

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

August 18, 2023

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

Dear Senator Nelson:

The Aerospace Safety Advisory Panel (ASAP) held its 2023 Third Quarterly Meeting in-person at NASA's Marshall's Space Flight Center, August 1-3, 2023. We greatly appreciate the participation and support that were received from NASA's leadership, the subject matter experts, and the support staff.

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

Sincerely,

A handwritten signature in cursive script that reads "Patricia Sanders".

Patricia Sanders

Chair

Enclosure

AEROSPACE SAFETY ADVISORY PANEL

Public Meeting

August 3, 2023

Hybrid

2023 Third Quarterly Meeting Report

ASAP Panel Member Attendees

Dr. Patricia Sanders, Chair (*virtual*)

Mr. William Bray

Lieutenant General Susan J. Helms, USAF (Ret.)

Mr. Paul S. Hill

Mr. Kent Rominger

Dr. Mark N. Sirangelo

Mr. David B. West

Dr. Richard S. Williams, MD, FACS

NASA Advisory Council (NAC) Member Attendees

Dr. John Daniel Olivas, NAC

ASAP Staff and Support Personnel Attendees

Ms. Carol Hamilton, NASA ASAP Executive Director

Ms. Lisa Hackley, NASA ASAP Administrative Officer

Ms. Ashley Mae, Tom & Jerry, Inc, Technical Writer

[Appendix A – Teleconference Attendees](#)

Ms. Carol Hamilton, Aerospace Safety Advisory Panel (ASAP) Executive Director, called the meeting to order at 1:30 p.m. central daylight time (CDT) and welcomed everyone to the ASAP's Third Quarterly Meeting of 2023, held at the National Aeronautics and Space Administration's (NASA) Marshall Space Flight Center (MSFC). Ms. Hamilton noted that the Federal Registry Notice gave the public the opportunity to send safety-related statements or to make comments prior to the scheduled meeting. It was noted that no such comments or statements had been submitted prior to the meeting, but time would be allocated at the end for public comments.

Lieutenant General Susan Helms informed all those in attendance that Dr. Patricia Sanders, Chair of ASAP, was not present due to surgery that left her unable to travel. Lt. Gen. Helms reassured everyone that Dr. Sanders had been present, virtually, for the entirety of the meeting. She also stated that interfacing with NASA had led to a very rich meeting over a myriad of topics including the International Space Station (ISS), the Commercial Crew Program (CCP), the Office of the Chief Health and Medical Officer (OCHMO) overview, the Moon to Mars (M2M), and the commercial low Earth orbit (LEO) planning. She then discussed how the Panel would be

revisiting three of their strategic recommendations with a summarization of knowledge, understanding, and development of said recommendations.

Lt. Gen. Helms then handed the meeting over to Mr. Kent Rominger.

Mr. Rominger stated that they had a great briefing on the ISS. The ISS program continues an impressive operations tempo managing crew and cargo visiting vehicles, extravehicular activities (xEVAs), ISS science, and maintenance while maintaining a high degree of safety. The program has strong collaborative relationships with all international partners including Russia. The Panel is pleased to hear that communication and collaboration between Russian and United States (U.S.) programmatic personnel has continued to be very professional and productive. There are several ongoing issues and concerns that the program, and the Panel, continue to monitor.

Soyuz and Progress coolant leaks are being closely monitored, and the ISS Program has contingency plans in place to return astronaut Frank Rubio on a crew Dragon should additional leaks manifest themselves on future Soyuz vehicles. As reported before, cracks have been identified and repaired in the Russian Service Module hull. Other areas have been identified that might be contributing to the very slow leak rate from the module. All cracks are small, show no sign of propagation or potential for structural compromise, and are currently not thought to impact structural life. Investigations are proceeding to identify possible causes of the leaks, with U.S. support. Repair materials and data for testing and analysis are being shared freely between the ISS partners. The Panel remains confident the ISS team is managing the situation to maintain a safe environment. The ISS program is closely monitoring the preparation of Boeing's crewed flight test that will pave the way for a second U.S. crew transportation provider. There are a few issues being addressed, and those are covered in more detail later in today's briefing.

