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

June 1, 2022

The Honorable Bill Nelson
Administrator
National Aeronautics and Space Administration
Washington, DC 20546

Dear Sen. Nelson:

The Aerospace Safety Advisory Panel (ASAP) held its 2022 Second Quarterly Meeting in-person at the Kennedy Space Center, May 10-12, 2022. We greatly appreciate the participation and support that were received from NASA leadership, the subject matter experts, and the support staff.

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

Sincerely,

Patricia Sanders

Patricia Sanders
Chair

Enclosure

AEROSPACE SAFETY ADVISORY PANEL
Public Meeting
May 12, 2022

2022 Second Quarterly Meeting Report

Aerospace Safety Advisory Panel (ASAP) Attendees:
Dr. Patricia Sanders, Chair
Lt Gen (Ret) Susan Helms
Mr. Paul Sean Hill
Dr. Sandra Magnus
Dr. Amy Donahue
Mr. William Bray
Mr. David West
Dr. Richard Williams
Dr. Mark Sirangelo

ASAP Staff and Support Personnel Attendees:
Ms. Carol Hamilton, NASA ASAP Executive Director
Ms. Lisa Hackley, NASA ASAP Administrative Officer
Ms. Kerry Pettit, Technical Writer/Editor

Telecon Attendees:
See Attachment 1

Opening Remarks

Ms. Carol Hamilton, ASAP Executive Director, called the meeting to order at 1:30 p.m. ET and welcomed everyone to the ASAP's Second Quarterly Meeting of 2022. She indicated that no comments or statements had been submitted prior to the meeting, but time would be allocated at the end for public comments.

Dr. Patricia Sanders, ASAP Chair, opened the meeting by stating that the ASAP (or Panel) was overjoyed to be able to hold this meeting in person and the members greatly appreciate the Kennedy Space Center (KSC) for hosting our discussions and fact-finding meetings this week. Dr. Sanders stated that it was not only great to reacquaint the Panel with each other and the NASA family, but they were actually able to interact with the three Panel members who had come onboard since the pandemic required meeting virtually. In particular, Dr. Sanders noted the introduction of the most recent Panel participant, Dr. Mark Sirangelo, who adds to the ASAP's broad set of talents and experience.

Dr. Sanders added that the Panel was also able to view actual flight hardware for the first time in over two years, and it was a thrill to see the entire Artemis I stack in the Vertical Assembly Building (VAB).

More importantly, she personally believes that the quality of the Panel's engagements is enhanced with face-to-face interactions at the Quarterly meetings; she looks forward to the promise of continuing in-person working sessions in the future.

This week the Panel focused on the responses to their three most recent, and significant, recommendations relative to risk management: addressing the strategic outlook for NASA; its governance processes; and the management of the Artemis initiative. Dr. Sanders stated that the Panel saw some substantive progress in those areas, which would be discussed later in the meeting. She added that at an especially and intensely active time for NASA human exploration missions, the Panel delved into many of the areas affecting the safety and mission assurance of ongoing and near-term operations and some of the developments critical to the Moon-to-Mars campaign.

With the recent return of Crew-3, the launch of Crew-4, and the impending launch of Orbital Flight Test (OFT)-2, Dr. Sanders indicated discussions will start with the Commercial Crew Program (CCP). She then called upon Mr. David West to start those discussions.

Commercial Crew Program

Mr. West stated that during some of the past week's very productive and informative meetings, the Panel learned a great deal about progress and recent accomplishments of the CPP. The Panel has come away with some favorable impressions about improved communications and working relationships between NASA and both CCP providers. However, Mr. West added, the Panel also has some significant concerns, which he would discuss.

Boeing is pressing toward the launch of the second uncrewed OFT (OFT-2) of the Starliner spacecraft; the launch could occur as early as May 19, a week from this ASAP Quarterly Public Meeting. The OFT-2 Flight Readiness Review (FRR) was held yesterday, Mr. West stated, and preliminary reports are that the FRR successfully met its objectives, clearing the way for next week's planned launch. Before the FRR, previously identified hardware concerns involving service module oxidizer isolation valves were resolved through remediation measures approved by the appropriate control boards. Flight rationale was also approved for issues involving a high-pressure latch valve in the command module propulsion system. Mr. West indicated that there remains some question as to whether a valve redesign will be required for future flights, after OFT-2. Also, there is concern that the certification of Boeing parachutes is lagging behind.

