NASA AEROSPACE SAFETY ADVISORY PANEL
National Aeronautics and Space Administration
Washington, DC 20546
Dr. Patricia Sanders, Chair

June 5, 2017

Mr. Robert M. Lightfoot, Jr.
Acting Administrator
National Aeronautics and Space Administration
Washington, DC 20546

Dear Mr. Lightfoot:

The Aerospace Safety Advisory Panel (ASAP) held its 2017 Second Quarterly Meeting at Marshall Space Flight Center, Huntsville, Alabama, on May 23-25, 2017. We greatly appreciate the participation and support that was received from the subject matter experts and support staff.

The Panel submits the enclosed Minutes and Recommendation resulting from the public meeting for your consideration.

Sincerely,

Patricia Sanders

Patricia Sanders
Chair

Enclosure

ASAP AEROSPACE SAFETY ADVISORY PANEL
Public Meeting
May 25, 2017
Marshall Space Flight Center, Huntsville, AL

2017 Second Quarterly Meeting Report

Aerospace Safety Advisory Panel (ASAP) Attendees
Dr. Patricia Sanders, Chair
CAPT (Ret.) Christopher Saindon *(via telecon)*
Mr. John Frost
Dr. Donald McErlean
Dr. James Bagian
Lt Gen (Ret.) Susan Helms
CAPT (Ret.) Brent Jett
Dr. Sandra Magnus
Dr. George Nield

ASAP Staff and Support Personnel Attendees
Ms. Carol Hamilton, NASA ASAP Executive Director
Ms. Marla King, NASA NAC Administrative Officer
Ms. Paula Burnett Frankel, Writer/Editor

Telecon Attendees: 23 participants – see attached listing

Other Attendees:
Ken Bowersox, Human Exploration and Operations Committee

NASA Attendees:
Kim Henry, MSFC IAO

Opening Remarks
Ms. Carol Hamilton, ASAP Executive Director, called the meeting to order at 9:30 a.m. CST. She indicated that there had been no comments or requests submitted prior to the meeting, but there would be time at the end for public comments.

On behalf of the Panel, Dr. Patricia Sanders, ASAP Chair, thanked Mr. Todd May, Marshall Space Flight Center (MSFC) Director, Ms. Jody Singer, MSFC Deputy Director, and the personnel at the Center for their hospitality and support in hosting the Panel's Second Quarterly Meeting of 2017. She also expressed appreciation for tours of the various Space Launch System (SLS) test stands. She remarked that it is gratifying to see the progress on the test facilities and the hardware beginning to arrive to populate those stands. The SLS Program has many challenges ahead, but has much to show for the work accomplished so far. The efforts of the Program Office and the Center's personnel are really beginning to pay off.

Before introducing the Panel members and their discussions, observations, and assessments based on the insights of this week's activities, Dr. Sanders made a few opening comments.

In the case of two recent mishaps on commercial launch vehicles, the Panel believes that the underlying root causes could be traced to escapes on systems engineering and integration (SE&I) processes and controls. At its last meeting, the ASAP recommended that NASA require the commercial crew providers to produce verifiable evidence of the practice of rigorous, disciplined, and sustained SE&I principles in support of NASA certification and operation of commercial crew transportation services to the International Space Station (ISS). The Panel recognized that the Commercial Crew Transportation Capability (CCtCap) contracts were written with a tailored approach to allow the providers to employ efficient practices aligned with their corporate policies and practices rather than strict adherence to prescriptive, traditional SE&I processes. The Panel also recognized that the Commercial Crew Program (CCP) expects to gain evidence of adherence to SE&I principles through requirements verification, contract deliverables, and insight into the providers' management systems and processes.