Cargo launch vehicle redundancy is going to be a concern for, at least, the next one and a half years since Northrop Grumman is planning to fly the Cygnus resupply vehicle on a Falcon 9 booster after the next Cygnus flight until their new first stage booster is certified for flight.

The ISS program has released a draft request for proposal to develop a U.S. ISS deorbit vehicle, and the final request for proposal (RFP) should drop later this year. The ASAP Panel views the ISS program's RFP as an initial response to the recommendation made in late 2022 to "define an executable and appropriately budgeted deorbit plan that includes implementation on a timeline to deliver a controlled re-entry capacity to the ISS as soon as practicable to be in place for the need of a controlled deorbit in the event of an emergency as well as in place before the retirement of the ISS, to ensure that the station is able to be deorbited safely."

The number of low earth orbit satellites has grown significantly over the last several years to over 7,500 which will result in an increase in orbital debris and potential damage to ISS throughout the decade. As previously reported, the ASAP recommends that this deorbit capability is fully resourced as soon as practicable to ensure that the ISS can be safely deorbited when the need arises.

The Panel continues to be concerned about the aging extravehicular spacesuits on the ISS. Collins Aerospace Exploration has been awarded NASA ISS extravehicular mobility unit (EMU) suit design and development responsibility through critical design review (CDR) with options through an on-orbit demonstration. Axiom has been awarded the EMU contract for the Artemis

lunar missions and has also scoped ISS usage for NASA consideration. Internal NASA work to develop and maintain current spacesuit capability to support transition to the new suits continues, to ensure U.S. xEVA capability remains available. While the Panel is pleased with these efforts, the Panel retains a sense of urgency to replace the current spacesuits as soon as practical.

Mr. Rominger concluded that the ASAP Panel, all in all, is very impressed with the ISS program's performance managing a highly complex and dynamic program.

Lt. Gen. Helms commented that it is a huge challenge to maintain the ISS program at the level that it is being managed. It is so impressive how the team is managing those challenges. She gave kudos to the team regarding their efforts to not only maintain but also to fully utilize the ISS. She then asked Mr. Paul Hill to take the lead on the CCP.

Mr. Hill started with SpaceX and a few items from the current work status. Crew-6 has been at ISS since March 3, 2023. The mission is going well, and their return is planned after handover to Crew-7 in late August. In preparation, the Crew-7 mission is heading to agency flight readiness review (FRR) on August 14, 2023. As a measure of the continuing improvement that is an inherent part of this business, Mr. Steve Stich, Program Manager (PM), reviewed a long list of SpaceX design upgrades that will be flown on this mission. Overall, SpaceX and the Program are continuing to turn the crank on next missions' preparations for keeping ISS resupplied and crewed all while making a difficult and unforgiving job look easy. Mr. Stich is keenly aware that it only looks easy, and the risks are still great. In fact, he described this as an on-going concern, namely that the program and SpaceX must work hard to remain vigilant and not miss anything because of both the work pace and their success to date.

Mr. Stich also reviewed several engineering challenges that SpaceX has been working through and their closure rationale, all of which they have already discussed publicly, so going into detail isn't necessary other than to say their engineering approach appears sound.

As a reminder that one can never relax in this business, SpaceX had a liquid oxygen heat exchanger explode in their ground support system at Kennedy Space Center (KSC) pad 39A. No personnel or NASA equipment were affected, and SpaceX has already moved out on a design fix. But it's this kind of anomaly in a ground system rather than in a rocket or spacecraft that is a reminder of the very wide array of risks that must be continuously managed in this industry – from tests to manufacturing and launch processing, in addition to flight operations.

