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

February 24, 2015

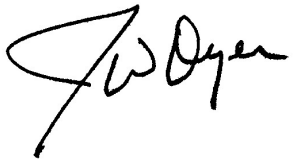
Mr. Charles F. Bolden, Jr.
Administrator
National Aeronautics and Space Administration
Washington, DC 20546

Dear Mr. Bolden:

The Aerospace Safety Advisory Panel (ASAP) held its 2015 First Quarterly Meeting at Kennedy Space Center, Cape Canaveral, Florida, on February 9-11, 2015. 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 the public meeting for your consideration.

Sincerely,



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

Enclosure

AEROSPACE SAFETY ADVISORY PANEL
Public Meeting
February 11, 2015
Kennedy Space Center (KSC)
Cape Canaveral, Florida

2015 First 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
Mr. Brent Jett
Dr. George Nield
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, Writer/Editor

NASA Attendees:

Boutin, Rick	NASA/KSC
Braden, Barry	NASA/KSC
Chandler, Meredith	NASA/KSC
Eggert, Julie	NASA OIG
Gordon, Mark	NASA/KSC
Hill, Linda	NASA/KSC
Martin, Dawn	NASA/KSC
McMillan, Billy	NASA/KSC
Nguyen, Hung M.	NASA/KSC
Nguyen, Johnny	NASA/KSC
Philman, Amber	NASA/KSC
Stover, Billy	NASA/KSC

Telecon Attendees:

Atkinson, Loretta	NASA
Condes, Al	NASA
Cunningham, Mark	Ares Corp.
Mannion, Sashka	NASA OIG
Marel, Fil	*[private]*
Mayberry, Noreen	NASA
Rausch, Diane	NASA HQ
Riggenbach, Scott	NASA
Serafini, Samuel	NASA HQ
Thompson, Christina	Northrup Grumman
Wilson, Rebecca	NASA

Other Attendees:

Dean, James	*Florida Today*

Opening Remarks

The Aerospace Safety Advisory Panel (ASAP) Chair, VADM Joseph Dyer, called the public meeting to order at 1:00 p.m. and welcomed attendees. He noted that the Panel had just concluded its first quarterly fact-finding meeting, February 9-10, 2015, at Kennedy Space Center (KSC), Cape Canaveral, Florida. Dr. James Bagian was not present at this public meeting due to travel conflicts, but did participate in the fact-finding sessions over the past two days. Dr. Donald McErlean also attended the fact-finding sessions and part of this public meeting, but departed early to catch a flight. Because of some constraints that would be imposed on his business as an aerospace consultant, Mr. Brent Jett, who recently joined the Panel, recused himself from any information and discussion related to the commercial space program that is not publically available.

This the first meeting since the Panel published its 2014 Annual Report to the NASA Administrator, the Congress, and the public. In the Report, the Panel noted that constraints to the flow of information precluded the Panel's ability to speak to the adequacy of the commercial crew certification process and the sufficiency of safety. The NASA Administrator, Mr. Charles Bolden, committed to correct this situation, and the Panel has been seeing significant improvement in the openness and transparency associated with commercial crew. Specifically, the Panel commended the efforts of the Commercial Crew Program (CCP) Manager, Ms. Kathy Lueders, in this regard.

The fact-finding agenda included an update on KSC from Mr. Robert Cabana, KSC Center Director. He noted that morale is continuing to improve, and the Panel observed that as well. This is particularly impressive, because the workforce is down 43 percent from its peak at the Space Shuttle Program's most energetic point. Facilities have been reduced by some 28 percent, and the cost of doing business is down about 30 percent. All this has been achieved as KSC is evolving to become a genuine multiuser spaceport. The Space Launch System (SLS) is a matter of pride throughout the Agency and particularly here at KSC. It is the rocket that will carry humans to deeper into the solar system. It will launch from KSC, which will be the gateway to Mars. The Panel also noted the close cooperation between KSC and Johnson Space Center (JSC) on SLS.

Space Technology Mission Directorate and the Mars Story

Dr. McErlean reported on the Panel's review of the Space Technology Mission Directorate (STMD) programs with the Deputy Associate Administrator (AA) for Programs, Dr. James Reuther. It was an extremely interesting and valuable presentation that covered a number of new technology projects oriented against several objectives. The technology program is working on enabling a new class of NASA missions—those that go beyond low-Earth orbit (LEO) to deliver innovative solutions—not only from the NASA workforce, but from academia, industry and small business, other government agencies, and the broader aerospace enterprise. They are developing technologies and capabilities that will make NASA's missions more affordable and reliable, encouraging investments in the space economy by working to create markets and spurring innovation, and trying very hard to engage the brightest minds from all of those enterprises and focus them on solutions to NASA's mission problems. They have created a "slogan:" go there (to improve the Nation's capabilities for access to and travel through space), land there (to enable landing more mass more accurately throughout the solar system), live there (perhaps to spend a year or longer in place before coming back), observe there (to transform the ability to observe the universe and answer science questions), and invest here (to improve the Nation's aerospace capabilities and leadership). They have done a remarkable job of sorting through a long list of things one might do and have down-selected using their own technical resources as well as referencing other sources such as the National Research Council (NRC).

