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NASA ADVISORY COUNCIL

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NASA Armstrong Flight Research Center
The AERO Institute
Palmadele, CA

MEETING MINUTES

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Executive Director

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Meeting Report prepared by
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Wednesday, November 30, 2016

Call to Order, Announcements

Ms. Diane Rausch, Executive Director of the NASA Advisory Council (NAC or Council), called the meeting to order and welcomed Council members and attendees to the third NAC meeting of 2016 in Palmdale, California. She explained that the NAC is a Federal advisory committee established under the Federal Advisory Committee Act (FACA), and as such was subject to relevant Federal regulations and laws. The meeting is open to the public. She noted that the Council meeting minutes were being taken for the public record, and will be posted to the NASA website, www.nasa.gov/offices/nac. Each NAC member had been appointed by the NASA Administrator, Mr. Charles Bolden, and possessed individual subject matter expertise that is directly relevant to NASA. All members are Special Government Employees (SGEs), subject to ethics regulations, and must recuse themselves from Council discussions on any topic that presents a potential conflict of interest. All public attendees were asked to sign in.

Ms. Rausch introduced the NAC Interim Chair, Mr. Kenneth Bowersox.

Opening Remarks by NAC Interim Chair

Mr. Bowersox welcomed everyone, and noted that this would be the last meeting of the NASA Advisory Council with Mr. Bolden as NASA Administrator. He said was very sorry to see Mr. Bolden depart as part of the upcoming transition of Presidential Administrations. He said that this NAC meeting was being held at The AERO Institute in Palmdale, which is a Science, Technology, Engineering and Mathematics (STEM) facility of the NASA Armstrong Flight Research Center (AFRC). This would provide easy access for the general public to attend the meeting. Having this meeting in Palmdale also allowed the Council members to tour the AFRC facilities nearby and familiarize themselves with the many ongoing projects nearby at AFRC. Two new Council members have come onboard since the last NAC meeting in July 2016: Dr. Penina Axelrad (absent), and Dr. Elisabeth Paté-Cornell (present). Dr. Patricia Sanders, the Chair of the another NASA advisory committee, the NASA Aerospace Safety Advisory Panel (ASAP), was not physically present but would be participating in the NAC meeting virtually via telecon and WebEx. The Council members introduced themselves around the table. Mr. Bowersox described how his interim chairmanship had followed the April 2016 resignation of former NAC Chair, Dr. Steven Squyres. Mr. Bowersox acknowledged the presence and hospitality of the NASA Armstrong Flight Research Center (AFRC) Director, Mr. David McBride, and his staff.

Mr. Bowersox introduced the NASA Administrator, Mr. Charles Bolden.
 Remarks by NASA Administrator

NASA Administrator Bolden opened his remarks by expressing his pleasure at being able to tour ARFC and the Mojave Air and Space Port the previous day. He then briefly introduced the Mayor of Palmdale, Mr. James Ledford, who expressed his gratitude for NASA’s presence in Palmdale and the greater Antelope Valley region of California. Mayor Ledford explained the purpose of The AERO Institute, which was for the City of Palmdale to extend educational support to the surrounding community, aerospace and space industry, in partnership with NASA. He noted that there are approximately 10,000 students in the region pursuing STEM-related fields. Mr. Ledford acknowledged NASA’s important role in supporting The AERO Institute. On the strength of NASA involvement, he said the Palmdale Aerospace Academy would be building a new $50M campus that is strictly STEM-based. The City of Palmdale recognizes the fact that the pre-K through 12 population is tomorrow’s science and technology pipeline. This is economic development at its best, and Palmdale is extremely appreciative of NASA’s continuing support.

Mr. Bolden noted that this was the last meeting with the Council, expressed his deep appreciation for the efforts of NAC members, recognizing that their commitment takes valuable time away from business and family concerns. He confirmed that he had recently appointed two distinguished individuals to fill the current vacancies of NAC “members at large”: Dr. Elisabeth Paté-Cornell of Stanford University, and Dr. Penina Axelrad of the University of Colorado at Boulder.