Since the last meeting, the NASA CCP and Boeing each conducted reviews geared towards validating closure rationale for previous Starliner reviews, variances, and certification. The Program's Chief Engineer led an internal review from the program team, and Boeing engaged senior engineers from outside their Starliner team for an independent look. The Panel applauds these very positive efforts to reinforce readiness for Starliner's first crewed flight. As for where they are in flight readiness, NASA and Boeing are conducting a press conference Monday afternoon to discuss just that, so the Panel will defer to them.

Mr. Stich reviewed several recent engineering challenges, their resolution, and sound rationale for each. Like the SpaceX challenges, the Agency has already discussed these publicly, so the Panel will not spend time on most of them today.

That said, a recently discovered flammability risk from a tape that was used to wrap Starliner electrical wires has a complicated nuance. This P-213 tape has multiple entries in the material database, some of which show low flammability depending on the specific physical application, and high flammability in others. Unfortunately, these entries were not cross-referenced, therefore it is understandable how this oversight manifested itself into the design. In addition to actions Boeing is taking to mitigate this risk, the program sent a letter across the agency to raise awareness and has made changes to the database to ensure the multiple entries are cross-referenced. It is not clear that there is a rigorous method to inform the broader community of findings like this, not just across NASA but also other government organizations and industry, and the Panel will follow up with the Agency on methods to close that admittedly complicated loop.

Lastly, the Panel suggested the CCP lead an effort to document programmatic lessons learned from the original Commercial Cargo Program through today's commercial resupply and crew transportation contracts. With the Agency leaning further into services contracts (for example for Human Landing Systems (HLS) and Exploration Production and Operations Contract (EPOC) rather than legacy or "traditional" procurement arrangements, the CCP is in a unique position to look back and then inform next programs and contracts on best practices, things to watch out for, contractual focus areas, engagement techniques, etc.

Lt. Gen. Helms then turned the meeting over to Dr. Richard Williams for discussion of the health and medical briefing.

Dr. Williams stated that the NASA astronaut health care system is transitioning to a personalized medicine paradigm, where health risks specific to individuals are identified through a variety of medical tests. These risks can be addressed in a preventive fashion, optimizing health and mission ready capability. An example would be testing for the presence of lipoprotein [a], which increases the risk of cardiovascular disease. The presence of this type of cholesterol would justify early and robust therapy to lower levels and prevent disease. NASA is subject to the Genetic Information Nondiscrimination Act (GINA); NASA medical authorities are careful to remain within the limits of this act in the use of covered health care information.

Spaceflight Associated Neuro-Ocular Syndrome (SANS), which manifests as a visual acuity change in over 60% of crewmembers at about 2-3 months into a long duration flight, needs to be better understood and mitigated as soon as possible. Ocular changes are a prominent component of this syndrome, but anatomic changes also extend to the central nervous system. 3 Tesla MRI evidence suggests brain edema develops in some crewmembers, which raises concern about function at the cellular level. Potential long-term health effects need to be considered. Some pharmacologic interventions, such as short acting glucagon-like 1 receptor agonists, might be effective in mitigating these effects, but much remains to be clarified. Long duration flights in LEO afford the best venue for understanding this risk and should be leveraged to the maximum extent in the coming years. SANS will be a risk attending missions requiring Mars transit.

NASA health authorities are assisting the European Space Agency (ESA) pursue their para-astronaut program. Prosthetics fit on orbit for amputees, prosthetics materials testing and certification, prosthetics suitability for on-orbit exercise equipment, and physiological challenges unique to amputees are all being studied to facilitate para-astronaut space flight participation.

NASA continues to share space flight medical experience with government entities and the private sector domestically and internationally. All NASA medical selection and qualification standards are now available on the NASA website, as are spacecraft development standards with technical briefings. NASA medical authorities are actively sharing their expertise worldwide.

Dr. JD Polk, the NASA Chief Health and Medical Officer, also highlighted the array of activities conducted by the Health and Medical Technical Authority in support of NASA human space flight programs. The Panel is particularly interested in the escalation of human health risks attending the M2M programs, and how this impacts the integrated human space flight risk mitigation effort. The Panel looks forward to more detailed briefings in the future about changes to NASA's approach to human health risk mitigation, including those risks related to isolation and confinement, as the Agency transitions to long duration missions beyond low Earth orbit.