STMD has focused the program into eight thrust areas: high power solar electric propulsion (SEP), which is extremely important for Mars and the Asteroid Retrieval Mission (ARM); space optical communications to improve bandwidth and higher resolution speeds; advanced life support and resource utilization (*in situ*); Mars Entry, Descent and Landing (EDL) systems, which can be applicable to other atmospheric reentry capabilities; space robotics systems (humanoid in nature and capable of working with humans); lightweight space structures, such as space habitation modules and planetary habitats; deep space navigation, enabling more capable science and human exploration; and space observatory systems, which would allow for significant gains in science capabilities. They have put together a technology pathway to Mars as one possible application of these technologies, covering everything from SEP through optical communications, life support, and structures on the surface. They are also working on new thermal protection systems for interplanetary reentry speeds. The Directorate

noted that high-power SEP, a critical technology, has a wide variety of applications. The technology group is taking today's state-of-the-art and stepping it up several orders of magnitude in terms of the amount of thrust produced, even perhaps high enough to serve as a propulsion system for crewed vehicles. Another interesting item of technology investment is putting an atomic clock into medium space to help coordinate message traffic and navigation in the interplanetary regions. Additionally, in the Panel's discussions, Dr. Reuther talked about decelerators. This is a technologically complex problem, because there are always at least two problems with deceleration when one enters a region of denser atmosphere: heat dissipation and speed reduction. One interesting example of this work is STMD's project for a decelerator that would deliver mass from the International Space Station (ISS) to the surface of Earth without a retro-rocket or a capsule; in other words, an "inter-space parachute." Finally, Dr. Reuther discussed his Directorate's work on decelerators for low-density atmospheres. Parachute decelerators designed for a Mars landing would be considerably different than those designed for Earth. The Mars atmosphere is not dense when compared with Earth's, but it is sufficiently dense to cause heating upon entry. A Martian atmospheric decelerator would have to be capable of providing a deceleration force within a low-density atmosphere.

The ASAP made one observation: the Panel is looking for linkages between the technology work and the systems work. It will continue to explore for such linkages and also plans to examine other technology organizations within NASA to determine the level of coordination between the technology developers and the systems developers to ensure that the technologies being developed are those that are, as a minimum, required by the systems. Overall, it was a very good presentation and discussion. STMD has an interesting portfolio of work.

VADM Dyer commented that it was interesting to note how the character of the Panel meetings has changed over time. A few years ago, the Panel talked primarily about the Space Shuttle; it has been engaged with commercial cargo and commercial crew for last few years; now, there are more discussions about the pathway to Mars.

Human Research Program and Path to Risk Reduction (the "Mars Chart")

The Honorable Claude Bolton reported on the Panel's discussions with Mr. Steve Davison, who provided the ASAP with information on a variety of research efforts underway in NASA to identify, address, and mitigate risks to human space flight, particularly those related to space flight to Mars. The Human Research Program (HRP) has developed an integrated path toward reducing these risks, which shows risk mitigation over time. Mr. Davison provided a color-coded timeline that, at one glance, gives one an idea of where they are going, what the risk areas are, and the mitigations going forward. Along those lines, about 30 risks have been identified with details and schedules. Some of those risks were highlighted by a study by the National Academies Institute of Medicine (IOM) in 2006. The title of the study was "Human Exploration of Space." Mr. Davison referred to a quote from the report that supports everything that NASA is doing: "Human space flight remains an endeavor with substantial risks, and these risks must be identified, managed, and mitigated appropriately to achieve the Nation's goals in space." From what the Panel was told by Mr. Davison, this is what the HRP is all about and validates what they are doing. At the top level, the goal is to enable successful space exploration by minimizing the risks of space flight hazards by identifying space flight/design reference missions, hazards, evidence, risks, standards, and mitigations. Mr. Davison stated that the Human System Risk Board (HSRB) has identified 30 human space flight health risks in five areas: altered gravity field, radiation, distance from Earth, isolation, and hostile/closed environment-spacecraft design. Mr. Davison discussed the HRP mission, goals, and program approach. He stated that the efforts of the HRP are integrated and coordinated with Advanced Exploration Systems (AES), the ISS Program, Orion, STMD, space biology, the