Mr. Bolden gave an account of the Agency’s last several months since the previous NAC meeting was held in July 2016 at the NASA Glenn Research Center in Cleveland, Ohio. Major progress has been made in the area of NASA technology development, which included a cubesat launch initiative and the iTech initiative call to aid in the Journey to Mars, soliciting white papers in five critical areas of radiation protection; life support systems in space; astronaut crew health; in-space propulsion; and high-resolution measurements of key greenhouse gases. NASA has also signed a Memorandum of Understanding (MOU) with the Chinese Aeronautical Establishment to begin a collaboration in air traffic management, marking the first formal agreement between the China and the U.S. in 22 years. NASA recently selected five green technology concepts on the subject of aviation emission reduction, including the development of alternative fuel cells, 3D printing for lithium batteries, and the use of aerogels for aircraft antennae, particularly for electrically propelled aircraft.

In the Science Mission Directorate (SMD), earlier this year, NASA launched the Origins, Spectral Interpretation, Resource Identification, Security-Regolith Explorer (OSIRIS-REx) sample return mission to rendezvous with the asteroid Bennu. Among the data received from the Juno mission to Jupiter were the first high-resolution images of the Jovian North pole. Juno is also a unique mission for NASA, in that it used solar power for the first time to propel a spacecraft to an Outer Planet. Center-of-curvature testing on the James Webb Space Telescope (JWST) mirror was carried out at the NASA Goddard Space Flight Center, ensuring that the optical acuity issues suffered by the Hubble Space Telescope will be avoided. The JWST follow-on mission, the Wide Field Infrared Space Telescope (WFIRST), is also moving forward. NASA also launched the Geostationary Operational Environmental Satellite-R (GOES-R) satellite for the National Oceanic and Atmospheric Administration (NOAA) earlier this month. GOES-R is critical to supporting advancements in weather forecasting and imaging. The Cyclone Global Navigation Satellite System (CYGNSS) satellite constellation is scheduled to be launched on December 12, 2016; it will study the development of typhoons and hurricanes in an effort to improve extreme weather prediction, and will be air-launched from a Pegasus rocket. The Mars Reconnaissance Orbiter (MRO) recently discovered ice deposits on Mars, possibly representing as much water as that found in Lake Superior. A launch vehicle has been procured for the Mars 2020 rover mission.
In the NASA Human Exploration and Operations Mission Directorate (HEOMD), recently issued was the Next Space Technologies for Exploration Partnerships-2 (NextSTEP-2) Broad Area Announcement (BAA) for deep space habitats, inviting the commercial sector to help NASA in its Journey to Mars. The International Space Station (ISS) Expedition 48 and 49 crew landings were successfully carried out. Mr. Bolden reported having visited the Baikonur Cosmodrome in Kazakhstan to mark the launch of ISS Expedition 50. This launch had special meaning for him, as it had launched his colleague Dr. Peggy Whitson to the ISS; she will hold the U.S. record for long-duration space flight at the end of her mission. NASA has issued a Request For Information (RFI) for input on Orion and Space Launch System (SLS) maintenance, to help support future operations. The RFI briefly caused some controversy, necessitating an explanation that in so doing, NASA aimed to reduce the cost to the Federal Government for operating both Orion and SLS. The goal of the RFI is to create an analogue to the United Space Alliance, which managed Space Shuttle operations. Mr. Bolden noted that the Orion Underwater Recovery Test, in which the capsule was dropped into the Pacific, was successfully carried out in an exercise with the U.S. Navy. The heat shield for Exploration Mission 1 (EM-1) has arrived at the NASA Kennedy Space Center (KSC) for installation on the Orion spacecraft. For EM-1, NASA will fly an interim cryogenic propulsion stage. NASA TV aired a very popular Orbital ATK launch from the Wallops Flight Facility in Virginia in November 2016. There were 100,000 mobile streams, 17,000 desktop viewers, and 197,000 page views on the NASA.gov website. Those are impressive numbers; many people living on the East Coast could see the launch ascent since it was a beautiful clear night for a launch. Many citizens submitted their photos of the launch.