Lt. Gen. Helms responded to Dr. Williams' briefing with a statement regarding Dr. Polk's presentation. She stated that it serves as a reminder that the human body does change in space. On the ISS, they can capture that data, bring it back for analysis, and establish that things are occurring. She posed the question of what is the broader risk picture of sending people to the Moon and then further on to Mars. She stated that the Panel wanted to bring Dr. Polk back in his Technical Authority (TA) role to provide them with a big picture view as done some years ago. Mr. Hill added that a focus of the Panel is to be informed by Dr. Polk's risk summaries and then to look to the Agency for how the M2M architecture and design solutions address and mitigate those human health risks. Mr. William Bray added that the work done in architecture should help with the long-range view.

Mr. Bray thanked all those in attendance and Lt. Gen. Helms prior to delving into the topic at hand. The Panel once again had the opportunity to meet with the M2M Program Manager, Mr. Amit Kshatriya, and his team. It was an excellent update, and the Panel continues to be pleased with the Program Management team's stand up of the organization, the progress towards the next Artemis Missions, continued programmatic and technical alignment of the elements, and the application of good system engineering practices based on first order principles with a focus on risk.

On the organizational restructuring to a Program Management Office, it is clear to the Panel that it has been seamless, and after only a few short months, there does not appear to have been any loss in momentum or focus on the overall program execution. Kudos to Mr. Jim Free, Mr. Kshatriya and the entire NASA team.

Mr. Kshatriya also provided a detailed program brief, highlighting key accomplishments since the last ASAP meeting for Artemis I through III missions. Artemis I wrapped up its Post Flight Analysis Review (PFAR) process with the bulk of the issues identified, root caused, and dispositioned. The few remaining unresolved issues are being carried forward as risk items into the Artemis II mission. The Panel will continue to watch these remaining risks to closure. The Artemis II Mission Integration Review has been completed. Hardware and software system tests and integration plans are being executed and, although early in the process, NASA continues to make progress towards a Certification of Flight Readiness (CoFR).

With respect to Artemis III, a mission priorities summit to establish a baseline of specific objectives and priorities was completed so that the go forward plan is aligned and focused on

understanding risk items and driving them down as the team progresses towards a launch. This technical focus early in the Artemis III mission planning is critically important because of all the technological firsts that will occur on this mission. Focusing on this now will pay dividends in the future so that risks are truly understood, mitigated, and clearly communicated along the way.

As a recurring theme throughout the Panel's discussions, it was good to see the M2M Team's continued technical focus on these missions founded on engineering rigor, risk identification and management, and disciplined execution. And as a reminder, it's always important to continue to involve and engage the operators, even in the development stages, to best understand and identify operational risks and challenges for these missions. This includes the core operational precepts of appropriate vehicle command and control, comprehensive navigation, and robust communication.

Also, updates on specific program elements within the program manager's Artemis portfolio were discussed to include Gateway, xEVAs, and HLS. Of those elements, Ms. Lisa Watson-Morgan provided the Panel with an excellent update on the HLS Program that included program updates for both SpaceX and the new second source Blue Origin. To best understand technical risk and resolution of any risk in these service contracts, Ms. Watson-Morgan has instituted a management approach that is based on open, transparent dialogue to enable knowledge sharing among NASA, SpaceX, and Blue Origin. The Panel views the use of joint meetings and technical interchange meetings with all stakeholders present as positive and encourages continuance of this approach so that technical and safety challenges and risks are understood and, most importantly, effectively resolved. This should prove particularly important given the tight development and delivery schedules to support the Artemis Lunar Missions. The Panel also looks forward to detailed briefings on HLS as well as Gateway, xEVAs, Lunar Rovers and other elements in future ASAP meetings.