Science Mission Directorate (SMD), and Crew Health and Safety (ISS medical operations). Mr. Davison described how the HRP has used a program architecture to achieve its vision, mission, and goals. That structure is: evidence, risks, gaps, tasks, and deliverables. The several charts that illustrated this architecture were helpful to the ASAP's understanding of the HRP benefits as well as identifying a possible shortfall: there appeared to be minimal linkage to the operational/program side of NASA that would benefit from many of the technical risk reduction efforts underway by the HRP for the Mars endeavor. This same shortfall was observed in the STMD briefing. It would be helpful, both inside and outside NASA, to see these various NASA organizations aligned and linked in one "picture" or vision. Given the increased focus on the Mars mission, this may be the right time to do that.

Most of the 30 risks will be mitigated by performing tasks on the ISS. It is a unique platform for performing these types of tasks. One of those projects involves two astronauts—the Kelly twins. One of the twins, Astronaut Scott Kelly, will be onboard the ISS for a year, and the other twin, retired Astronaut Mike Kelly, will be on the ground. It will be a unique opportunity to study identical twins and what changes, if any, occur. This again points out unique capability of the ISS that will help NASA and the international partners in their journey deeper into space.

Overall, it was a very informative briefing and very much appreciated by the Panel.

Mr. John Frost added a reminder, a compliment, and a suggestion. The reminder was about the critical importance of Station in resolving health risks. Of the 30 health risk categories that have been identified as critical for going to Mars, 24 of those require the ISS to resolve. He stated that we need to put that in the forefront on the purpose for the Station. It has many uses, but this use is critical to human exploration of space. The compliment concerned the progress of the health personnel. They have divided the categories of health risks into 30 clear channels, have committed to establishing standards for what the safe exposure levels will be in all channels, and have a road map to get there. The suggestion is a nomenclature item. The community working the health issues characterizes these risks as either "not yet accepted risks" or "accepted risks." NASA rightfully has a very organized method for programs accepting risks and this is not part of that method. What they really meant by "accepted risk" is that the risk will "meet the standard." Those are slightly different words, and the Panel encourages them to use the nomenclature that the rest of the risk acceptance community within NASA uses.

Software Assurance and Capability Maturity Model Integration Requirements

Dr. Patricia Sanders reported on the Panel's discussion with Mr. James Shaver, the software engineering Technical Authority (TA) at KSC, who provided the Panel with an update on KSC's progress towards Capability Maturity Model Integration Requirements (CMMI) Level 3 maturity. NASA's Software Engineering Requirements proscribe that a project manager shall acquire, develop, and maintain software from an organization with a non-expired CMMI-development rating of Level 3 or higher for Class A software. The CMMI model is used to ensure that NASA projects are supported with the necessary skills and processes to produce reliable and safe products within cost and schedule. By CMMI rules, a Standard CMMI Appraisal Method for Process Improvement (SCAMPI) must be performed and updated (and passed) every three years. All of NASA's Centers except KSC are staying on top of their assessments.

Software for Ground Systems Development and Operations (GSDO) at KSC is considered Class A and is among NASA's top projects with respect to software criticality, and yet it has struggled to achieve a Level 3 rating. The ASAP has followed their status for nearly three years and is disappointed in their failure to date to meet that benchmark. In fact, the Panel is dismayed at the seeming lack of focus and

sense of urgency to meet this requirement. A SCAMPI A is scheduled for June 2015, but it is not clear that the project will be ready to succeed by that date. A SCAMPI B—somewhat of a "dry run"—is planned in March 2015. The SCAMPI B should indicate probability of readiness. The ASAP continues to strongly urge that KSC focus on improving software assurance on this critical project. Dr. Sanders indicated that the Panel's ongoing recommendation on this topic will remain open and the Panel will continue to monitor.

VADM Dyer added that those of the Panel who have been deeply associated with systems integration have special feelings about CMMI. He noted that his "shorthand definition" is that you really don't have to learn everything yourself—you can take advantage of a broad pocket of knowledge throughout the community. That, along with peer review at the community level, is something that CMMI brings to the party. The ASAP feels strongly that it needs leadership attention, good energy, and significant progress going forward.

Shuttle Landing Facility

Mr. Brent Jett reported on the Panel's discussions with Mr. Trey Carlson, KSC's Master Planner. The Panel had inquired into the status of the NASA Shuttle Landing Facility (SLF) partnership with Space Florida that was announced about a year and a half ago. Mr. Carlson provided information for the Panel to review and was available to answer questions. Mr. Jett noted that in his days as an astronaut, he spent many hours at the SLF, training to land the Space Shuttle as well as hundreds of T-38 take-offs and landings. On each of his Shuttle missions he landed back at the SLF, which was important not only for the Program, but for the families waiting at KSC. On a personal note, it was nice to hear about the partnership with Space Florida that will transform the SLF into a vibrant and commercial spaceport.