In the area of NASA personnel, Dr. Rich Williams has retired as NASA’s Chief Health and Medical Officer, but will stay on for an additional short while to establish a medical care program. He will be replaced by Dr. J.D. Polk, who has a background in infectious disease and disaster response. SMD has a new Associate Administrator, Dr. Thomas Zurbuchen from the University of Michigan. Dr. Patricia Sanders is the new Chair of NASA’s Aerospace Safety Advisory Panel (ASAP), replacing Vice Admiral Joseph Dyer.

Mr. Bolden stated that the “state of NASA” is as strong as it has ever been. Mr. Bolden recalled that at his Senate confirmation hearing in 2009, he had been blindsided by Senatorial remarks on the difficult history of NASA audits, and was proud to announce that NASA had just received its sixth consecutive “clean audit.” He noted that around the world there is much enthusiasm for space missions, with Jordan, the United Arab Emirates (UAE), Niger, and Thailand entering this arena. Jordan is a dominant partner in infectious disease and disaster response. SMD has a new Associate Administrator, Dr. Thomas Zurbuchen from the University of Michigan. Dr. Patricia Sanders is the new Chair of NASA’s Aerospace Safety Advisory Panel (ASAP), replacing Vice Admiral Joseph Dyer.

NASA continues to be rated the “best place to work in the Federal Government.” This has been the case four years in a row. NASA’s website, www.nasa.gov, had 1.9 million page views last week alone. Asked if he had any advice for the next NASA Administrator, Mr. Bolden cited the advances the Agency has made in the last six years, since the issuance of President Obama’s Mars challenge. The challenge allowed NASA to revamp its vision. The Agency now has two successful commercial cargo carriers to Low Earth Orbit (LEO), and selected a third this year. NASA continues to work in its Commercial Crew Program to develop U.S. alternatives to replace the Russian Soyuz vehicle; the first U.S. commercial crew vehicle may be ready to fly in 2018. International cooperation at the ISS continues to be strong: astronaut Scott Kelly and his Russian counterpart just completed a one-year tandem mission. NASA has extended the ISS lifetime to 2024. NASA has also conducted numerous
milestones, including Experimental Flight Test-1 (EFT-1), Orion’s first test flight into space. Successful engine firings for NASA’s heavy lift rocket, the Space Launch System (SLS), have been held at the NASA Stennis Space Center, as well as a final test for the QM2 solid rocket booster. Earth science missions launched in unprecedented numbers, five in 2015 alone. NASA’s science portfolio is thriving with the successes of Curiosity, the Mars Atmosphere and Volatile EvolutioN (MAVEN) mission, the Juno mission to Jupiter, and the New Horizons mission to Pluto. The Mars mission Interior Exploration using Seismic Investigations, Geodesy and Heat Transport (InSIGHT) will be launched in 2018. JWST is progressing toward a 2018 launch, within cost and on schedule. Mars 2020 is making good progress as well. NASA Aeronautics research has made air travel safer, greener and more efficient. In the new Aviation Horizons program, the X-57 Maxwell, an all-electric aircraft, is under production. Advances are being made in restoring supersonic flight over ground; Mr. Bolden thanked Ms. Marion Blakey for helping to advocate with the President for this activity. Technology drivers for exploration, such as solar electric propulsion (SEP), are well under way. NASA has built on the newest communication technologies; it now has 20 million-plus followers on Twitter. NASA is also learning to tell better stories, increasing its presence on Facebook, Instagram and Tumblr. The Agency has been holding NASA “Socials” to provide public access to personal launch experiences.

Mr. Bolden felt confident of a smooth transition of Presidential Administrations. Mr. Chris Shank, former aide to House Science Committee member Rep. Lamar Smith (R-TX), has been named the Agency Review Team lead for NASA. Mr. Tom Cremins is NASA’s Transition Official, and Ms. Jolene Meidinger is NASA’s Transition Coordinator.