It was clear throughout our discussions on M2M that the PM and his team have safety and technical risk as an overarching priority and fundamental to NASA's decision-making processes. As one example, the M2M PM has embedded Independent Review Team (IRT) members, with past relevant experience and knowledge, across his various program teams to provide an objective view, encourage knowledge learning from past lessons learned, and provide overall program feedback in near real time rather than waiting for a problem to manifest. That kind of proactive initiative is encouraged.

In closing, the Panel really appreciated the detail and insight provided by the HLS PM and how she is managing and executing the service contracts. At the next ASAP Quarterly, the Panel would like to continue the dialogue with NASA on contracting best practices and application of these approaches to understand how they plan to manage technical program risk across the contracting spectrum, especially for service contracts.

Lt. Gen. Helms stated that the Panel wants to better understand how risk management is constituted in service contracts, who has what authorities and responsibilities for risk decisions, and what level of oversight and insight is contractually necessary to achieve that risk management. Dr. Patricia Sanders replied that the world has evolved a lot since NASA went to the moon. With all the commercial industry capabilities out there, it is good that they can take advantage of that, but they must find a way to do it that allows them to utilize the advantages of

the commercial industry while maintaining proper risk management. Shared risk management is a critical aspect of what is important for NASA.

Per Lt. Gen. Helms, the Panel is about to review NASA's current plan for leveraging the commercial industry to augment and sustain NASA's use of LEO through ISS Utilization. In the context of the M2M's very comprehensive architecture development and objectives which drive plans and resourcing for the Artemis Campaign, in the 2022 Annual Report, the Panel touched on the need for a similar strategic vision for NASA's future in LEO to include how that vision in implementation would support risk reduction for the Artemis campaign. Clearly there is a maturing, near term plan to strengthen the commercial component of NASA's LEO operations, but the Panel remains interested in better understanding the longer-term strategic vision that NASA has for LEO, particularly after the retirement of the ISS. This will be a focus area for the next Quarterly meeting. She turned the meeting over to Dr. Mark Sirangelo for further discussion.

Dr. Sirangelo thanked Ms. Angela Hart, who as the manager of the Comm LEO program and representing a strong dynamic team, provided a compelling and informative briefing. The agenda for the discussion in this important area covered the following areas of interest: Commercial LEO Destinations (CLD) Status; CLD Requirements Development Status; Private Astronaut Missions (PAM) Status; Commercial Space Capabilities (CSC) Status; and top concerns from the program leadership.

The Panel discussed the recent significant accomplishments of the Commercial Leo Development Program of which there have been several. Axiom Space is planning the Axiom Hab 1 (first element) subsystem CDRs with NASA. They have begun the fabrication for primary structure for the first two modules and have started long lead system procurements for flight and development hardware. They have established a system of jointly developing hazard reports and controls/mitigations with NASA and it seems to be progressing well.

Blue Origin in May 2023 completed their Milestone 5 Creep Test, a short-duration test of the soft goods for the Orbital Reef Large Integrated Flexible Environment (LIFE) module, and this milestone was accepted by the CLDP program. Nanoracks successfully completed their Metallic Habitat Material/Manufacturing Demonstration in April 2023 and their Starlab System Readiness Review (SRR) in June 2023. They also signed a memorandum of understanding (MOU) with Indian Space Research Organization (ISRO) to explore use of Gaganyaan crewed spacecraft to service Starlab. Northrop Grumman continues to be making steady progress as a partner. Their post-SRR maturation activities continue, and Design Analysis Cycles are underway in preparation for software defined radio (SDR).

Regarding the upcoming activities of this program. Axiom is continuing their work towards CDR and expects to conclude this effort in fiscal year (FY) 2024. They also expect to take delivery of their first 2 modules from Thales Alenia Space Italy (TASI) during third quarter FY24 and will concurrently expect to be commissioning their Assembly, Integration & Testing (AI&T) facility at the Houston Spaceport in mid-2024. Blue Origin expects to complete their Milestone 10 Window Demo which is a pressure test of a new window design by the 4th Quarter of 2023 as well as their Milestone 7 Core Structural Test, a load test of a full-scale prototype of a

habitable pressure vessel during that same period. Nanoracks and Northrop Grumman will be doing their System Design Review in the 3rd Quarter of 2023.