The negotiations between NASA and Space Florida on the details of the final agreement are nearly complete. NASA expects to have that document finalized and the facility turned over to Space Florida in the very near future. This was KSC's first facility partnership effort. When dealing with two government agencies, things take more time. Although it has taken over a year and a half, the delay has been through no lack of effort or diligence by either party. The people at KSC deserve a lot of credit for the planning, preparation, and hard work that has gotten them this far with the SLF. As early as 2004, KSC began the process to answer the question: What do we do with the SLF once the Space Shuttle Program is over? From 2004 to 2011, they sent out multiple Requests for Information (RFIs) to gauge the amount of commercial interest for the SLF. A key event occurred in June 2012—NASA released the decision memo that concluded there was no NASA requirement for the SLF. That led directly to the competition that selected Space Florida to operate and manage the SLF complex for a diverse base of both government and commercial users. Use will be primarily for horizontal launch and landing of space systems as well as some advance aerospace development and operations. Potential users include X37, XCOR, Stratolaunch, Sierra Nevada, and Swiss Space Systems. The Panel is looking forward to finalization of the agreement and following the future activities at the SLF. This should be a very exciting time for the Space Coast. In response to a question, Mr. Jett noted that the length of the airstrip is 15,000 feet.

International Space Station

Dr. Sanders recapped the status report on the ISS. The Panel had its usual candid discussion of status as well as new and ongoing issues. The ASAP continues to be impressed with the openness and transparency of its interchange with this program. At this meeting, Mr. Dan Hartman, the Deputy Program Manager, provided the overview in lieu of Mr. Mike Suffredini, but it was evident that the culture of candor is pervasive throughout the Program and not resident solely in its Manager. The ISS has been in orbit for a number of years, and it would be tempting to consider it a complete program or,

at least, a mature program with diminished risks. However, in reality, it is a program that continues to break new ground, push the edge of the envelope, face challenging issues, and learn important lessons for the continuance of its own mission and the future of space exploration. What is noteworthy and commendable is the way in which the ISS Program addresses each issue that arises, solves the problem, learns from the experience, adjusts procedures and technologies appropriately, and applies the emerging knowledge to future endeavors.

Dr. Sanders noted a few examples of issues that the ISS has faced since the Panel's last review. In mid-January, an event in the cabin resulted in false values being reported, pointing to a possible ammonia leak in the cabin—a potentially toxic and catastrophic event. Appropriate emergency procedures were immediately implemented until telemetry indicated that there was actually no leak. There was no adverse impact to operations, but important hardware lessons were learned in the process as well as the exercise of emergency steps, including crew isolation. Another example is the failure of multi-filtration beds at a faster rate than anticipated and a current sparing plan that puts the projected on-orbit need at risk, because no viable operational workaround presently exists. Because of the loss of Orbital (Orb)-3 and an underestimation of sparing needs, there are currently no flight-ready spares on the ground. The current risk posture is mitigated by: a medium probability of failure prior to August, on-track delivery of charcoal filters to extend the multi-filtration bed's life, and planned delivery of replacements in July. Two units were returned for possible refurbishment. The ISS is now reevaluating its needs for flight-ready spares of Category 1 and 2 components as a lesson learned.

The impact of the loss of Orb-3 has been assessed, and future manifests have been reworked to meet ISS needs. Dr. Sanders reported that the Panel was relieved to see that the ISS consumable status reflects acceptable levels in all categories, including water.

With respect to the ASAP's ongoing interest in planning for eventual deorbit of the Station, the Panel was informed that, because of the loss of one of the four power strings on Automated Transfer Vehicle (ATV)-5, the planned shallow reentry would not be possible. ATV-5 will reenter on its nominal trajectory. The Panel was sorry to hear about this occurrence and lamented the loss of valuable data for reentry planning but understands and supports the decision.

Mr. Frost emphasized what Dr. Sanders said about the ISS event. A near-miss or a false alarm can reveal things, and one can learn as much from these events as from a mishap. The ISS Program has shown itself to be a learning organization. Not only did the procedures work well and were demonstrated, but they are taking the time and effort to learn what can be done better.

VADM Dyer added that in the 2014 Annual Report, the Panel spoke about the ISS Program as a great example of culture. Its openness and transparency has built confidence within this Panel and with others that the Program is in command of the issues. When problems arise, they have speed, process, and purpose to deal with them, and they have leadership that goes deep into the organization. It is a great training ground for people and NASA.