In closing, Mr. Bolden again noted that this was his last NAC meeting as the NASA Administrator. Looking ahead, he stated that he agreed with the American writer Mark Twain when he said, “Predictions are very difficult to make, especially about the future.” Nevertheless, Mr. Bolden said he felt confident that he had put a healthy foundation into place during his seven and a half years at NASA. Looking back at his extremely rewarding years as NASA Administrator, he stated that the NAC had brought immeasurable value to NASA, and he had greatly valued its input. He thanked Ms. Diane Rausch for having done an exceptional job as Executive Director of the NAC during his entire tenure as NASA Administrator. Mr. Bolden said he had met with the NAC a total of 22 times, and had received 103 formal recommendations and 86 formal findings from the NAC, a total of 189 pieces of advice. Many of these recommendations and findings have had a very significant positive impact on the Agency. He realized that forging consensus advice in such a diverse and talented group of experts as the NAC presented a daunting task, and personally thanked Council members for their spirit of cooperation and focus. He said he had responded back to the Council on every formal NAC recommendation with a NASA written response, and noted that the Agency had agreed with most of the advice the NAC had provided. Even when NASA had disagreed with the NAC, he had explained the Agency’s rationale in writing. “The NAC advisory system works,” he said. “The NAC challenges NASA, and this is good,” he added. Mr. Bolden quoted Dr. Bradley Peterson as having said, “NAC has the knack” for seeing contradictions immediately. This is one of the most important functions of the NAC, and one that he has appreciated very much. Mr. Bolden ended his remarks by wishing the Council his very best wishes for continued success in the years ahead.

Council Discussion

Dr. William Baumhau commented that while Mr. Bolden’s major accomplishments at NASA were well recognized, he also felt it necessary to highlight Mr. Bolden’s efforts to rebuild the technology development program at NASA as a job extremely well done. One of its results was the establishment of the Space Technology Mission Directorate. It has rekindled the interest of students and faculty members. Ms. Blakey commented on the Administrator’s truly remarkable support for the Aeronautics Research Mission Directorate, which at one point in time in the past had become nearly irrelevant. Today, the industry and the Administration are working collaboratively in air traffic management, as well as in Unmanned Aircraft Systems (UAS) traffic management,
i.e., controlling Unmanned Aerial Vehicles (UAV) in lower airspace. Aeronautics has become increasingly important.

Ms. Blakey asked Mr. Bolden what he might advise the next NASA Administrator. Mr. Bolden replied that he strongly recommended that the next NASA Administrator work hard to foster collaboration and partnership between “the two ends of Pennsylvania Avenue” (i.e., White House and Capitol). He said he had no doubt that the U.S. is the greatest nation in the world. American openness to public discourse and criticism is one of its great strengths. The U.S. Government and NASA must continue to be open to compromise. Economically, Aeronautics is the largest contributor to the U.S. Gross Domestic Product (GDP). NASA and its predecessor, the National Advisory Committee for Aeronautics (NACA), together have been in existence for 100+ years, and the NASA/NACA unique and important place in history must not be forgotten. He pointed out that in the early 20th century, the Wright Brothers were hard-pressed to convince the U.S. that flight was important. NACA helped to change this view. Science, including Earth science at NASA, is critically important; it is also very important to avoid confusing policy and regulatory discussions with what NASA does. NASA helps us understand our planet, and Earth science is critically important to this understanding — humanity cannot be migrated to another planet. Earth science also supports national security with its data on terrain. The largest security threat to the nation is climate change, and with it by extension, food and clean drinking water. NASA is the strongest “soft power” agency in the U.S. Government, in this respect. Mr. Wayne Hale spoke for the NAC in extending its appreciation for Mr. Bolden’s outstanding leadership as NASA Administrator and his dedicated service to the nation.

Mr. Bowersox concluded the discussion by pointing out the many impressive activities, programs and projects going on at NASA, and expressing the hope that the Transition Team will take a close look at NASA without preconceived notions. He was impressed with how Administrator Bolden had handled differences of opinion in a consistently civil way, and wished him the best in his post-NASA endeavors.

