

NASA AEROSPACE SAFETY ADVISORY PANEL

National Aeronautics and Space Administration

Washington, DC 20546

Lieutenant General Susan J. Helms, *Chair*

March 15, 2024

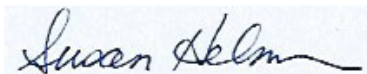
The Honorable Bill Nelson
Administrator
National Aeronautics and Space Administration
Washington, DC 20546

Dear Senator Nelson:

The Aerospace Safety Advisory Panel (ASAP) held its 2024 First Quarterly Meeting in-person at NASA's Headquarters, February 26-28, 2024. 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 black ink, reading "Susan Helms", with a stylized flourish at the end.

Susan J. Helms, Lt Gen (Ret), USAF

Chair

Enclosure

AEROSPACE SAFETY ADVISORY PANEL

Public Meeting
February 28, 2024
Hybrid

2024 First Quarterly Meeting Report

ASAP Panel Member Attendees

Lieutenant General Susan J. Helms, USAF (Ret), Chair
Mr. William Bray
Dr. Amy Donahue
Mr. Paul S. Hill
Mr. Kent Rominger (*virtual*)
Dr. Mark N. Sirangelo
Dr. Richard S. Williams, MD, FACS

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](#)

[Appendix B – Statements](#)

Ms. Carol Hamilton, Aerospace Safety Advisory Panel (ASAP) Executive Director, called the meeting to order at 11:00 a.m. eastern standard time (EST) and welcomed everyone to the ASAP's First Quarterly Meeting of 2024, held at the National Aeronautics and Space Administration's (NASA) Headquarters. 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. One request was received from Dr. Brian A. Williams from the Veterans Affairs (VA) Pittsburgh Anesthesia Service and the University of Pittsburgh School of Medicine. Dr. Williams read his statement which is attached as Appendix B.

Lieutenant General (LTG) Susan J. Helms, United States Air Force (USAF)(Ret), the new chair, began by thanking Mr. Dave West and Dr. Patricia Sanders for their extensive time and contributions to the ASAP during their tenure.

LTG Helms mentioned the recent publication of the ASAP's 2023 Annual Report which can be found on NASA's ASAP webpage. She discussed three highlights from the report including the continued focus on the long-term strategic vision for the Agency in terms of managing risks, the Agency wide governance, and the Agency's organizational structure. The Panel was able to close a major recommendation regarding the Artemis organizational and management structure at the end of 2023.

LTG Helms handed the meeting over to Mr. William Bray to lead the discussion over the Artemis Program. The Panel received multiple briefings from the Exploration Systems Development Mission Directorate (ESDMD) and the Artemis program management team and expressed satisfaction with their efforts. ASAP acknowledges the value of the establishment of the Artemis Program Manager's (PM), praises the leadership within ESDMD and the program office, and commends their commitment to systems engineering discipline and transparency. The Panel believes this organizational structure enhances the likelihood of success in the complex and challenging Artemis Program.

Mr. Bray noted that Ms. Catherine Koerner, the newly appointed Associate Administrator (AA) for the Exploration Systems Division, provided a status update on architecture work to the Panel. NASA has completed the second cycle of updating the Architecture Definition document and is progressing towards Strategic Analysis Cycle 24. The expanded architecture now covers Moon to Mars (M2M) missions across the campaign and includes detailed white papers in thirteen key focus areas. Engagements with international partners, industry, and academia for feedback have been undertaken, creating a continuous cycle of learning and definition which is crucial to the campaign. The architecture and associated top level requirements are closely aligned with the M2M Program, establishing programmatic and technical coherence, and setting priorities across the Agency and its Centers.

Mr. Paul Hill added that the Panel has discussed the architecture work at great length. The direct alignment Mr. Bray described between strategy, architecture, and program element requirements is a clear example of the deliberate governance that the Panel has been recommending for the Agency to embrace. With this governance and alignment, they are all working towards the same programmatic objectives.

Mr. Bray stated that Mr. Amit Kshatriya, Deputy AA for the M2M Program, provided a comprehensive update on the Artemis Program, displaying a thorough understanding of key milestones, challenges, risks, and mitigation strategies. NASA has adjusted the launch date to September 2025, a change deemed appropriate by the Panel. The Artemis team is addressing technical issues from the Artemis I mission, with specific focus on heat shield char loss and the Orion hatch door.