Exploration Systems Development

Mr. Frost reported on the Panel's review on this topic, which was led by Mr. Bill Hill, Associate Administration for Exploration Systems Development (ESD) in the Human Exploration and Operations Mission Directorate (HEOMD). Mr. Hill reminded the ASAP that "it is about the journey, not the destination," meaning that while the eventual goal is Mars, NASA's short-term focus is developing the capabilities for deep space human exploration. There are many implications to those approaches, which

the ASAP discussed at length its Annual Report. ESD has three major components: the SLS (the rocket), Orion (the capsule), and GSDO (all of the ground systems). The Panel looked at all three of these.

ESD continues to make progress in all three areas. Mr. Frost noted a few examples: a qualification solid rocket motor test coming up in March; completion of a RS-25 engine test for 50 seconds at Stennis Space Center (SSC); completion of Preliminary Design Reviews (PDRs) on all three subsystems; and launch and recovery of Exploration Flight Test (EFT)-1. They are now upgrading the mobile launcher to handle the new stack. The greatest and most visible (to the public) progress made was the EFT-1 launch and recovery. The public learned a lot from that flight. Many people now say "NASA is back in business." There was successful orbit and separation. The Thermal Protection System (TPS) worked well at the 25,000 mph reentry. EFT-1 met 85 of its 87 objectives, which is amazing for a flight test. One of the two things that didn't work as anticipated was the orange stabilizing balloons that right the system if it comes down in a non-stable position. It did come down stable and the inflatables weren't needed, but three of five floatation devices didn't work as designed. They were not aerospace quality—they were off-the-shelf—and will be replaced. Mr. Hill discussed some of the issues surrounding them, such as the gas used. This is the purpose of a test flight—to sort those things out. As the capsule landed, the water recovery took considerably longer than planned. One of the main reasons was that the sharp edges that had been exposed posed a risk to divers, who backed off, took their time, and did a safety review before recovery. The process took about 7.5 hours instead of the planned 4. This led to a discussion about astronauts remaining in the capsule in rough seas. NASA is exploring the concept of open water transfer (as was done in Gemini and Apollo). This has advantages as well as risks. Mr. Frost cautioned NASA to look very carefully at the risk trade on a water transfer. Even though EFT-1 was extremely successful, he pointed out how hard space is. The public needs reminding. In this test flight, NASA was using a surrogate booster that was not designed for this part of space. Because of that, it did not have the micrometeoroid and orbital debris (MMOD) protection that would normally be needed for this environment. Consequently, the entire flight had an estimated 1 chance in 30 of failure. The risk was identified and recognized in advance, the NASA Administrator was briefed, and he made the proper decision. NASA would gain tremendous data from this and it was a risk worth taking. Mr. Frost emphasized that there are risks on these types of tests, and everyone involved should understand what a test flight is—pushing the envelope to find out where the envelope edges are.

Another issue being tracked closely by the ASAP is unbonds in the solid rocket motor propellant liner. NASA had proposed a chemical treatment that they thought would stop that. It was applied and a test pour was done; they did 2300 X-rays. There were zero propellant liner unbonds, which indicates tremendous success of the technique. This will be proved out in a full-scale qualification motor test in March.

The ASAP took a look at the ESD Probabilistic Risk Analysis (PRA). The PRA is the technical-informed identification of hazards, the assessment of how likely they are, and how effective the controls are. It provides a relative number of what the risk is. ESD has one of the most complex and comprehensive PRAs, and NASA is trying to make it better. The ASAP has identified issues and NASA has been addressing them. One new issue came up at this meeting: they have identified a threshold for acceptable probability of loss of crew (LOC), but they have not yet identified the goal or objective. There are several reasons for this. The mission has not been defined completely, and there are some mathematical problems concerning how to deal with the uncertainties. Mr. Frost strongly encouraged NASA to deal with those and set an objective as soon as possible. This gives the designers a "design to" goal—it enables an informed design, not just a "best efforts" design. The ASAP hope to see a LOC objective soon. When doing a PRA, there is always a concern about missing hazards, and ESD is going to

great lengths to identify any gaps. There are two separate efforts. One is an independent fault tree effort that will separately look at what can go wrong, build a fault tree, and compare it to the ESD fault tree. The second effort is utilizing the NASA Engineering and Safety Center (NESC) to identify gaps between the existing PRA and what the NESC can find. Mr. Frost noted that it is much better to do this now than after a mishap years later—now is the time to bring that talent to bear.