Nevertheless, the ASAP remains concerned that no amount of insight or oversight by the CCP can ensure that the appropriate level of engineering discipline and control is employed unless the providers have internalized the need for it and made it an inherent part of their corporate culture. Currently, one provider has a history of employing rigorous SE&I practices. However, they need to continue to ensure that these controls are not employed blindly but with an awareness of the rationale for doing so. The other provider has placed a value on agility and rapid problem solving with beneficial results. They are also showing signs of evolving to reconcile their approach with the benefits and need for discipline and control. However, they need to ensure that the evolution reflects an inherent desire to adopt the tenets of systems engineering. Dr. Sanders indicated that the Panel will continue to emphasize the need for disciplined engineering processes and controls and will persist in recommending that the providers demonstrate their employment. Regardless of the methodology employed, both providers need to demonstrate that the proper controls are in place to ensure the hardware is properly qualified, hazards are identified and appropriately mitigated, and the system is employed within the constraints of that qualification.

At the last quarterly meeting, the Panel commented on the study that NASA had initiated to examine the feasibility of flying crew on Exploration Mission (EM)-1, which had been planned as an uncrewed test mission. NASA provided the Panel insight into the study as it progressed, and the Panel members believe that NASA did a thorough and credible assessment of the feasibility, risks, and benefits of such a course change. While the study indicated that flying crew on EM-1 was technically feasible but with added risk, the decision was ultimately made to stay the course with the program of record. Accelerating the incorporation of crew would have required significant additional resources whose commitment could not be guaranteed. The ASAP concurred with this decision. However, the Panel noted that the study was a worthwhile investigation and did provide tangible benefits—revealing some risk mitigation steps for consideration to incorporate in the ongoing program. In particular, the Panel encouraged NASA to seriously consider moving forward the ascent abort test to obtain earlier insight. Should resources become available, the Panel also encouraged NASA to fabricate a second mobile launcher to help close the time gap between EM-1 and EM-2. The ASAP believes that the current 33-month lapse between those flights could potentially incur risk due to the infrequency of operations and loss of learning.

Dr. Sanders' third observation was the Panel's perception of a disconnect between national policy and budget authority. She noted that while the recently passed Authorization Act and statements by the Administration are highly supportive of space exploration—both by humans and robotic means—the resources allocated for that purpose do not match. The flatline proposed budget is not appropriate to the developmental stage of the current exploration programs, nor is the lack of an assured resource commitment conducive to planning for safe and reliable human space flight.

Deep Space Gateway and Transportation Plan

Dr. George Nield reported on the Panel's review of a briefing on what is known as the Deep Space Gateway (DSG) and Transportation Plan. Mr. William Gerstenmaier, NASA's Associate Administrator for the Human Exploration and Operations Mission Directorate (HEOMD), reviewed the top-level provisions of the NASA Transition Authorization Act of 2017. He noted that it represents an ambitious, forward-looking set of goals and objectives that has received strong support and widespread agreement, both in the Administration and Congress. Specifically, it identifies the long-term goals of NASA's human space flight and exploration efforts, including "to expand permanent human presence beyond low-Earth orbit and to do so, where practical, in a manner involving international, academic, and industry partners." It goes on to discuss enabling human habitation on another celestial body and a thriving space economy.

At the very top level, NASA's plan involves using the ISS now, operating near the Moon in the 2020s, and then leaving the Earth-Moon system and reaching Mars orbit after 2030. The more detailed plan contains four different phases. Phase 0 involves continuing research and testing on ISS to solve exploration challenges, evaluating the potential for the use of lunar resources, and developing standards. Dr. Nield noted that it was interesting to hear about the standards effort, led by NASA Headquarters but encompassing a number of Centers. NASA expects to publish individual documents for each system, such as environmental control and life support, power, data, storage, etc., that would contain voluntary standards rather than requirements, with the hope that both international and industry partners would be able to develop hardware and software that could easily be incorporated into the overall architecture. Phase 1 marks the beginning of missions in cislunar space, including building the DSG and initiating assembly of the Deep Space Transport (DST). Phase 2 involves completion of the DST and conduct of a year-long, Mars-simulation mission—sometimes called a "shakedown cruise"—in 2029. Phases 3 and 4 would involve the beginning of sustained crew expeditions to the Martian system and to the surface of Mars, with a mission to Mars orbit in 2033.