It is clear, he added, that there will be a tremendous amount of work to accomplish between OFT-2 and the Starliner crewed flight test (CFT). In addition to the expected heavy task load required just to make the jump from an uncrewed to a crewed flight, the resolving of all identified process escapes is on the critical path to CFT. The Panel is pleased that from all indications, there is no sense of needing to rush to CFT. The view consistently expressed is that the program will proceed to CFT when—and only when—they are ready. Of course, the best path to CFT is a successful OFT-2, Mr. West emphasized.

He acknowledged that there is a significant programmatic concern with the limited and dwindling number of Atlas V launch vehicles remaining. Any further delays with Starliner launches would exacerbate this concern. Another factor is that the Vulcan launch vehicle, slated to replace the Atlas V for Starliner launches, needs to be certified for human spaceflight. The process of getting that certification could take years.

The concerns over workforce and retention of critical skills that were mentioned earlier have particular significance in Boeing's case. The Panel has noted that Boeing's staffing levels seem to be especially low. The Panel will be monitoring this situation in the near future to see what impact, if any, this could have on the existence or mitigation of any safety risks. Plus, while the Panel does not want to see any undue rushing toward the CFT launch, Boeing should ensure all available resources are applied to meet a reasonable schedule and avoid unnecessary delays.

Dr. Mark Sirangelo emphasized and called to note that the Panel is certainly behind the idea of not launching until the program is ready to launch and all safety issues have been taken care of, but at the same time, if the delays are caused by a lack of resources being applied to the program, that may have significant effects on the NASA schedule for its return to the Moon and many other things that are going to fan out from those delays. Dr. Sirangelo called attention to the need for a review and reassessment of the resources that are being placed on the program, both to ensure safety and to ensure that the schedule is delayed for the least amount of time as possible.

The SpaceX Crew-4 mission was launched on April 27, followed shortly by the return, and landing, of Crew-3. Mr. West stated that SpaceX is shifting production focus toward their Starship product line, and they have announced that there will be no more Dragon capsules made. The Panel is definitely concerned about whether requirements for transporting astronauts to and from the International Space Station (ISS), through its remaining life (whatever that is), can be met without any additional Dragons. It would be advisable, Mr. West added, to conduct parametric studies to inform and support relevant decisions about whether more Dragon capsules are required. The Dragon launch rate continues, however, and measures are being taken to keep the launch rate up. Some of these measures may include deferring preventive maintenance and reusing Dragons several times. The Panel will be watching closely to see if these measures can be implemented without increasing risk. It should be noted, Mr. West continued, that there is a huge amount of data coming from all these SpaceX launches; while all this data can benefit NASA, care needs to be taken to keep from becoming overwhelmed by too much data.

Speaking of Starship, Mr. West added, one possible option that has been identified for launching Starship is from a planned new facility within the physical boundaries around Pad 39A at KSC, where Dragons are launched from. There are obvious safety concerns about launching the large and as yet unproven Starship in such close proximity—reportedly only 300 yards or so—from another pad, let alone the pad so vitally necessary for the CCP.

In conclusion, Mr. West stressed that these are extremely complex times for CCP. As the Starship launch site issue demonstrates, there are numerous external but related considerations to be made. One thing that continues to be clear, though, is that it is still very important to reach the point where NASA has two viable CCP providers.

Dr. Sanders thanked Mr. West for his insights and noted that discussions on CCP are always linked to the ISS, which is also experiencing a very high operations tempo. She then asked Lt Gen Susan Helms to lead the discussion of the Panel's thoughts on the Station activities.

International Space Station

Lt Gen Susan Helms stated that ISS operations continue to execute well overall, and they continue to follow a very busy timeline and will be for the foreseeable future. The Panel appreciates the continuing diligence exercised by the ISS program in managing the complex traffic management and flight timelines of this flagship mission.

Lt Gen Helms then indicated that she would discuss some takeaways from the Panel's interactions with ISS program staff: training and readiness operations with Russia, given the context of Ukraine; the latest status of leak investigations; a status update on the extravehicular activity (EVA) spacesuits on-orbit; and a preliminary look at the first private astronaut mission (PAM) performed by Axiom.

First of all, Lt Gen Helms noted, considering the current geopolitical climate right now, the work to accomplish training and preparation in Moscow continues without serious interruption. She emphasized that the worker-level relationships are healthy, and the objectives continue to be accomplished with little difficulty, if any. The teams are getting along very well. The Panel does not see any concerns about the relationship in terms of visa approvals or access to Star City or Mission Control Moscow. It seems the relationship continues to be as it has always been—the teams are working together for the partnership.