Overall, this critical program continues to make great progress and it is critical to all of NASA's future human exploration endeavors.

Commercial Crew Program

Dr. George Nield reported on the CCP discussions. VADM Dyer noted that they are fortunate to have Dr. Nield, Associate Administrator for Commercial Space Transportation at FAA. He wears several important hats: as an advocate, as a regulator, and as a member of the ASAP. Dr. Nield noted that the ASAP spent a considerable amount of time this week talking about the CCP, and the Panel was fortunate to have Ms. Kathy Lueders, CCP Program Manager, to go through the material with them. She discussed the status of both commercial providers, Boeing and SpaceX. The information included schedule to reach certified crew transportation system capability, major milestones, integrated testing activities, accomplishments of the partners to date, actions being worked, upcoming milestones events, and a summary of NASA's assessment of each providers' risks and top issues.

The ASAP reviewed some detailed information on NASA's highest risks to certification, including the result of the meetings that have been held to date, the mitigations in work, and the forward plan. As VADM Dyer mentioned previously, NASA's communications with the ASAP on commercial crew had been an item of concern to the Panel and was discussed in the Annual Report. The ASAP received assurances from the NASA Administrator that the Panel's concerns would be addressed and corrected going forward. Dr. Nield was pleased to report that in the most recent two briefings by the CCP, the communications have been much more thorough and have focused on some of the ASAP's particular concerns. The Panel is pleased to see that. The two providers clearly have two very different philosophies and very different capabilities. This provides NASA with an excellent investment portfolio that will hopefully enable the Nation to take advantage of the capabilities of each of the providers. At the same time, the ASAP is pleased to see that NASA, so far, has been able to keep those two providers in the Program. The Panel believes it will be very important for NASA and the Nation to continue with that competition going forward. This approach provides significant benefits in terms of checks and balances and avoiding a bind should there be unexpected concerns that arise going forward.

In addition to talking about the status of the CCP itself, the ASAP also talked about the CCP's LOC requirement and some recent developments as a special topic. The current LOC requirement for CCP is that for a mission to the ISS, the mean value must be no greater than 1 in 270. One of the biggest contributors to the LOC estimate is MMOD. Currently, the way the contracts have been issued, the providers are allowed to take advantage of operational controls, such as inspections from the ISS on the status of the heat shields and other systems onboard their vehicles. NASA has recently recognized that this is the perfect time to do system trades to see what can be done to enable the safest possible transportation systems. NASA has reached a decision that the thing to do going forward is to back off from the 1 in 270 LOC number and going forward, to no longer allow providers to use inspections from the ISS as a way to meet that requirement. Dr. Nield explained that the reason that can be very important is that we don't want to be in a position of levying requirements on the ISS crew or resources. Rather, NASA wants to focus on the contributions the ISS is making going forward. While in the design/development/test phase of commercial crew, NASA wants to enlist the capabilities, creativities,

and innovation of the companies to see how they can do design work to bring down the risk from MMOD, resulting in overall safer systems. The best way to do that at this point is to back off from the 1 in 270 number, but no longer allow inspections from the ISS as part of the way to achieve that.

In terms of forward work, the CCP will take another look at what assets NASA has that could potentially aid the providers in meeting the 1 in 270 number, e.g., cameras that could be made available for inspection, and develop a schedule to support the overall strategy. NASA will also perform a high-level assessment of how the providers could meet 1 in 200 (the "back-off") number and what models they are using to assess their capabilities. It is important to recognize that the overall requirement levied on the CCP is still 1 in 270. To the extent that the providers are not able to meet that target, there will need to be a discussion at the Agency level on a mission by mission basis. How NASA is addressing this particular challenge appears to the ASAP to be a reasonable way forward. Everyone wants the goal to be the safest system possible rather than having workarounds with the operations in order to meet a particular number.

Mr. Frost noted that Dr. Nield makes a good point about the importance of balance and how we try to control risk—some approaches can be by design, and some can be by operations. We want to optimize the risk mitigation. Mr. Frost expressed his concern about NASA slowly increasing the acceptable level of risk over the years. There was a time after the Exploration Systems Architecture Study (ESAS) and during the Constellation Program where 1 in 1000 was used as an acceptable level; that was found to be difficult because of MMOD and parachute issues, and it was reduced, ultimately ending up with 1 in 270. The 1 in 200 is a further reduction. While it is a valid point that other controls can help that number out, the ASAP worries about the trend and hope that it does not continue.