Public Input

The NAC opened the microphones for a ten-minute period of public input; there were no public comments noted. While awaiting public comments, Mr. Bowersox made remarks about the afternoon’s very full agenda, which he described as an experiment to try to get NAC business accomplished in one day. He asked speakers to keep remarks brief and stick to findings and recommendations to more quickly resolve differing opinions.

Human Exploration and Operations Update

Mr. William Gerstenmaier, Director of NASA’s Human Exploration and Operations Mission Directorate (HEOMD), briefed the Council on the directorate’s latest activities. HEOMD’s current focus is on fitting components into the integrated mission Journey to Mars, moving along the path from Earth-Reliant through Proving Ground to Earth-Independent phases. All these elements that get NASA to the vicinity of Mars are in some stage of development today, while the Agency continues to work out the details of habitats and life support in space. The established principles for sustainable exploration remain unchanged, and are universal things that are independent of administrative changes and guidance. The strategic principles are fiscal realism, scientific exploration with SMD, technology pull and push, gradual buildup of capability, economic opportunity, architecture openness and resilience, global collaboration and leadership, and continuity of human spaceflight. Acceptance of these principles in the wider community is starting to happen. If there are issues, HEOMD will work to change them if it must. The future Administration seems to be receptive, thus far.

Mr. Bowersox asked why “communicating to the public” had not been included previously in the listing of principles. Mr. Gerstenmaier agreed that the statement belongs in the list, and that it had not been consciously omitted. He said he welcomed suggestions on how the list of principles could be further developed. The Journey to Mars mission is so complicated that it needs engagement on all levels. HEOMD is starting to break down tasks
needed to advance life support technology on ISS; examples include expanding urine processing all the way to dry powder, using a Sabatier process to generate oxygen, and dedicating space on board ISS to improve these technologies. In the area of cis-lunar flight, testing of exploration systems is well under way. HEOMD is starting to work with the Science Mission Directorate on Entry, Descent and Landing (EDL) systems to start thinking about Mars Sample Return (MSR), and is looking at both entry and ascent vehicles. NASA still has until the 2020s to sort out these technologies before bringing them to an operational level.

In the meantime, a set of near-term missions is being defined, as HEOMD works toward a year-long validation cruise in cis-lunar space that will validate readiness to explore beyond the Earth-Moon system in the late 2020s. These efforts are based on strategic objectives from the Agency, as well as strategic principles. HEOMD is starting to define the Earth-Reliant and Proving Ground phases and drive them down toward the architecture. The next step is to allocate phase objectives to flight objectives. To date, most activity is centered around Exploration Mission (EM)-1, including development of ground launch support and infrastructure. EM-2 will advance to crewed capsule recovery, crewed operations integration and crewed flight systems. EM-2 will also include an Exploration Upper Stage (EUS) performance phase and the development of an integrated payload capability (up to 7 metric tons). Currently, NASA is trying to figure out what will benefit science and HEOMD together; docking and rendezvous technology development might prove to be mutually advantageous.

EM-1 is well defined; it will be a 25- to 26-day mission, orbiting 75,000 km above the surface of the Moon. It will be the first test of the integrated SLS/Orion stack. EM-1 will demonstrate initial SLS engine performance, a test of uncrewed Orion systems in deep space, and demonstrate an ability to enter, operate, and exit Distant Retrograde Orbit (DRO) around the Moon. Sample returns can be acquired from such an orbit. EM-1 is designed to prepare the way for EM-2, the first flight of SLS/Orion with crew and the Exploration Upper Stage. The flight profile has been baselined as an 8-day crewed mission with Multi-Trans-Lunar Injection (MTLI) with a lunar flyby free return trajectory. The spacecraft will spiral out slowly toward the Moon, incrementally increasing distance while easily allowing the mission to abort in case of an incident. In this way, major pieces of the mission can be accomplished without undue risk to crew. These are flight-test types of objectives, matching risk levels to hardware maturity levels. Mr. Bowersox pointed out that the HEOMD strategy allows a lot of checkout high above the Earth, a more vigorous checkout of the upper stage, without the need to “do a burn” to return to the Moon.