However, Lt Gen Helms stated, the geopolitical sanctions levied on Russia have created an environment where some administrative difficulties are becoming apparent. Examples include limited travel options by airline to and from Moscow and getting folks to and from the NASA footprint at Star City. Credit cards have become difficult to use, for example. In addition, the Panel has seen the voluntary departure of some NASA workers and their families from Russia, which has put NASA in a position of needing to manage the workforce more tightly and aggressively than in the past. But as far as mission operations and programmatic and medical work, crewmembers continue to train in both countries without any apparent issues, Lt Gen Helms noted. So far there have been no flight readiness impacts, and no impact to necessary visits to Mission Control Moscow, Energia, Roskosmos, and Star City. The geopolitical sanctions on Russia are beginning to have peripheral impact on Russia's contribution to the ISS, such as the suspension of support by Microsoft to Russia, but these impacts are being aggressively worked by the ISS program working closely with Russian teams. In spite of ongoing geopolitics, the Panel remains resolute that a crew swap strategy between the SpaceX Dragon and the Russian Soyuz remains a significant risk reducer to the overall program.

The second thing that was a takeaway from the ISS program discussions was the investigation into the leak analysis in the PrK of the ISS Service Module, which has been a focus area for the Panel now for several quarters. The new information the Panel has now is that strain gauges have been installed around the noted leak locations, and NASA and Russia continue to work cooperatively to determine root cause, risk margins, and mitigations. There are a number of opportunities that offer additional characterization of the structural behaviors of the module, such as specific thrust firings, the thermal day/night cycles, and docking/undocking events. Lt Gen Helms indicated that this work is ongoing; it is definitely not complete. However, the teams continue to work very well together on trying to characterize not only just what is happening and where it is coming from, but also what might happen if things propagate.

Lt Gen Helms noted that Russia has also provided NASA with material samples from the actual lot used to build the service module and the PrK area. NASA is working on developing a test plan to better

understand the structure. Testing of that material will include excursions in condensation, temperature, corrosion, and other factors they think are in play in a gravity-free environment.

The Panel also reviewed the latest update on ISS EVA space suits. Lt. Gen Helms stated that there continues to be evidence of water migrating into the helmet at the conclusion of an EVA or even during an EVA. The investigative work continues to try to uncover root cause and to scope the risks. The team has worked some additional mitigations by adding some additional absorbing material inside the back of the helmet. They are continuing to alter the design to try to improve it. The team is also conducting surveys to characterize the general level of helmet moisture that is normal for the suit design and crewmember workloads during space walks.

The EMU that recently experienced the higher degree of helmet water is now scheduled to return on the SpaceX 25 flight, giving engineers an opportunity to further investigate the particular event that created additional moisture in the helmet, stated Lt Gen Helms.

Right now, the EMU is "no-go" for planned EVAs, pending an investigation into what they discover. Should a contingency EVA be necessary, the management is postured to perform an overall risk assessment to support a "go/no-go" decision for contingency EVA.

Lt Gen Helms then discussed the fourth takeaway from discussion with ISS program management. The Panel has been keenly interested in the advent of the PAM as a new player for the ISS, and the first PAM mission was executed by Axiom since the last ASAP quarterly meeting. At this point, full debriefs of the mission with ISS crew, and flight operations teams are still in work, and so the Panel does not yet have all the final information.

First, Lt Gen Helms stated, there have been no apparent overt safety issues reported in the conduct of this mission, and all PAM personnel executed safety-related procedures as trained. Having said that, she added, there were some real-time dynamics related to the flight crew timelines and the addition of the four PAM personnel who had their own flight objectives. In essence, the arrival of the PAM personnel seemed to have a larger than expected impact on the daily workload for the professional space station crew. Lt Gen Helms indicated that insights on the advantages of commercial activity on ISS continue to develop. This particular mission provided an opportunity to develop another avenue for important science, as well as an additional opportunity to transfer a modest amount of cargo for NASA. However, she noted, there were some opportunity costs in the form of overly stressing the workload of the onboard ISS crewmembers and the mission controllers who support them.