In terms of basic functionality, the DSG is being planned to support multiple NASA, commercial, and international objectives. It would be designed for the deep space environment and would support a crew of 4 for total mission durations of up to 42 days with the Orion vehicle attached. It would include a power and propulsion bus and a habitat, and would incorporate a logistics strategy that could involve cargo resupply or crew transportation flights by industry or international partners, such as what is done now for the ISS. Mr. Gerstenmaier indicated the DSG is not intended to be a huge or complex system like the ISS. The intent is to keep it simple. It would be launched on three flights of the SLS over three years and would be moveable in orbit. It would incorporate solar electric propulsion (SEP), which uses much less propellant than chemical propulsion systems, but is slower. The DST, which would potentially be used for the human missions to the vicinity of Mars, could be a hybrid system with chemical propulsion for Mars gravity-well capture and departure, and SEP for the rest. This would potentially eliminate the need for a pre-deployed propulsion system at Mars for crew return. The DST would be designed for 3 Mars-class missions of about 1000 days each with a crew of 4, launched on a single SLS Block 1B vehicle. The thinking is that it could be refueled, resupplied, and have at least a minimal outfitting performed in cislunar space.

Dr. Nield noted that the ASAP had encouraged NASA to start doing more detailed planning for exploration-related launches post EM-2. The Panel is seeing that now and is very pleased with the kind of system design and engineering trade studies that are being conducted. The Panel acknowledged a lot of progress and believes NASA is on the right track.

Dr. Sanders added that while the timelines on some of this may seem lengthy, when one considers all of the technical challenges that need to be addressed and the constraints on resources, NASA appears to have a very credible plan going forward.

Enterprise Protection Program

Lt Gen Susan Helms introduced this topic by highlighting the ASAP's open recommendation from 2016 related to Enterprise Protection:

> *NASA should make it a matter of policy that priority is given to obtaining the appropriate level of security clearance for all personnel essential to implementing the Enterprise Protection Program, including the appropriate program managers.*

The Panel met with the lead for this Program, Mr. James Leatherwood, who provided a good update and a chance for the Panel to review NASA's progress toward meeting the recommendation. There has been progress,

but there is still much more work to do. The ASAP will continue to follow this progress closely. As noted in the 2016 ASAP Annual Report, resources allocated to NASA's Enterprise Protection Program continue to be a concern.

During this quarterly meeting, the Panel reviewed some of the current and emerging challenges for the Program Manager. Mr. Leatherwood himself plans to retire shortly, and the Panel was keenly interested to learn who the successor will be and how his responsibilities to manage the Program will transition to his successor. Since the last quarterly meeting in February, a cybersecurity Executive Order was issued by the Administration, which requires all agencies to report back to the Administration on their adherence to the National Cybersecurity Framework by mid-August 2017. Mr. Leatherwood does not have the lead on this effort for NASA, but he did mention that the Enterprise Protection Program expertise pool was required to support that effort as well. At the last quarterly meeting, the Panel discussed the top six recommendations from the NASA Inspector General (IG) Audit Report on Critical Infrastructure Cybersecurity and the fact that NASA had set a deadline to meet all those recommendations with corrective actions by October 1, 2018. This represents a considerable amount of work.

In summary, Lt Gen Helms stated that the Panel remains concerned about the resources NASA has allocated to the Enterprise Protection Program in the face of these challenges. At the ASAP's third quarterly meeting in July, the Panel looks forward to a number of updates related to these challenges, including the personnel transition, the NASA response to the Executive Order, and NASA's progress toward answering the NASA IG report recommendations.

Commercial Crew Program

Dr. Donald McErlean reported on the Panel's interactions with the CCP Manager, Ms. Kathy Lueders, and her team. Ms. Lueders and her managers discussed the status of the total program involving all the providers. The Panel was pleased to note significant progress by everyone. They are moving ahead with plans for the first test flights in 2017 and 2018. Boeing is progressing with its software releases. Its structural test article testing is underway, and the first spacecraft crew module has gone under initial power activation. The second and third spacecraft and facilities are progressing. The SpaceX Dragon has completed its first pressurized space suit test and assembly is underway. Pad 39A is undergoing final acceptance testing. The new Merlin 1D engine is under developmental test. Both providers have completed parachute testing for landings and are moving into production and qualification. In areas of somewhat less visibility, participants in non-reimbursable Space Act Agreements are busy as well. Blue Origin is building and testing its facilities, developing software, and performing some high-altitude parachute deployment testing. Sierra Nevada Corporation, with Dream Chaser, has tow-tests in progress at Armstrong Flight Research Center and is moving towards the potential for flight testing. The CCP is facilitating development and certification of U.S. industry-based crew transportation systems.