VADM Dyer commented that there is still a lot that we don't understand about commercial space, but the candor is real and the ASAP is confident that as the year goes on, it will gain deeper insight. The providers' programs are on different design review timelines, Boeing being a little further along in its efforts than SpaceX, but for good reasons. Both are progressing well. VADM Dyer saluted NASA's wisdom in maintaining both providers as competitors going forward. One must be appreciative of the diversity. Boeing is a long-established and very experienced aerospace company, and one could postulate that its challenge going forward will be finding innovation, speed, and less expensive ways to do business. On the other end of the continuum is SpaceX, which has vastly improved in terms of aerospace process from what the ASAP saw years ago—the factory is a different place, the people are very impressive—and it is a very innovative company. One could expect that its challenge could be stability, process control, and change management. These two companies together will provide a real path forward. They will be good competition in support of NASA's mission as well as good competition for each other, good for the industry, and good for the Nation. VADM Dyers summarized that in other words, in the Panel's opinion, it would not be as good a situation if NASA had thrown its lot completely with only one of the companies without the stimulation of competition.

Mr. Frost added that in addition to redundancy, we want dissimilar systems. These are two different types of organizations that have different driving factors and different strengths and weaknesses. It is unlikely that both will suffer the same problem. Therefore, there is not only redundancy, but dissimilar redundancy. VADM Dyer noted that all of these are reasons to refute the view of "down-selection" and going with one developer to save money. Unanimously, the members of the Panel would say that this competition will save us and support us in the long run in many different ways.

Knowledge Management

Mr. Bolton stated that NASA is a world-class, knowledgeable organization. A year ago, the ASAP made a formal recommendation to NASA on knowledge management. Dr. Ed Hoffman, NASA's Chief Knowledge Officer (CKO), provided a status update on NASA's response to that recommendation: "The ASAP strongly recommends a continuous and formal effort in knowledge capture and lessons learned that will make them highly visible and easily accessible." Dr. Hoffman stated a goal that was interesting—it was expressed in the form of a question: "Where does the NASA technical workforce go to find and use critical knowledge required now and in the future to achieve mission success in a highly complex and unforgiving environment?" Dr. Hoffman parsed the knowledge process into three areas: capture and retain; share and apply; and discover and create. The first two areas are somewhat in hand; the third is a work in progress. The ASAP discovered that by attempting to log onto the website in real-time during the discussion. It had some good results, particularly with established NASA databases. However, ties to an integrated, single NASA database or portal are still a work in progress. There are imperatives to the knowledge services, according to Dr. Hoffman. These include: improved accessibility, "searchability," "findability," and visualization. Other imperatives are "no additional cost" and "least administrative burden." Goals and objectives to address these imperatives include improved communications across complex interfaces, improved work processes, improved knowledge services, and increased participation in fostering science, technology, engineering, and mathematics (STEM) outreach.

NASA initiated the "Critical Knowledge and Knowledge Referee" process to accomplish the goals and imperatives. This entailed the CKO going out and visiting Centers on a regular basis, gathering information, working with the Knowledge Referees (for people, process, technical, and knowledge services), looking at lessons learned, and eventually placing them in various knowledge sites. The NASA Knowledge Site is: www.km.nasa.gov. Mr. Bolton observed that the website is not connected to some of the capture databases—that is part of the work going forward. Dr. Hoffman also monitors and advises the leadership. The Administrator and other leaders see the need for this activity and are supporting it. Dr. Hoffman concluded by discussing the various digital tools available to the NASA Knowledge Services Initiative and being used across NASA. These digital tools include: the Jet Propulsion Laboratory's (JPL's) "JPLTube," a video with spoken, key-word search capabilities; Goddard Space Flight Center's (GSFC's) capture and sharing lessons, with over 50 case studies; and Langley Research Center's (LaRC's) oral lessons learned, with documentation and digital distribution. Benchmarking with companies is ongoing, and "Young Professionals" are assisting NASA with better digital tools. Dr. Hoffman's last chart showed all the NASA Centers superimposed on the U.S. map with each Center's knowledge tools highlighted.

Mr. Bolton noted an ASAP suggestion: when going out to benchmark, one of those benchmarks should address how to incentivize the workforce to actively aupport a Knowledge Services/management process. An employee will see value in getting information from such a process, but in order for the process to be viable, data must be put into the process. The ASAP suggested that as Dr. Hoffman benchmarks with industry, he should determine how companies incentivize their employees to provide inputs to the companies' knowledge databases and keep those databases current and accurate. NASA's ability to do what it has to do, today and into the future, will depend upon the knowledge that it has today, lessons learned, and applying those and new knowledge going forward.

Mr. Bolton stated that overall, NASA is making progress on the recommendation, and the Panel will most likely change the "color" status on it.