The Panel can only conclude that having a PAM to the ISS creates a more tightly integrated set of onboard activity to the overall mission than previously anticipated. Also, although NASA is still in the preliminary stage of discovery, the Panel can already see the value of advising that PAMs be managed within and to normalized processes that fully integrate on-orbit operations, and that PAM operations move through established ISS risk management decision boards. Lt Gen Helms informed that this risk management posture would include: managing the PAMs using ISS cargo transport vehicle integration processes for logistics management; ensuring PAM flight activity timelines are fully integrated across all onboard flight operations, including increasing the assumptions of time inefficiencies appropriate for the four nonprofessional ISS crewmembers; and ensuring PAM science payloads are vetted by normal risk management processes given to all payloads destined to fly on ISS.

In conclusion, the Panel has already mentioned how incredibly busy the overall ISS manifest is, and how the entire ISS enterprise operates with a sustained level of risk with the plus-up from seven to eleven people. PAM operations such as Axiom add additional performance demands on the overall ISS configuration. Lt Gen Helms observed that the ISS program should continually lead ongoing risk-related impact discussions surrounding both opportunities and opportunity costs of future PAM flights.

Lt. Gen Helms added one last discussion point. She noted that the Panel received input from the ISS program that the recent Russian anti-satellite (ASAT) test that was accomplished in November has notably added to the debris field, putting the ISS at higher risk now. She believes it may be as much as double the risk at that particular altitude than was occurring before the test event. So, Lt Gen Helms stated, the Space Traffic Management of orbital debris is obviously not a diminishing concern, but rather, a growing concern. In this case, it was a step-function growth in the concern after that ASAT test. That is a safety risk the Panel will continue to track going forward.

Dr. Sandra Magnus added that the Panel has commented several times about how important it is that our nation take the increasing crowdedness of space seriously, and the nation's ability to manage it by creating a civil authority to take this over to help NASA and the people and companies that are trying to engage in on-orbit activities safely. Dr. Magnus stated that she was excited to find out there was a hearing on the House side of Congress today on this topic and hopes this means there will be some [legislative] action taken. In the meantime, the Panel will continue to comment on the safety aspects of this problem and the need to get this issue addressed.

Dr. Sanders added that the Panel has an open recommendation to Congress to take this action. The Panel has clear indication that Congress acknowledges the threat and the reason for having to take some action. Congress has not finalized—or indicated—what that action might be. The risk, Dr. Sanders emphasized, only continues to grow. Hopefully, there will be some positive steps forward in the very near future.

Dr. Sanders indicated that the Panel has said it before and will repeat it again—the ISS program works the issues of operating in space in a very focused and effective manner. They do it so well, in fact, that it seems routine and almost easy. Dr. Sanders said we should all remember that it is neither and that risk management is a constant necessity.

With respect to the ASAP's Annual Report recommendations, the Panel invested time during the week to look into the steps that have been taken toward strategic planning, reorganization, and Artemis program management. Dr. Sanders then asked Mr. Paul Hill to initiate comments on these topics.

Moon-to-Mars

Mr. Hill stated that the Panel was impressed and encouraged by Jim Free's and Kurt Vogel's discussion about Exploration Systems' shift in the strategy to deliberately define a Moon-to-Mars architecture based on campaign objectives. The Panel had two top-level reactions to Mr. Vogel's exceptional approach to effective systems engineering and the typical hindrances to achieving it:

1) The ideas are fundamental, if not basic and almost obvious points to manage by.

2) They are *exactly* what have been missing in NASA's Moon-to-Mars strategy and discourse.

By that, what the Panel saw that was so encouraging was a deliberate shift away from developing open-ended capabilities in search someday of a mission and, instead, a deliberate definition of programmatic goals and objectives. From this, then, is derived the architecture of systems to achieve the goals. In other words, first define the *why,* then develop the *how*, and from that, the top-level requirements from which to form programs and detailed development and performance requirements. Mr. Hill emphasized that the Panel believes this strategy to be exactly right.

The goal now is for Mr. Free's team to map the systems that are now in varying levels of development into the needs as defined by the goal-driven architecture, Mr. Hill explained. Of course, that could lead to changing some previous decisions or discarding some systems that do not support the deliberate architecture, but it will focus the NASA team on what is critically important in going to Mars. In short—deliberate strategic planning and development, and all under a single leadership structure.

To the extent that this thinking is influencing Agency leadership, it is safe to say the Panel applauds it. Mr. Hill added he personally wanted to stand up and cheer when he heard this.