In reviewing the Program's concerns, Ms. Lueders noted the top safety-related concern is the current situation with respect to loss of crew (LOC). The CCP placed requirements for threshold values for LOC in the contracts. The ASAP had recommended that this be done and was pleased to see that those requirements appeared to drive systemic behavior by both providers. They have expended considerable time and energy in making their systems substantially safer than they might have been without such an incentive and have achieved considerable progress from the initial LOC estimates. However, the threshold values were acknowledged to be challenging, and both providers still are striving to meet that precise number. This remains a risk to the Program that must be addressed by a risk acceptance or waiver process. While these LOC numbers were known to be challenging, and both providers have been working toward meeting the challenge, it is conceivable that in both cases, the number may not be met. The ASAP is on record agreeing with the Program that one must be judicious in how one applies these statistical estimates. In the case of LOC, the numbers themselves depend very heavily

on the orbital debris model that is used to develop the risk to the system. Orbital debris is a driving factor in determining the potential for LOC. The orbital debris models have been used and validated to some degree, but they are not perfect. One must be wary of being too pernicious in the application of a specific number and must look at whether the providers have expended the necessary efforts and engineering activity to make the systems as safe as they can and still perform the mission. Currently, review of both providers appears to be positive. There was no indicated area where by spending additional dollars the providers could have made their systems considerably safer. The ASAP was pleased with the progress in this area, and realized that it may be necessary for NASA to do a formal risk acceptance of the variance from the requirement. The Panel reminded NASA that the risk acceptance, including a complete presentation of the alternatives and the consequences, should be made formally and risk acceptance should be signed off by the appropriate authority.

Mr. John Frost agreed and pointed out that projected numbers for LOC would exceed the contract threshold, and the risk acceptance decision could be at the highest levels of NASA.

Dr. Bagian added that it is not only important to present the alternatives and consequences in the risk acceptance package, but it is essential to include the rationale for the path that was ultimately chosen.

Before introducing the next agenda topic, Dr. Sanders commented that between the last ASAP meeting and this one, a few members of the Panel traveled to the NASA Safety Center (NSC) and Glenn Research Center (GRC) for insight visits. During that time, a few questions arose related to system safety assessments, system audits, and other related topics. Consequently, the Panel had asked to have some engagement with Mr. Terry Wilcutt, NASA's Chief of Safety and Mission Assurance (SMA). Dr. Sanders introduced the newest Panel member, Dr. Sandra Magnus, who discussed the Panel's observations on the SMA update provided by Mr. Wilcutt.

Safety and Mission Assurance

Dr. Magnus noted that the Panel had some very good discussions with Mr. Wilcutt about safety and mission assurance in general across the Agency. NASA has several systems in place that allow employees to report, and NASA to investigate, various types of safety related issues. The processes vary across the Agency from the highly structured and formal reporting to the more informal and direct reporting through the supervisory line. These processes are both Agency-wide and locally at the Centers. Mishaps and close calls, for example, are generally cataloged and tracked globally and formally. The safety reporting system, which deals with all other types of safety issues (excluding the mishaps and close calls), appears to be implemented inconsistently across the Agency. The Panel has requested that the Office of Safety and Mission Assurance (OSMA) examine the benefits of establishing a consistent and integrated safety reporting system that is Agency-wide. The Panel believes that such a system will not only ensure compatibility of data but will also allow the Agency to evaluate trends or systemic problems that otherwise go unnoticed in an incoherent, "siloed" approach. The Panel expects further conversations with Mr. Wilcutt at future meetings.

In response to prior ASAP recommendations regarding system safety and risk accountability, NASA has been working on a NASA Program Requirements (NPR) that contains a requirement for single individual to hold accountability and sign off on risk. This document is expected to be completed by fall of 2017. The Agency has already issued a NASA Interim Directive (NID) that communicates this requirement to the workforce. The ASAP encouraged NASA to continue its efforts to ensure that the entire workforce is informed and held accountable to the requirements.