The program also made significant progress toward requirements development. The request for information (RFI) #2, Concept of Operations and Utilization Whitepaper, was released on February 13, 2023, and 332 Comments were received on the Concept of Operations Whitepaper, as well as 131 Comments received on the Utilization Whitepaper. There has been a considerable amount of interest, thought, and effort which displays the progress made in engaging the industry around this concept.

The Draft of the CLDP-REQ-1130 Requirements and Standards has been completed and is in final NASA review with plans to release an RFI to industry this summer. This draft reflects efforts to define end-to-end services; Transportation to the Destination, On-Orbit Destination, as well as Crew Return.

Dr. Sirangelo wanted to speak briefly about the private astronaut missions (PAM). PAM 2 was successfully executed. This PAM mission was conducted by Axiom Space on SpaceX Falcon 9/Crew Dragon from May 21 to May 30, 2023. During this mission the Axiom 2 crew successfully implemented a full manifest of science, outreach, and commercial activities. Notable firsts of this mission included the first Saudi astronauts to visit the ISS, first Arab woman to orbit Earth, first female commander of a PAM, and fastest launch to docking for a Crew Dragon. The mission also helped NASA by returning over 300 pounds of NASA cargo including a nitrogen oxygen resupply tank (NORS) tank.

PAM 3 will also be led by Axiom Space and fly on a SpaceX Falcon 9/Crew Dragon for a mission duration of 16 Days and 14 Docked Days. It is currently expected no earlier than (NET) November 2023, although that is under review. The PAM 4 award selection is currently pending. There is very good progress with the PAM missions.

As for the Collaborations for Commercial Space Capabilities (CCSC) 1 and 2, the CCSC1 unfunded Space Act Agreement (SAA) collaborations that began in late 2014, with Final Frontier Design (now Paragon), Northrop Grumman, SpaceX, and United Launch Alliance have all been successfully closed out. Each of these Partners achieved their intended capabilities, and NASA support was instrumental in their efforts. Following on the CCSC1, the CCSC2 competition was completed in June 2023, and 7 Unfunded SAAs were awarded to Blue Origin, Northrop Grumman, Sierra Space, Special Aerospace Services, SpaceX, ThinkOrbital, and Vast Space for U.S. commercial LEO capabilities benefiting human spaceflight.

The program continues to track and mitigate the same top risks discussed with the Panel in the past and each has their own specific set of mitigations. Of the concerns being tracked, the higher priority ones are that the CLD Partner schedule may slip past ISS end of life which also may be challenged by the increase in orbital debris activity in LEO that could compromise the full expected remaining life. As a new market that is not yet mature, the markets and demand for non-NASA Services are uncertain both in quantity as well as in profitability. Also, they continue to track the concern that the common Interfaces between CLDs are currently not defined and this may limit the use of common systems which could enable a more seamless transition. One new developing concern is that the anticipated budget challenges may produce new risks to this

critical program's plans and challenge or limit the availability of NASA to support the commercial enterprises in their development efforts to the level it wants to achieve. In closing, the ASAP Panel would like to thank Ms. Hart and her team for their strong efforts and to thank NASA's commercial partners for their vision of and commitment to the future of LEO for the U.S.

Lt. Gen. Helms segued into the strategic recommendations. In 2021, NASA was at an inflection point regarding its future; the many challenges facing NASA including budget, manpower strategies, clarity of purpose, and acquisition strategies were likely to have an impact on NASA's abilities to manage risk as it embarked on the most challenging human endeavor of recent times. In the face of that, the Panel developed three recommendations for the 2021 report that they felt would help NASA address their most strategic challenges and would better position the Agency for a risk managed future in human exploration. Today the Panel would like to recap those three recommendations and convey their sense of NASA's progress. She handed the meeting, first, over to Mr. Bray.