This shift is a critical component to answering the first recommendation from the ASAP 2021 Annual Report, **[2021-05-01]: Development of Agency Strategic Vision for the Future of Space Exploration and Operations**:

> NASA should develop a strategic vision for the future of space exploration and operations that encompasses at least the next twenty years, including potential alternative scenarios driven by how the Agency is going to understand and manage risk in the more complex environment in which it will be operating.

There is more work to do before this recommendation is fully closed, but the Panel sees this as a very positive and critical step.

That said, the Panel is still puzzled by the Artemis campaign's program structure and their rationale for acquisition type, meaning a hardware development approach vs. buying a "service" element-by-element of the architecture. In the third recommendation from the ASAP 2021 Annual Report, **[2021-05-03]: Establishment of an Artemis Integrated Program**, the Panel said:

> NASA should manage Artemis as an integrated program with top-down alignment, and designate a Program Manager endowed with authority, responsibility, and accountability, along with a robust bottoms-up, collaborative feedback process for both Systems Engineering and Integration (SE&I) and risk management.

Although NASA took some initial steps toward consolidating Artemis program responsibility and authority, their structure splits accountability for development and operations, Mr. Hill observed. This appears to add complexity and difficulty in consistently managing risk from the development phase into flight operations. The Panel will be very interested in understanding the transition points of programs between these two departments.

Again, the Panel was impressed by this very deliberate, goal-driven architecture definition approach. Mr. Hill echoed the Panel's combined opinion to encourage the Agency to communicate this strategy both internally, to align the workforce and leadership, and to inform and gain support from external

stakeholders who, otherwise, will snatch defeat from the jaws of victory and crush the Agency's hope of pulling out of their death spiral.

Dr. Sanders added that obviously, for NASA to execute a strategy for Moon-to-Mars, NASA needs the external stakeholders to support the strategy with a constancy of purpose. The Panel also engaged with the leadership and workforce on the Artemis initiative and several of its components. Dr. Sanders asked Dr. Magnus to expound on these points.

Exploration Systems Development

Dr. Magnus indicated that with the reorganization starting to take shape, the clarity on the architecture and development components is also starting to benefit the various programs that are part of the Artemis campaign. As Mr. Hill mentioned, the new organizational structure has embedded in it an integrated mission architecture and top-level requirements identification and subsequent flow and allocation to the programs. As NASA continues to refine the architecture and drill down into the next level of details necessary to design, build, deliver, and operate systems that can function together, the ability to track and allocate requirements across that complex system of systems and adjust as necessary will help identify, manage, and mitigate risk for the lunar program, Dr. Magnus informed. With this alignment of the approach that the ASAP has been recommending for some time, and in the briefings that were received, the Panel is already starting to see the positive impact of this dynamic on some of the programs.

As Dr. Sanders mentioned, the Panel was able to visit the VAB to view the Artemis 1 rocket, which was a wonderful opportunity to see the hardware ASAP has been discussing for so long. NASA is preparing the system to return to the pad to continue the wet dress rehearsal testing. As this is the first time the full system—both hardware and software—has been integrated and put through the launch preparation processing, it is no surprise that the Agency has been learning things along the way, Dr. Magnus stated. The next wet dress rehearsal attempt will be early next month (June) and no doubt the Agency will learn more as the journey continues toward launch.

The Panel continues to be concerned about the Human Landing System (HLS) and its end-to-end acquisition approach. As stated earlier, the acquisition approach of using a service contract to acquire a critical system in an area with limited institutional and foundational knowledge adds increased risk. Dr. Magnus stressed that unlike Commercial Crew Services to low-Earth orbit, where decades of engineering and operational knowledge are available and easily accessible to the whole community—along with a broad understanding of risk and mitigation strategies—there is little information, or a developed experience base, on the "gotchas" and best design and operational strategies to employ to minimize risk, when it comes to landing on the Moon. Basically, the "unknown-unknown" space is much larger. NASA has worked hard to create a list of human certification requirements, Dr. Magnus continued, which it feels will provide enough guidance to drive the risk posture to an acceptable level. NASA also feels that based on experience from the CCP—through informal channels, based on insight discussions—the Agency will be able to drive the design in the direction it would like. Dr. Magnus stated that the success of this approach relies heavily on the good-will and transparency between the contractor and NASA and will require mindfulness and constant vigilant program management. While there are examples in the CCP where this approach has worked, there are also examples where this approach has not been sufficient. Design decisions do have an impact on operations and risk posture

and NASA must stay on top of this dynamic and engage early and often to truly understand the risk posture they will be accepting when the "service" is delivered, Dr. Magnus advised.