In visiting the Centers, the Panel found some "holes" in the audit system--such as system safety--where it became apparent that the workforce was not adhering to policies and procedures, or that policies and

procedures were not well understood. The Panel believes that a healthy and regular audit process would highlight these deficiencies and lead to corrective action and/or the appropriate training.

Dr. Sanders noted that one of the topics discussed at the NSC was their audit process. While in some cases there was integrity in audit processes, in other areas the NSC did not appear to be auditing at all or auditing infrequently. For example, systems safety was not being audited. In Panel discussions with Mr. Wilcutt, it appeared that part of the impediment to having more effective auditing was insufficient resources to perform the audits that are needed. NASA needs to put more emphasis on the audits, prioritize them if there are not enough resources to do them all, and elevate the need for doing this.

Dr. James Bagian added that during the discussions with Mr. Wilcutt, he noted that they had not had formal mechanisms to really understand the variability that might occur from Center to Center. There is also an issue beyond compliance—understanding what goes on at the various Centers and if they have their own unique ways of dealing with problems. With this understanding through audit or other information gathering techniques, they could supply information across the Agency that would be beneficial.

CAPT Brent Jett agreed that the audit program is important. It sends a message to the workforce. Even more importantly, the elements that are required from a safety perspective need to add value to the people who are required to perform them. The workforce needs to see the value and embrace it. Safety requirements should be written and structured in such a way that the NASA team can integrate them into their normal work processes, and those actions become part of getting the job done. He indicated that the Panel may want to look further into this aspect.

Mr. Frost commented on the lack of staffing at NASA Headquarters and the NSC to perform these types of audits—not only numbers but specializations. Mr. Wilcutt mentioned something of merit—modeling their safety program audit after the aviation program audit, where the auditors periodically go to the aviation Centers and bring aviation experts from other Centers in to participate.

Because the Panel was concerned that safety policies and procedures may not be implemented consistently or appropriately across the Agency, Dr. Magnus offered the following recommendation, which was accepted by the Panel members:

> *NASA should establish, prioritize, resource, and implement a rigorous schedule of audits, executed by OSMA and conducted at the Center level, to ensure that documented safety requirements, processes, and procedures are consistently applied across the Agency.*

CAPT Jett added that this recommendation could also be tied back to risk acceptance. If the budget does not allow for all the prioritized audits desired, someone must accept the risk of not auditing certain areas.

Exploration Systems Development (ESD)

CAPT Brent Jett reported on the Panel discussions with Mr. Bill Hill, HEOMD Deputy Associate Administrator for Exploration Systems; Mr. Marshall Smith, ESD Chief Engineer; and Mr. John Honeycutt, SLS Program Manager.

CAPT Jett noted that Dr. Sanders had already covered the EM-1 crew feasibility study results and mentioned some of the positive benefits of the study. In addition to potentially accelerating the ascent abort 2 test, there were some other benefits that came out of the feasibility study: the work on understanding the MicroMeteoroid and Orbital Debris (MMOD) vulnerability of the Interim Cryogenic Propulsion Stage (ICPS) and composite

overwrapped pressure vessels (COPVs), and the work on options to improve Orion's heat shield testing. These are important elements in moving forward with the baseline plan.

The progress at MSFC and around the Agency on developing the Exploration Systems is going very well and is impressive. However, NASA is still facing many challenges, which can be expected in a complex development program. NASA has publicly announced that EM-1 will not make a 2018 launch date due to some of these challenges. The new official date is still being worked, as well as the required notifications to Congress and other stakeholders. There are multiple factors driving this schedule slip. Delivery of the European Service Module (ESM) is coming later than expected. Software development at Kennedy Space Center (KSC) is delayed, some of which is due to prime contractor key personnel retention issues. These challenges are being addressed, but they have made an impact on the schedule. Also, there are SLS core stage issues – more specifically, self-reacting weld strength on the liquid hydrogen (LH2) tank and the lower dome mishap on the liquid oxygen (LOX) tank. This was compounded by the tornado damage at Michoud Assembly Facility (MAF) last February. These issues have put the core stage behind schedule as well. The Program Manager, Mr. Honeycutt, has an independent team looking at the weld issue on the LH2 tank. They think they have a solution and hope to have this issue resolved soon. The LOX tank mishap is still under investigation, so there was not much that could be discussed at this time. On the positive side, there has been increased coordination between the engineering team at MSFC and the production team at MAF. Both Boeing and NASA are committed to increasing the workforce and conducting more work in parallel to mitigate the schedule impacts as much as possible.

