it was noted by CAPT Conway that it has been quite a while since the ASAP had received a brief on the Aircraft Management Division. The NASA Aircraft Office supports all mission directorates—Human Exploration, Science Research, Aeronautics Research, and Space Technology. They also have worldwide operational capabilities. There are seven main NASA locations in the U.S. from which aircraft fly; the largest concentrations are at Armstrong Flight Research Center and JSC. The authority under which the aircraft operate was noted, and Mr. Abbed specifically discussed the oversight by the Inter-Center Aircraft Operations Panel (IAOP), which includes several subpanels and groups: the Aircraft Advisory Council, the Maintenance Subpanel, the Aviation Safety Subpanel, and the Unmanned Aircraft System (UAS) Working Group. It was interesting to note that NASA does not operate under FAA rules (they are exempt from those) unless NASA aircraft are flying in the national air space. There is some contract work with commercial air services, but those flying NASA missions under contract are subject to the NASA policies on air operations, maintenance standards, airworthiness, and flight readiness. Commercial air services are now being used frequently and are forecasted to increase in the future. They are mainly centered today on microgravity research and high water ice content research.

Flight hours have been decreasing, mainly due to reductions in the astronaut corps and termination of the Shuttle Program, and it was understandable that the bulk of the reduced flight hours were attributed to astronaut training. It was also interesting to the ASAP to learn that while flight training includes pilot training, as many assume, it also includes training that is critical to space crew aeronautical adaptation and performance in highly dynamic environments.

The IAOP is an extremely effective organization in maintaining oversight and can be considered a best practice for the organization itself as well as in its business practices. It is a great check and balance that enables maximum adherence to operational and maintenance standards. The IAOP was established in August 1978 with its members representing the various flight locations at NASA Centers. They meet as a panel twice per year to discuss issues and provide advice to senior leadership based on the flight Center audits that have taken place. The IAOP conducts audits on each flight Center every two years, and those audits are very thorough. CAPT Conway noted from first-hand experience at one of the audits that these are formal peer reviews and do not represent a "good old boy" network. He noted that it was very professional, in-depth, and thorough. It covered the full gamut of aircraft operations and maintenance. An example of the objectivity and thoroughness of an IAOP audit was one from 2013, where Armstrong Flight Research Center was recommended not to fly until they could address some major non-conformities. The professionalism of the Armstrong team enabled a timely return to flight.

The NASA Aircraft Management Information System (NAMIS), a NASA-built system, is an important management system that is mandated by NASA policy for use at all Centers for flight scheduling, aircraft maintenance, aircraft configuration, crew qualifications/proficiency/currency, aircraft parts and inventory management, post-flight feedback, and other reporting. What the ASAP finds troubling is inconsistent funding for NAMIS, which is under increasing pressure. When not fully funded, the system has been saved thus far through supplemental funding from other areas, mostly from JSC's Operation and Maintenance (O&M) funds. However, the loss of funding will create significant safety risks if this system or if NASA software engineers are reduced or eliminated.

The Panel discussed safety surveys and climate and culture assessments. CAPT Conway noted that in his experience in naval aviation and safety, climate and culture were two of the most important things in aviation safety. The NASA survey addressed six key areas: safety climate and culture, safety management and supervision, organizational effectiveness, safety information dissemination, workload and fatigue, and maintenance operations. There have been three surveys to date—in 2009, 2011, and 2013. Important information can be gleaned from this already, but as time goes on, trending and data mining will improve. This is a very encouraging practice and is similar to DoD approaches that have proved very successful.

Mr. Abbed also discussed the Safety Management System (SMS), which has been commended by the International Business Aviation Council. The SMS is a systematic approach for managing safety that includes the necessary organizational structures, accountabilities, policies, and procedures. NASA was one of the first federal agencies to adopt it. They have been Stage II qualified and are on track to become Stage III qualified this December. The Aircraft Division has won multiple awards over the past years; since 2005, there has been an individual and/or Center organization award every year.

CAPT Conway noted that NASA has not had any Type A aviation mishaps for a long time. There have been a few Type Bs, but most of the mishaps have been Type Cs and Ds. Ground operations lead the pack on the smaller mishaps, with most of the flight mishaps involving bird strikes.