Regarding the heat shield, a detailed investigation has made good progress in understanding the root cause of the char loss. The investigation team is close to finalizing findings related to shield material density, coating composition, permeability, and porosity characteristics. NASA aims to determine the root cause in the coming months, which will potentially influence the re-entry trajectory for Artemis II as well as long-term solutions for the heat shield. The Panel encourages transparency, inclusivity, and constructive challenging of data throughout the investigation process for this very complex concern.

NASA is also investigating issues with the Orion side hatch design that may impact crew ability to open it in contingency operations. User involvement remains crucial, and ongoing efforts are expected to unveil potential solutions, including design changes and modifications to the crew's concept of operations. The Panel anticipates further updates on this matter as work and discovery progress.

LTG Helms discussed risk management in the absence of a Prime Integrating Contractor (PIC) for the Artemis Campaign. The Panel would like to better understand how the risk management for Artemis, as a Campaign, happens when one is not relying on a PIC. ASAP will be delving into this topic further in 2024.

Mr. Bray continued with Artemis II. The path to Certification of Flight Readiness (CoFR) is on track, and the timetable is being maintained. Progress is reported as positive in Space Launch System (SLS) Hardware (HW) and mating, with no significant issues identified. Similarly, mission operations, planning and ground systems preparations are advancing smoothly. Overall, the efforts for Artemis II are progressing well, and the resolution of the heat shield and any side hatch issues in the next six months is crucial. The Panel currently does not foresee any major obstacles, affirming confidence in the planned September launch for Artemis II.

For Artemis III, the focus is on the Human Landing System (HLS). There are ongoing Starship flight tests which will provide valuable learning for both SpaceX and NASA. The Panel is keenly interested in the broader concept of operations and technical challenges related to HLS for lunar surface access, with an upcoming propellant transfer flight test that should provide additional insights. For Artemis IV, Blue Origin is making commendable progress on its lander, set to complete its internal Preliminary Design Review (PDR) by the end of the month. Kudos are extended to NASA and the industry partners for conducting joint reviews, fostering shared learning across lander programs, and contributing to the overall success of the M2M Program.

LTG Helms stated that no fact-finding was completed for the International Space Station (ISS) or the Commercial Crew Program (CCP), but meetings are scheduled and will be discussed in the future. The Panel has concerns about the transition planning of Low Earth Orbit (LEO) operations. She turned the meeting over to Dr. Mark Sirangelo to discuss.

Dr. Sirangelo described how the Panel received a comprehensive overview of the Commercial LEO Development Program (CLDP). ASAP places emphasis on NASA's need for a detailed understanding of the ISS to CLD transition plan. The CLDP aims to maintain a continuous government and commercial presence in LEO.

As of 2023, NASA has made significant progress, completing twenty of the thirty-six phase one milestones. Collaborative efforts with various entities showcase achievements and milestones. Blue Origin completed essential tests and added new milestones. Nanoracks established Starlab Space LLC and is progressing towards upcoming milestones. Northrop Grumman has upcoming milestones including the technology gap analysis. SpaceX collaborated on telemetry and imagery support, consulting for medical research, and exercise for private missions. Sierra Space achieved milestone one and is progressing towards milestone two. Vast Space completed a program management review and has upcoming milestones. The Special Aerospace Services (SAS) is collaborating on software and developing a cold gas propulsion system. Think Orbital is collaborating on welding, development, and testing. Axiom is progressing in Critical Design Reviews (CDR), facility certification, and upcoming objectives.

Axiom also served as the launch provider for the Private Astronaut Mission (PAM) 3, extending its duration due to weather conditions, while accomplishing various activities, investigations, and

outreach events. NASA is preparing for the fourth PAM, scheduled for October 2024, with objectives focused on human research, technology demonstrations, outreach, media, and commercial activities.

LTG Helms stated that, despite not receiving a fact-finding session for the ISS, the Panel is adamant that a deorbit capability must come to fruition. This is one of the most urgent safety issues that the Panel sees currently, not only for the end of lifetime disposal but more urgently for contingency response now.