The ASAP reviewed the status of the three major elements for EM-1—Orion, SLS, and Ground Systems Development and Operations (GSDO)—including the top concerns. CAPT Jett did not go into detail on all of the elements as there was not any one particular issue that raised a flag. He observed that looking in total at all the issues and challenges provided a very good perspective on how complex and difficult this total effort really is.

Mr. Smith provided an update on the Cross Program Integration (CPI) and focused on the team's progress in delivering the products required for EM-1. The Program must have: a mission definition baseline, which includes all of the constraints, priorities, etc.; the operations maintenance requirements and specifications (OMRS); and the launch commit criteria (LCC). Many products must be developed to conduct the mission: procedures for the crew, the operational controls, agreements, integrated hazard assessments, etc. The impressive part of this—and unlike previous programs—is the linking of all the databases in a way that can have a positive impact on safety.

Finally, the Panel had a discussion with Mr. George Gafka, the ESD Chief Safety Officer and Safety Technical Authority. After a brief review of the current safety work and a look ahead at a major milestone coming in June, the Mission Integration Review, Mr. Gafka discussed two independent assessments that were recently conducted. The first was essentially a benchmarking exercise to compare the way NASA SMA does safety and mission assurance for launches with the way The Aerospace Corporation does independent verification and validation for Department of Defense (DoD) launches of high-value payloads. It was informative and no gaps were found in either organization's processes from a safety perspective. A similar effort is underway in the engineering elements. The second assessment looked back at every significant incident in human space flight history and any potential applicability to the upcoming exploration missions. This study is still in progress but is an important part of ensuring that lessons learned at a very high cost are not forgotten. CAPT Jett remarked that personally, he continues to be impressed with the performance of the Exploration Safety Technical Authority and their independent assessments.

Dr. Bagian added that benchmarking and looking at past significant events are beneficial systems-based approaches to look at problems in a proactive way. The work that Mr. Gafka has done epitomizes the kind of things that the Panel would like to see done in the same proactive manner.

International Space Station

Dr. Bagian reported on the Panel's review of the status of the ISS as presented by the Program Manager, Mr. Kirk Shireman. The briefing depicted a program that is running very well with good planning, anticipating problems, and being prepared to deal with them. Mr. Kirkman reviewed the current flight plan and mentioned two uncertainties. Currently, there are only two Russian crew on orbit because they are awaiting the Multipurpose Laboratory Module (MLM) arrival, which may slip to the right and may change how the crews will be structured for the foreseeable future. Also, they have dates they are holding for potential demonstration flights on the CCP, which will be updated shortly. Mr. Kirkman expects there might be some changes to that schedule. However, the ISS Program is well positioned to deal with these changes to the current schedule. Crew utilization has been proceeding as scheduled and has been ahead of the benchmark plan in the most recent increment. Consumables continue to be well-managed, and there are no problems there. The Program has robotically reconfigured the way things are arranged on the ISS to accommodate the CCP arrivals. There was a good demonstration of Program flexibility and responsiveness when a recent multiplexer-demultiplexer (MDM) failure occurred. The issue was dealt with successfully without drama. Mr. Kirkman had briefed the Panel in the past on an ammonia leak that had been difficult to locate and resolve. Thanks to a GoPro camera on one of the crew during a recent extravehicular activity (EVA), the ammonia leak (seen as flakes) was detected when reviewing the post-EVA video. The Program has now isolated the leak and the leak rate has diminished. Dr. Bagian observed that this was a good example of unanticipated benefits from EVAs. The Cargo Resupply Services (CRS) Program is going well and cargo deliveries are being made. CRS-2 is moving forward according to plan.