In addition, the Panel continues to be concerned about the lack of a competitive environment for the HLS. Dr. Magnus stated that the "service" contract approach for the CCP was partially justified by the competitive environment that was established by having two providers, which gave NASA a lever to drive decisions for both providers in the direction they wanted, especially in areas to reduce risk. The HLS as of yet does not have the same environment. Instead, there is only one provider—one that has admittedly different ultimate goals for their system that may or may not impact NASA's risk posture for their own missions, Dr. Magnus added. Debates continue regarding the necessity of a second; the debates should include a careful look at how the acquisition strategy is related to and impacting NASA's ability to proactively, and to the maximal extent, manage the risk that the crew will face.

NASA is currently evaluating the responses to their request for proposals concerning lunar suits. The Panel is very pleased to see that a formal program has been put in place to manage this important project. Dr. Magnus explained that the suits are, after all, one-person spaceships, and should be managed with the same rigor and discipline as any other complex human spaceflight system, in addition to being on the critical path to a Moon landing. But while the Panel is happy to see that the lunar suit program is moving forward, it continues to be concerned about the age of the ISS suits. Lt Gen Helms had already discussed the most recent incident of water in the helmet. The suits—which were originally designed to be flown, used, and returned to Earth for refurbishment—routinely undergo extensive work on ISS that was never planned. Dr. Magnus stated that the ISS program and the engineers at NASA are doing great work trying to keep the suits in service, but for some time the hardware has been "talking," and the Panel continues to emphasize the need to replace these suits. The suit program, understandably looking forward to the lunar suits, should not neglect the criticality of addressing the ISS suit issue, Dr. Magnus concluded.

Dr. Sanders stated that for the first time in a while the Panel did some follow up digging into the status of cybersecurity with pleasant results. Dr. Mark Sirangelo was invited to summarize the progress that has been made.

Office of the Chief Information Officer

Dr. Sirangelo stated that the Panel had a session led by the NASA CIO and the NASA CISO. He then highlighted some challenges in protecting the Agency. Just as an example, these offices provide cybersecurity for over 275,000 devices. Also, there are over 800 system security plans and authorizations to operate. Every month, 1.5 million hours of cloud computing happens, and there are over 2,500 physical servers and over 7,000 virtual servers. This is all to support something on the order of 35,000 daily remote workers in the Agency. This is, as you can imagine, a very large challenge, Dr. Sirangelo noted.

The organization has been following and continues to follow Executive Order 14028, which lays out the cybersecurity objectives of 2022. This has been done with strong support from the NASA leadership, Dr. Sirangelo mentioned. There are really five areas in this Executive Order that define the objectives for the year. The first is cyber hygiene: how to protect data, intellectual property, and digital identities. The second objective is zero-trust architecture, which is becoming more and more important throughout the course of the U.S. Government. The second and third objectives involve software supply chain security

and the consolidation and transference of all information technology (IT) architectures with a data-centric "zero-trust" cybersecurity model. This is a very difficult and aspirational goal, Dr. Sirangelo added, but it is extremely important in what NASA does. The fourth objective, which is the event-logging goal, is to enhance real-time cybersecurity event data and threat detection and concerns. The final objective is on the contractor side, and that is to standardize cybersecurity requirements in Agency contracts.

Dr. Sirangelo stated that, looking back over the history of this Panel before he joined, there had previously been a number of concerns and issues which the Panel had raised during its reviews. He added that collectively, the Panel now feels very encouraged and optimistic about the direction NASA is going. Particularly, Dr. Sirangelo called attention to a couple major achievements that have happened recently. The first is that the Agency has now moved to one CIO organization, where previously, there were multiple organizations at multiple centers. The Panel thinks this is a very good trend. The idea behind this is to centralize the budget and workforce authority for all of NASA IT under the Agency CIO to create common funding models for IT services across NASA and replace any inconsistencies that might be there. Furthermore, this will standardize the IT organizations across the NASA field centers. This will also help move NASA to a zero-trust model. And in doing that, of course one of the other objectives is to standardize the contracting process. The Panel is pleased to see the CIO is in the final stage of the selection process for NASA's first security enterprise-wide contract.