Mr. Bray emphasized that the Panel understands that these action items could not have been completed overnight, that they take an immense amount of time and effort. Mr. Bray recalled **Recommendation 2021-05-01** on the strategic vision:

“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, that is driven by how the Agency is going to understand and manage risk in the more complex environment in which it will be operating.”

The vision should describe the role that NASA intends to play during that period and how it plans to engage with both commercial and international partners. When the Panel reviewed this plan and what has been completed currently, it noted amazing work regarding the overall NASA strategy, M2M objectives, and communication of that to key stakeholders and the workforce. The follow-through activities, such as the M2M Architecture, have been excellent.

However, one focus area is the assessment of the NASA workforce. Assessing the workforce to include the number, types, skills, experience, and responsibilities that will be required, and the infrastructure facility requirements, to create a plan for managing changes necessary to meet those requirements. While Ms. Casey Swails briefed the Panel on items related to this concern in the past, the Panel looks forward to hearing from her in the future on progress made.

Looking forward, another area of focus for the Panel to understand will be how NASA will propose general criteria for evaluating “make, manage, or buy” decisions on future programs or projects. All aspects of the strategic vision and its implementation should continue to be clearly and unambiguously communicated throughout the Agency.

As stated previously, there has been good work and progress made regarding the strategic vision, but the Panel wishes to see how NASA is going to drive this going forward.

Lt. Gen. Helms thanked Mr. Bray and turned the meeting over to Mr. Hill regarding ASAP's governance recommendation. Mr. Hill reiterated what Mr. Bray discussed. Culture within NASA's leadership ranks is an important factor, and Mr. Bob Cabana has been supportive through this process.

Mr. Hill recalled **Recommendation 2021-05-02** on shared governance:

“As a part of an overall risk management approach and in order to develop and execute its strategic vision for the future of space exploration, NASA should establish and provide leadership through a “board of directors” that includes the Center Directors and other key officials, with the emphasis on providing benefit to the Agency’s mission as a cohesive whole, and not to the individual components of the Agency. The Board should act to identify the strategic risks and obstacles that NASA may encounter in executing its mission, evaluate Agency-level mitigation approaches, and align the efforts of all Centers to ensure desired outcomes.”

NASA formally responded to this recommendation last year, which led the Panel to clarify the intent of the recommendation. Specifically, the Panel is focused on how the senior leadership engaged, were aligned to agency-level priorities, and then are held accountable to execute accordingly – rather than on establishing a separate governing body.

That said, as the Panel has pointed out in our last two quarterly meetings with NASA, the Panel sees the Artemis architecture concept review process and the NASA 2040 effort to be outstanding steps towards articulating Agency-level priorities and strategy. It cannot be said too strongly how supportive the Panel is in both efforts and their direct contribution to achieving the governance process that the Panel has recommended.

The Panel also said in last year’s annual report that they concur with NASA’s approach in using their existing management forum structure to, “deliberately use the full and open forums to maximize transparency and engagement” and to “deliberately align to Agency goals.” It is clear the Agency is taking deliberate steps in this direction.

The final step the Panel recommends, Mr. Hill said, is about accountability, or, referring to the last phrase from the formal recommendation: “align the efforts of all Centers to ensure desired outcomes.” As the Panel stated in the 2022 annual report: “Expect the Centers to then execute accordingly, bringing exceptions, new information, reclaims, et al. back to the” full senior leadership team as a group. Inherent in this are both the expectations to execute accordingly and being held accountable to do so, from budget submissions to the related infrastructure and workforce decisions.

All of this is intended to pivot the agency at all levels to executing to the top-down strategy and missions. Again, the Panel strongly supports the steps NASA has taken and sees these final steps in alignment and accountability as critical to ensuring Agency resources are best positioned to manage the full array of humbling risks associated with their full-mission portfolio.