Mr. Charles Gray reviewed the status of the ISS deorbit strategy. Dr. Bagian noted that this topic was a long-standing recommendation and had been discussed in the ASAP Annual Reports for several years. In the beginning, there were no concrete plans for either a nominal deorbit at ISS end of life or a contingency deorbit. Over the past few years, the Panel has seen considerable progress, and the planning for what needs to be done has continued to take a more defined form. There are still open issues. Some of them require responses from Russian component, and the original due date of March 2017 has been deferred into the future. Mr. Shireman noted that if something happened today (from a contingency standpoint), they would have a chance to deal with it based on the blueprint they have today. The biggest issue is the footprint and the probability of what it would be. The better the blueprint is defined, the smaller the footprint. The greater the uncertainties, the bigger the footprint. The Program continues to work the uncertainties and the ASAP will continue to follow this issue.

Knowledge Management

Mr. John Frost reported on the Knowledge Management topic, which has been on the ASAP agenda for several years. He noted that NASA is a huge developer of knowledge, but is also a user of knowledge. The critical part of Knowledge Management is taking the expensive and hard-earned lessons, both successes and failures, and using those on future projects. NASA has responded to ASAP's emphasis on this issue. Several years ago, the Agency created the position of Chief Knowledge Officer (CKO) and began making inroads, but then forward progress slowed. The CKO position has been vacant since August 2016. The ASAP was concerned about this topic and addressed it in its latest Annual Report. Knowledge Management is now regaining its momentum and is under the wing of NASA's Chief Engineer, Mr. Ralph Roe. Mr. Roger Forsgren, Director of NASA's Academy of Program/Project and Engineering Leadership (APPEL), is temporarily serving in the CKO position and is making significant improvements in getting the program moving forward. Currently, they are working on an integrated search engine, much like a Google approach. There is a lessons-learned database that is being actively used. They are developing new courses based on lessons learned and have a revised website with good data. The

Chief Engineer has assured the Panel that all the human space flight lessons learned are included in the database. Mr. Frost strongly encouraged NASA to fill the CKO position as soon as possible.

Dr. Sanders opened the floor to the public for comments. There were none, and she adjourned the meeting at 10:35 a.m. CST.

ASAP RECOMMENDATIONS, SECOND QUARTER 2017

2017-02-01 **Schedule and Cycle of Safety Audits** [ASAP Point of Contact: Sandra Magnus]

Finding: In visiting the Centers and the NASA Safety Center (NSC), the Panel found some deficiencies in the audit system--such as system safety--where it became apparent that the workforce was not adhering to policies and procedures, or that policies and procedures were not well understood. While in some cases there was integrity in audit processes, in other areas the NSC did not appear to be auditing at all or auditing infrequently.

Recommendation: *NASA should establish, prioritize, resource, and implement a rigorous schedule of audits, executed by OSMA and conducted at the Center level, to ensure that documented safety requirements, processes, and procedures are consistently applied across the Agency.*

Rationale: The Panel believes that a healthy and regular audit process would highlight deficiencies and lead to corrective action and/or the appropriate training. The audit program is important. It sends a message to the workforce. Even more importantly, the elements that are required from a safety perspective need to add value to the people who are required to perform them. The workforce needs to see the value and embrace it.

Attachment: Telecon Attendees

Alfredo Colon	NASA
Ann Zulkosky	Lockheed Martin
Anthony Colangelo	Main Engine Cutoff
Benjamin Reed	SpaceX
Carl Meade	Northrup Grummond Corp
Crystal Jones	NASA Commerical Crew Program
Dan Shorik	
Diane Rausch	NASA HQ
Ethan Hopper	SpaceX
James Dean	Florida Today
James Gleason	SpaceX
Jeff Foust	Space News
John Honeycutt	NASA SLS
Josh Brost	SpaceX
Linda Karanian	Karanian Consulting
Lynne Loewy	NASA HQ
Marcia Smith	Space Policy Online.com
Patricia Soloveichik	Boeing
Rebecca Regan	Boeing
Stacy Henderson	The Boeing Company
Tabathia Thompson	NASA
Tom Pitt	SpaceX
William Barksdale	Boeing