Dr. Sirangelo called a couple of other accomplishments into the record. He mentioned that seeing the development of NASA's first ever cyber risk dashboard for NASA leaders to help monitor the Agency is a major step forward. Over the past five years, management and the hard-working people of these two organizations (CIO and CISO) have reduced NASA's risk exposure of unpatched critical vulnerabilities by 97 percent. Dr. Sirangelo mentioned that an Office of the Inspector General financial audit, which was conducted in FY21, resulted in no significant IT findings—a first in NASA's history—and should be congratulated. Also, improvements to NASA's internet perimeter to combat cyberattacks is now blocking approximately 5 billion attempts per day of malicious and unauthorized traffic, which is simply stunning, Dr. Sirangelo stated. He added that the system is now inspecting all inbound/outbound email at NASA, blocking approximately 1.5 million threats weekly.

Not all of this activity is in cybersecurity and actual software. There are major accomplishments in Agency education. The Panel was pleased to hear about the effort to improve and manage NASA's cyber risk with a dozen briefings to more than 5,000 employees and contractors. Dr. Sirangelo concluded by adding that these good things do not happen without good leadership. The Panel would like to give a big thank you to Jeff Seaton, the NASA CIO and to Mike Witt, the NASA CISO who briefed the Panel members and spearheaded the amazing changes. Dr. Sirangelo also thanked the CIO and CISO teams for all their hard work and results. He ended by stating that from what the Panel has seen and heard, NASA is now widely recognized as the USG IT Supply Chain Risk Management (SCRM) leader for all the efforts that have been done.

Dr. Sanders thanked Dr. Sirangelo for mentioning the contributions of leadership and their teams who did the actual work and to the leadership of the Agency itself that put the emphasis on the importance of such work. Dr. Sanders then noted that some may recall that the Panel has had a long-standing recommendation that bears on this topic. She asked Lt Gen Helms to provide an update on the status of that recommendation.

Lt Gen Helms read the related recommendation, **[2016-04-01]: Asset Protection - Security Clearance Policy**, opened in 2016:

> 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.

It has been a long time coming, not helped by COVID and all the focus on more important things for almost two years, Lt Gen Helms stated. But, she added, the Panel finally heard back from NASA on how the updated security clearance processes have worked their way into outcomes. And these outcomes are, according to the information that the Panel has had a chance to review, that the security clearances for key personnel are now in place, part of their job descriptions, and in effect. The Panel can see this not only reflected in the culture that Dr. Sirangelo just described, but the Panel also had a discussion with Mike Witt about how things have improved in the last five years. Lt Gen Helms added that it is the Panel's collective decision to close this recommendation.

Dr. Sanders agreed that the related recommendation is now closed. She stated that one additional topic to cover is Health and Medical. Dr. Richard Williams was asked to discuss this topic.

Chief Health and Medical Officer

Dr. Williams noted that the Panel had a meeting with the NASA Chief Health and Medical Officer, Dr. J.D. Polk. The Office of the Chief Health and Medical Officer is developing a focused effort on knowledge transfer in the areas of human health-related standards and investigation of human spaceflight mishaps. This effort started with the review of the cumulative experience and databases concerning human spaceflight mishaps. External partners and stakeholders, including the National Transportation Safety Board, the Federal Aviation Administration (FAA), and commercial spaceflight companies, can benefit from specific knowledge of the unique aspects of human spaceflight mishaps in areas such as biodynamics, forensics, vacuum and high-altitude exposure, as well as thermal environmental exposures during various phases of flight. The Office is organizing an educational effort in human spaceflight mishap investigation aimed at closing knowledge and experience gaps for the partners and stakeholders in the event of a commercial human spaceflight mishap.

NASA medical authorities are also working on a high-level NASA policy addressing the health aspects of human spaceflight mishap investigations. The Office of the Chief Health and Medical Officer recognizes the need for enhanced understanding of human health-related standards and requirements related to human spacecraft development and operation. The Health and Medical Technical Authority (HMTA) has been augmented from a staffing perspective: HMTA personnel are embedded with program personnel when possible. From a best-practice perspective, HMTA personnel are working to discern workforce understanding of human systems standards and to provide education when needed and appropriate, including understanding of the evidence base supporting those standards.

The Office has some workforce concerns. Many of the engineers in the workforce are early in their careers and have little experience with the health and medical aspects of human spaceflight. The HMTA is working on providing feedback and recommendations on standards and requirements early in the program development process. The Office is also trying to address the interaction between requirements from different standard owners at NASA to provide integrated input to program

personnel. Cut sheets have been developed to provide background information and context to facilitate integration between related standards. Tech sheets are being developed to explain the biologic evidence base of supporting human health-related standards and requirements. This effort toward enhancing understanding of human spaceflight-related standards and requirements also proves useful to the FAA as they develop their human spacecraft certification process.