She then stated that the Panel has a lot of open questions on what it means to send human beings to Mars and what that means for their health. She handed the meeting over to Dr. Richard Williams for discussion.

Dr. Williams stated that the Panel once again had the pleasure of meeting with Dr. JD Polk, NASA's Chief Health and Medical Officer. In ASAP's 2023 report, the Panel stated their intent to engage NASA's health and medical authorities in further discussions about health and medical risks as a contributor to overall mission risk and mission safety. The Panel regarded this meeting as the beginning of that more extensive interaction.

Dr. Polk reviewed the status of the NASA Health and Medical Technical Authority (HMTA). Thus far, the HMTA remains able to provide technical authority assistance to programs and projects. Budget constraints across the agency, however, may cause significant challenges to in-line program support work. This may translate to a negative effect on crew health and safety, such potential bears close observation.

ASAP received updates on risks attending long duration space flight in LEO, which will translate directly to risks in a Mars mission. Foremost among these risks is Spaceflight Associated Neuro Ocular Syndrome (SANS). Evidence is emerging which confirms SANS is a complex evolution of ocular and central nervous system changes including increased intracranial pressure. Evidence of head and neck venous stasis has been seen in some crew members experiencing SANS, which lends further credence to the theory that prolonged exposure to microgravity is likely intimately involved in the etiology of the syndrome. Venous stasis increases the risk of thrombosis, especially in the internal jugular system, which represents the risk of a catastrophic embolic event. The Chief Health and Medical Officer is working with the Human Research Program on countermeasures for SANS including testing of medications in bed rest studies. However, the Agency appears to have lost some ability to implement Detailed Science Objectives/Test Objectives, such as those performed in the Space Shuttle program, that could allow for rapid testing of clinical countermeasures. The Agency will need to recapture its ability to perform such operationally minded research for the M2M campaign. Some other long duration space flight risks exist including space radiation exposure, bone density loss, and neuro-vestibular compromise, along with some countermeasures in development that might be employed to mitigate these risks. Evolution and miniaturization of medical countermeasures, diagnostic capabilities, and the use of 3D printing for pharmaceuticals were also discussed.

ASAP discussed the upcoming transition from ISS operations to other proposed commercial LEO platforms during this quarterly meeting. Dr. Sirangelo addressed this transition a few minutes

ago. Dr. Polk emphasized the imperative of further understanding SANS and other health risks and finding and testing effective countermeasures while there is still access to LEO for long duration space flight. The Human Research Program risk reduction plan also depends on access to long duration space flight in LEO. The complex issues and challenges attending the end of ISS service life and successful transition to other commercial LEO platforms bear directly on successful human health and performance risk mitigation in preparation for Mars missions.

LTG Helms asked if the Panel had any remaining comments. None were voiced. She stated that the Panel would be focusing on resolving open recommendations, both to NASA and Congress. The Panel would also like to delve further into the topic of safety culture and where NASA stands on this topic. They will be looking at the workforce, budget impact, environmental impact, and aging ISS as it relates to risk management and safety. She also noted a myriad of technical issues that would be discussed in the future.

In closing, the Panel cannot emphasize enough how much complex and challenging work is ongoing within NASA – how demanding that environment is in which that work must be accomplished – and how much vigilance is required to execute that work safely and effectively. The Panel commends NASA for an impressive 2023 as they have strategically advanced the risk management posture.

Ms. Hamilton opened the meeting for public comment. No comments were received.

LTG Helms adjourned the ASAP First Quarterly meeting of 2024 at 11:51 a.m. EST.