Lt. Gen. Helms then addressed the third of three recommendations from the 2021 report. At that time, there was not a formal program office managing the Artemis campaign. While there were program offices for SLS and other various aspects of the Artemis campaign, the Panel questioned how integrated risk was being managed, who was in charge, and who made final decisions. A PM with this authority would be the end-all, be-all responsible regarding all aspects of this campaign.

Lt. Gen. Helms recalled **Recommendation 2021-05-03** on Artemis Program Management:

“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 bottom up, collaborative feedback process for both Systems Engineering and Integration and risk management.”

Lt. Gen. Helms stated that the Panel witnessed the bottom-up, but there was a lack of top-down authority, responsibility, and accountability. This was the genesis of the 2021 recommendation. It was a painful discussion, but nearly two years later the progress made has been phenomenal. NASA has pulled together a comprehensive team across the entire enterprise which is amazing to witness. With the establishment of the M2M program, the architecture work, and the M2M objectives that now guide resources and priorities, much progress has been made. NASA is to be commended. One area the Panel touched upon is NASA’s historical necessity to have a prime integrating contractor helping to manage risk across all the projects and subprograms covered by a program office. In the case of M2M, Mr. Kshatriya stated that the government would be performing that role. The Panel seeks information and clarity regarding this topic at its next Quarterly meeting.

Dr. Sanders stated that NASA has embarked on the most complex set of endeavors that they have ever undertaken, not just in human spaceflight but also in scientific endeavors. At the same time, NASA must work in extremely complex environments. It is not just NASA – it is NASA with industry and international partners. The Panel has a lot of confidence in NASA’s ability to work their way through this. It is a big challenge, but Dr. Sanders hopes that the Panel can offer NASA sound advice that they may use to meet this challenge head on.

Lt. Gen. Helms thanked the leadership and the fine team of MSFC for the use of their facilities, resources, and their hospitality.

Lt. Gen. Helms opened the meeting for public comment. No comments were received.

Lt. Gen. Helms adjourned the ASAP Third Quarterly meeting of 2023 at 2:28 p.m. CDT.

Appendix A
Teleconference Attendees¹

Achin Duvand	<i>Space Agency</i>
Adrienne Lewis	<i>Government Accountability Office</i>
Amanda Miller	<i>Military.com</i>
Britney Coffey	<i>Boeing</i>
Carrie Rogers	<i>JAO</i>
Catherine Fischer	<i>Ball Aerospace</i>
Catherine Williams	<i>Boeing</i>
Chang	
Dana Hutcherson	<i>NASA</i>
Danny Lentz	<i>NASA Space Flight</i>
Darlene Pokora	<i>NASA Langley</i>
David Gallus	<i>Unaffiliated</i>
David Millman	<i>Affiliated</i>
Deborah Fricelli	<i>Boeing</i>
Dee Resser	<i>Boeing</i>
Desgalota	<i>NASA</i>
Diane Rausch	<i>NASA HQ</i>
Dimitra Tsamis	<i>NASA</i>
Eric Berger	<i>Ars Technical</i>
Erin Kennedy	<i>US GAO</i>
Heather Scott	<i>NASA</i>
Jamie Groh	<i>Florida Today</i>
Jeff Foust	<i>Space News</i>
Jeremy Standbocker	<i>Moag</i>
Jessica Lunda	<i>NASA</i>
Joey Roulette	<i>Reuters</i>
John Williams	<i>Multiverse Media</i>
Josh Finch	<i>NASA</i>
Joy Kim	<i>GAL</i>
Juan Lavielle	<i>SpaceX</i>
Kathryn Hambleton	<i>NASA</i>
Linda Karanian	<i>Karanian Aerospace Consulting</i>
Linder Natz	<i>NASA Marshall Safety Mission Assurance</i>
Lindsey Eady	<i>Boeing</i>
Loren Grush	<i>Bloomberg</i>
Louis Groswald	<i>Lockheed Martin</i>

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