The Office shares concerns with other technical authorities about the progress of Boeing spacecraft. From the health and medical technical authority standpoint, questions remain in areas such as parachute performance and anthropometry, environmental control and life support system performance, and fire suppression system performance. The Office of the Chief Health and Medical Officer will continue to work with Boeing through the upcoming uncrewed OFT launch to support the future crewed flight tests.

Finally, Dr. Williams indicated that Dr. Polk briefly addressed with the Panel the necessary paradigm shift in treatment of injury and illness, with the shift to exploration class spaceflight missions. Medical treatment will be constrained but must be maximized within those constraints, since the ability for timely evacuation will not be available. The Office of the Chief Health and Medical Officer will continue to work with the Department of Health and Human Services, the Department of Defense, and other external partners on areas of mutual interest to translate medical capability to space. The Panel looks forward to following this effort in the future.

Dr. Sanders stated that the discussion Dr. Williams noted on the medical aspects of mishap investigations, recalls our long-standing and open recommendation on that topic. In 2015, the Panel made a formal recommendation to review and update the essentially obsolete Authorization Language with respect to space mishap investigations. It was already outdated in 2015, being much more focused on Shuttle era operations than the type of operations NASA now executes, Dr. Sanders added. It also reflected a cumbersome and inefficient approach. It is even more inappropriate at a point in time when increasing operations are being conducted by entities other than the government. While the Panel's charter is to be concerned with NASA spaceflight safety, the Panel would be remiss if it did not note the clear absence of regulation, standards, rules of the road, and procedures and processes for mishap handling for non-governmental space operations.

In closing out this meeting, Dr. Sanders reiterated the positivity in being able to conduct the ASAP engagements in person. But this brings to mind a topic that arose multiple times during the course of the week: workforce—skilled workforce—recruitment and retention for NASA. Clearly with a more robust commercial space industry, the competition for talent is intensified. NASA cannot likely compete for that talent on salary. But NASA remains an attractive employer because of the criticality and exciting nature of its mission. As the workforce begins to return to onsite work, the Panel hopes that brings an amplification of the sense of being a part of the NASA family and invested in the nation's success in space exploration.

With that, Dr. Sander opened the meeting up to comments from the public. No comments were received. Dr. Sanders thanked all who joined and adjourned the ASAP Second Quarterly meeting of 2022 at 2:27 p.m. ET.

ATTACHMENT 1

Note: The names and affiliations are as given by the attendees, and/or as recorded by the telecon operator.

PARTICIPANTS

Bill Harwood	CBS News
Linda Karanian	Karanian Aerospace Consulting
David Gaba	Stanford University
Amanda Miller	Air Force Magazine
Brent Duncan	Boeing Communications
Donald Wood	NASA
Josh Finch	NASA
Marcia Smith	Space Policy Online.com
Darlene Pokora	NASA Commercial Crew Program
Douglas Burkinring	Future Astronaut
David Kerley	Discovery Channel
Caroline Kostak	NASA JSC
Laura Forczyk	Astralytical
Jeff Foust	Space News
David Millman	
Susan Sawyer	Commercial Crew Program
Jessica Lawn	NASA
Ann Vulkosky	Lockheed Martin
Chris Davenport	Washington Post
Jared Stout	PLLC
Dillon Micins	SpaceX
Joey Roulette	Reuters
Johnny Nguyen	NASA
Rachel Kraft	NASA
Erica Laphase	
Mark Nappy	Boeing
Kristin VanWychen	USAGAO
Taylor Dacko	NASA
Stephen Clark	Space Flight Now
Diane Rausch	NASA HQ
Micah Maidenberg	Wall Street Journal
Catarina	AST International
Kathryn Hamilton	NASA
Michael Lapidus	SpaceX
Stephanie Schierholz	NASA
Fred Desousa	Bechtel
Ashely Accardo	Bechtel
Vanessa Lloyd	NASA

Louis Rosewall	Lockheed Martin
Chris Kunstadter	AXA XL Insurance
Richard McKinney	Private Consultant
Zack Goldman	Unaffiliated
Justin Bachman	Bloomberg
Heather Smith	University of North Florida
Christine Joseph	Senate Committee Staff
Amelia Batcha	NASA