VADM Dyer observed that one can have a peek at NASA's culture as it was, as it is, and as it is becoming. In one section of the knowledge database, one can see the information collected and arrayed by Center

rather than by Agency. That is coming together and knowledge management is one of the tools that will generate a better integrated NASA. VADM Dyer credited the NASA Administrator, Mr. Charles Bolden, and the NASA Associate Administrator, Mr. Robert Lightfoot, with quietly moving NASA in the direction of a more integrated and therefore more powerful force.

Mr. Frost added that he is looking forward to the "one-stop shopping" that NASA is working on. CAPT Robert Conway mentioned that maintaining the user-friendliness should be a priority as well—it will create the draw and demand for the system. NASA is leading the way in this endeavor.
Another point that Mr. Bolton noted was that there seems to be sensitivity to the term "knowledge management." It will be interesting to see how that resolves as they go forward and in the benchmarking with industry.

Mishap Privilege and Releasable Information
CAPT Conway reported on the ASAP discussion with Mr. Gerry Schumann, the Agency's Mishap Program Executive. The ASAP asked him to look into an issue that was raised in the Annual Report: the ASAP's concern over NASA's release of privileged witness statements and some mishap investigation information. With regard to any perception of conflict between the Panel's desire to be open and transparent and its position on the protection of sensitive or privileged mishap information, one must understand the definition and circumstances: privilege is the protection of statements made under promise of confidentiality and the deliberative investigation process. Referencing a very good article written about the Antares mishap in October that was circulated among the ASAP entitled "After an Accident, You Can Either Learn or You Can Blame – You Can't Do Both," CAPT Conway emphasized that the desire is to always learn from a mishap so that it or its causal factors are not repeated and, in order to maximize learning, to garner as much accurate information as possible. It is a well known fact that people under the promise of confidentially are apt to be more open in the information given in their statements. Because of that openness, we learn much more than we would if we did not have that. It is the desire of the ASAP to foster an environment of openness through the concept of privilege in order to maximize the learning from a mishap, thereby minimizing the risks of it recurring.

Mr. Schumann described how witness interviews are conducted and statements taken, which is much in line with how the Department of Defense (DoD) trains its safety investigators. The issue that sparked the topic in the 2014 Annual Report is a statement from the NPR 8621.1: "under certain conditions, privileged witness statements can be released to the Inspector General (IG)," and there is a detailed process on how that must happen. The ASAP was under the impression that any release of that privileged information will have impact on the ability of witnesses to be open and forthcoming. With some research done the previous day, the ASAP was informed that the Inspector General Act of 1978 says that the IG has the ability to obtain any information from a mishap investigation, whether it is privileged or not, and that the DoD is also subject to this Act. Basically, this says that if the IG needs to have privileged information, they can get it. Because the Panel was unaware of the Act's reach, it needs to step back and take a closer look at this and see what the effects are on the Panel's outlook. In the meantime, it was noted that NASA is seeking legislative authority to protect privileged information by statute, similar to a FAA statute that protects information in commercial safety programs. NASA is hoping to emulate that. The question remains: does the IG Act of 1978 still apply to the statutory protection they are seeking?

The second part of the discussion with Mr. Schumann was the public release of mishap information, once the deliberative process is complete. Release of mishap information is required for Freedom of Information Act (FOIA) requests, if there is demonstration of significant public interest, or if NASA

anticipates there will be significant public interest. The ASAP has no doubt that the current leadership and people involved in mishap investigations are protecting the privileged information and deliberative process; however, this is not adequately documented. It was also suggested that NASA explore the DoD approach where releasable data is only through a parallel Judge Advocate General Manual (JAGMAN) investigation. This approach allows the mishap report an additional layer of protection. The ASAP will continue its discussion on whether NASA is taking the correct approach and if there are other options. Currently, the Mishap Report goes through a redacting process, and the ASAP is comfortable with that for the moment. What it is uncomfortable with are the opportunities for any undue effect on how the report is deliberated and written.

Mr. Bolton noted that on the original point—the purpose of the investigation—the Safety Board purpose is to find out what happened and get lessons learned so that the mishap doesn't happen again. To achieve this, honest input is needed from the people involved. He was surprised with some of the things the Panel found out about the Inspector General Act and the applicability of it. He cited his experience in mishap investigation and JAGMAN investigation on same incident. The Air Force, like the Navy and Army, did this so that if the IG needed anything, it could go to the JAGMAN report.

In a wrap-up comment, Mr. Bolton noted that it is always a high note to come to KSC, chat with the people, see the professionalism, the technical expertise, and smart people doing things in a smart way in a challenging environment. He said "hats off to Mr. Cabana and everyone at KSC doing great work."

There were no public comments, and the meeting was adjourned at 2:20 pm.