Mr. Gerstenmaier stated that after EM-2, NASA is working toward a one flight per year cadence; the start of this cadence depends on the FY 2017 appropriations and program performance. Initial cis-lunar habitation capability would take place in the early 2020s, depending on the outcome of the NextSTEP activity, and international planning/contributions. Next would be the Asteroid Redirect Crewed Mission in the ~2026 timeframe, followed by the buildup of cis-lunar habitation/logistics capability in the mid/late 2020s, leading to a one-year shakedown cruise in 2029 with a Mars deep space transport vehicle. Mr. Gerstenmaier noted that NASA is aware of the timing contraints, and is developing missions and baselining technologies as needed. This approach allows for new capabilities and provides resiliency in a chaotic environment. He also noted that HEOMD, SMD and the Space Technology Mission Directorate (STMD) are collaborating on technology developments, precursors, and trade studies for Mars robotic missions.

Dr. Peterson asked about radiation risk to an EM-2 crew. Mr. Gerstenmaier said HEOMD understands the solar radiation environment as well as the cosmic radiation environment, and the shielding capability of Orion. HEOMD will also fly sensors on EM-1 to thoroughly understand the environment inside the capsule. There are 13 cubesats scheduled for EM-1, and they will also be included them EM-2. The cubesats will be carefully tracked by NASA; one type of cubesat orbits the Moon, another lands on the Moon, and another targets the deep space environment. EM-3 is scheduled to fly in 2023, although HEOMD is trying to move it to 2022, depending on the
budget. Eventually EM-9 and EM-10 will fly, with a goal of a 130 metric ton lift capability. NASA is conferring with the European Space Agency (ESA) about interest in collaborating on a Service Module.

In conclusion, Mr. Gerstenmaier noted that HEOMD has a solid approach for advancing human presence in deep space. Hardware development has some challenges. ISS operations are going well. The ISS role in enabling international cooperation for the Orion Service Module has been very beneficial for NASA. While the Agency seeks to increase international participation in ISS, it still has not seen private sector interest in ISS. The issue remains giving commercial interests a chance to generate revenue. Human exploration provides many benefits to the nation and humanity: inspiration, hope for the future, challenges that need support from a diverse international community, international leadership in technology, and direct benefits to population (e.g., research on genomic changes in space). HEOMD is well along on the EM-1 flight and is considering a number of possible payloads, including a cubesat-sized lunar rover.

Mr. Miles O’Brien brought up the subject of NASA “telling its story,” adding that not one of the projected 10 EM flights goes beyond the Proving Ground. Bringing the public along for that long a period is a tough sell. Is there an Apollo 8 style mission in there somewhere? Mr. Gerstenmaier said that progress is necessarily driven by the available budget, and some technology development hurdles. For instance, habitat development and propulsion techniques must be more advanced. The “tall pole in the tent” is funding, predominantly. If given a blank check, Mr. Gerstenmaier felt that to go beyond the Earth-Moon system safely, NASA would need the capability for a one-month return. HEOMD should know within a year whether a one-month return will be possible. Added up, the HEOMD budget times the number of years could get us to Mars by 2033. He agreed with Mr. O’Brien that it is a tough sell. HEOMD is trying to build a program that is not so dependent on budget, which can both tolerate budget swings and still make progress. Mr. Bowersox asked what might make the mission more compelling. Mr. O’Brien suggested a crewed fly-by of Mars. Mr. Gerstenmaier reiterated that 2033 is a planned fly-by; the question is how risky does NASA want to get for a Mars encounter without totally being knocked off its trajectory. Ms. Blakey noted that Elon Musk plans to reach Mars much more quickly; is this likely to supply a spur or a hindrance to NASA? Mr. Gerstenmaier said he was encouraged by the ambitions of Elon Musk and his Red Dragon mission. NASA is providing communications and navigation capability to the 2018 mission, while in return, the Agency will obtain data on retropropulsion on Mars. If the mission progresses, it may be possible to fly in-situ resource utilization (ISRU) instruments on his capsule. This approach is not “either/or.” NASA can advance its collective progress with the commercial sector while acquiring important data moving forward. The Journey to Mars challenge is so huge that it will take the best of all the sectors – private, public, government – to propel it forward.