CAPT Conway concluded his remarks by saying that NAMIS funding is the top risk, and the ASAP will continue to monitor this area. Other risks include oversight and management of commercial services and oversight of UAS. Most of the risks that Mr. Abbed noted were safety risks, but based on the Panel's observations, NASA is well-equipped and positioned to take these on as long as it has the budget to do so.

Mr. Bolton added that while there are only 72 aircraft, many of those aircraft are unique or experimental. Operating safely year in and year out is a noteworthy accomplishment.

Budget Trends – Mr. Claude Bolton

The Panel had a very good briefing and discussion with Mr. Andrew Hunter, NASA's Deputy Chief Financial Officer. He covered several areas, including the federal budget context, NASA's current budget, account comparisons, buying power, and information requested by the ASAP on robotics and Safety and Mission Assurance (SMA).

Uncertainty has been the watchword on the budget. There is "churning" inside NASA over every budget change. On the FY15 budget to date, there has been a low of $16.12 billion (B) (reflecting worst case sequestration) to a high of $17.9B (the recent Senate mark)—an uncertainty swing of about $1.8B. The staff has been doing a good job in keeping up with this. There may be some good news—in looking at budget trends and the deficit, the economic outlooks are good. The big "gorilla" is the national debt, which is about $17 trillion plus and growing—about 4.5 times what the federal government spends every year. That situation will eventually cause problems not only for NASA but for the entire federal government.

The ASAP looked at how the FY15 budget will be apportioned in the Agency and took a closer look at the portion entitled "Cross Agency Support" (CAS). CAS includes SMA. The Panel has been concerned over how the budget cuts to CAS have impacted SMA. Of particular concern was the fact that many stakeholders have not realized that safety was included in that account. The ASAP was told that the CAS account title was confusing to most, that the title has been changed by the House in its FY15 mark, and that NASA will change the title in its FY16 budget submit. The new title will be "Safety, Security, and Mission Success." Hopefully, when people see that, they will at least look deeper into the budget detail to see what is there.

At the top level, the NASA budget has been stable (flat) since FY12; however, there have been ups and downs in several areas, such as Commercial Crew, the James Webb Space Telescope (JWST), and Space Operations (due to Shuttle termination). ISS is going up slightly. CAS has been up and down. Education is going down. There is concern about all of these.

Mr. Hunter discussed "buying power." There is nothing unique here for NASA—over the years, it has gone down.

The Panel received some good answers on SMA and robotics. The ASAP asked Mr. Hunter to take another look at the budget trends for robotics funding in crewed and uncrewed aircraft.

Mr. Bolton noted that this was one of the better briefings that the Panel has gotten on the budget subject. It was complete, comprehensive, and understandable.

VADM Dyer commented on the capabilities-based approach for the SLS and the budget. The out-year budget planned during the years of Constellation was projected to be around $20B per year. We are now seeing a NASA budget that is running fairly constant at about $17B year, but is not staying current with inflation. The $17.4B in FY 2014 is reduced in a very few years to $16B in buying power in 2014 dollars. This has led NASA to a strategy that is called "capabilities-based." It is easier to talk about what it is not rather than what it is. Capabilities-based has to do with building the pieces of a system that is necessary to explore space beyond LEO, i.e., building equipment with the flexibility to undertake multiple and varied missions. What it is not is a grand goal to be accomplished on a specific schedule. It lacks the focus and the crispness of the planning and the budget that goes with that, but it does build capability that is growing and is sustainable with the budget that is available. This strategy should also bridge a transition between administrations. This strategy is less than one might want it to be, but it is pragmatic, realistic, and it flows from the budget challenges that Mr. Bolton addressed.

VADM Dyer joined Mr. Bolton in applauding Mr. Hunter's briefing on the budget. He remarked that it was the best budget briefing that he has received since he has been on the ASAP. It was not just a presentation of the numbers, but it included analysis and trending and was very informative.

There were no other comments or questions. VADM thanked the Panel members and attendees and adjourned the meeting at 3:17 pm.