Appendix A
Teleconference Attendees¹

Amanda Miller	<i>Military.com</i>
Brian Williams MD	<i>University of Pittsburgh</i>
Charles Radley	
Danny Lentz	<i>NASA Spaceflight.com</i>
David Gallus	<i>Unaffiliated</i>
Dillon Labeio	<i>SpaceX</i>
Eric Maier	<i>NASA</i>
Erin Kennedy	<i>Government Accountability Office</i>
Gene Mikulka	<i>Talking Space</i>
Jeff Foust	<i>Space News</i>
Johnny Nguyen	<i>NASA</i>
Joy Kin	
Kathryn Hambleton	<i>NASA</i>
Linda Karanian	<i>Karanian Aerospace Consulting</i>
Marcia Smith	<i>SpacePolicyOnLine.com</i>
Mark Carreau	<i>Aviation Week Space Technology</i>
Micah Maidenberg	<i>The Wall St Journal</i>
Michael Sarafin	<i>NASA</i>
NASA	<i>Aerospace</i>
Pam Whitney	<i>House Finance Committee</i>
Patricia Sanders	
Philip Sloss	<i>NASA Spaceflight.com</i>
Ramona Gallardo	<i>NASA JSC ISS</i>
Sylvie Espinasse	<i>European Space Agency</i>
Ted Kronmiller	<i>Law Office</i>
Terry Rogers	<i>Government Accountability Office</i>
Tonya Woodbury	<i>Government Accountability Office</i>
Veronika Fuhrmann	<i>European Space Agency</i>
William Readdy	<i>NASA ISAAC</i>
Zudayyah Taylor-Dunn	<i>NASA Space Operations</i>
Unnamed	<i>Government Accountability Office</i>

¹ The names and affiliations are as given by the attendees, and/or as recorded by the teleconference operator.

Appendix B

Could Recent Advances in Postoperative Nausea and Vomiting Prevention for Contexts of Anesthesia and Surgery be of Potential Value in Mitigating Motion Sickness and/or Simulator Sickness in Preparation for Space Travel?

Brian A. Williams, MD, MBA; VA Pittsburgh Anesthesia Service and University of Pittsburgh School of Medicine.

Simulator training is a preparatory centerpiece before space travel, let alone many other armed forces or military travel or transport applications. Virtual environment technologies allow trainees to simulate any number of scenarios they might encounter in, otherwise, complete safety, at low cost, anywhere that the technology is based, and at any time. One drawback of virtual environment training is simulator sickness and its resultant symptoms, including dizziness, pallor, cold sweating, increased salivation, stomach awareness, headache, fatigue, nausea, and vomiting.

Meanwhile, short-term and intermediate-term recovery from surgery and anesthesia, and opioids used for pain relief, can individually and collectively create many of these same symptoms, particularly nausea, vomiting or retching, dizziness, headache, and fatigue. In 1991, postoperative nausea and vomiting (PONV) was called “the big little problem” in the anesthesia context, serving as a major barrier preventing patients from going home the same day after a multitude of elective surgery subtypes. A “big little problem” can be further described as “very frequently encountered,” but “not linked to life-threatening outcomes.”

For over twenty years, consensus conferences addressing PONV have set forth guidelines restricting patients to either two to four preventative drugs before or during surgery, based on a oversimplified, narrow range of legacy risk factors that now appear to be incomplete. Success following this conservative strategy has been, at best, 70% on the day of surgery, and without any anti-PONV booster dosing after surgery, only 30-60% on the days after surgery, depending on the context. Further opioid dosing for pain management after surgery also serves as an unwanted “stress test” for creating PONV, in that when one or more intravenous opioid doses are given in hospital after surgery, the same-day or next-day PONV after-effects occurs in 44-72% of patients. The incidence of motion sickness or simulator sickness appears to depend on the study and the involved device, but ultimately, 3-5% is cited as the proportion of users that ultimately fail to adapt to simulations, and experience any of the array of symptoms limiting further activity with these motion-adapting requirements.

At our institution, we have developed a 5-drug anti-PONV plan, with two of these drugs also serving as “next-day booster doses” to bring day-of PONV prevention success from approximately 70% to 95%, and day-after PONV prevention success from less than approximately 50% to 90%. The 2-drug booster on the day after surgery is associated with over 90% PONV protection on the day after surgery when compared with no providing the described booster doses. We are unable to determine the extent to which our 5-drug anti-PONV drug combination before any simulator training exposure, along with 2-drug daily booster dosing as simulator training continues into later days, might have favorable neuroplasticity effects with respect to other simulator sickness and motion sickness symptoms such as dizziness, pallor, cold sweating, salivation, headache, and fatigue. However, it might be prudent to more actively

address a poly-pharmaceutical strategy based on newly reported PONV prevention success in the surgery and anesthesia context described above.