For instance, to land an ascent vehicle with no propellant, NASA will need a ten-fold increase in EDL capability, as well as ISRU, on Mars. Large, monolithic elements can be transported on SLS, but NASA will still need the commercial capability to transport smaller elements. HEOMD expects to phase in commercial activity for the Proving Ground stage of development. Dr. William Ballhaus asked what might be possible if the program were re-scoped to have an event every 18 months. Such a schedule might allow measurable progress that attracts interest in a project such as an international lunar base. Mr. Gerstenmaier conceded that NASA can do this, but it will have to make trades. The big challenge for NASA is EDL at Mars; the current plan is to let the commercial sector and the internationals place hardware on the Moon. HEOMD would much rather meet the EDL challenge, while recognizing that it is “boring engineering.” Dr. Ballhaus suggested putting forward the “soft power” argument of maintaining U.S. leadership in space. Mr. Gerstenmaier stated that NASA needs to focus on what it already has. Everyone wants the 130 metric ton capability. NASA is the only agency that has the ability to lift 105 metric tons. The U.S. is still the leader in this respect, but NASA wants others to cooperate in the way forward. Mr. Bowersox noted that developing habitat capability in cis-lunar space can buy down risk for other participants.
(international or commercial), and concurred with the concept of taking advantage of natural synergies, as with the Red Dragon mission. He felt it was important that NASA does not miss what it already has in its toolbox.

Mr. Bowersox thanked Mr. Gerstenmaier for his presentation, and introduced Mr. Hale.

Human Exploration and Operations Committee Report

Mr. Wayne Hale, Chair of the Human Exploration and Operations (HEO) Committee, reviewed its most recent meeting. The agenda included briefings on the status of HEOMD, and the status of the Commercial Crew Program, Exploration Systems Development, the HEO Research Subcommittee, and status of Human Research. Among topics reported were ISS consumables, current anomalies, and the oxygen generation system. Overall, ISS was reported to be in good shape. The Center for the Advancement of Science in Space (CASIS) activities are ramping up, now accounting for half of research time on the ISS. Several upcoming extravehicular activities (EVAs) were described, including one for battery replacement. Approximately 300 different investigations were carried out during Expeditions 49 and 50, about half of which were NASA investigations. In the Commercial Crew Program, the HEO Committee heard briefings from both providers (Boeing and SpaceX), who indicated they were making significant progress toward flight. For example, Boeing plans its first crew flight in late 2018. The September 2016 SpaceX anomaly investigation is ongoing, and involves the Federal Aviation Administration (FAA), U.S. Air Force, the National Transportation Safety Board (NTSB), as well as an independent NASA review team. The NASA Aerospace Safety Advisory Panel (ASAP), another NASA Federal advisory committee, is currently reviewing the details of SpaceX pre-launch operations.

The Commercial Crew Program had a successful annual review at the Agency level in 2016, where milestone schedules remain optimistic. The top program safety risks included the ability to close the Loss of Crew (LOC) gap for MicroMeteoroid and Orbital Debris (MMOD) risk for vehicles attached to the ISS. There is a new model of orbital debris that contains heavier constituents, which has consequently raised the risk of LOC (acceptable risk is 1 in 270). There are also worries about similar risks to the Russian Soyuz spacecraft. Overall, MMOD remains a high risk to the CCP. All the rest of the safety risks are proprietary to the relevant contractors, and have been discussed with ASAP, not the NAC. Mr. Hale felt that this division was appropriate, albeit the risks are not public knowledge. The ASAP Chair, Dr. Patricia Sanders, commented that the NASA program office has laid the risk requirement to the contractor as 1 in 200, while NASA takes measures to reduce the risk to Agency-acceptable levels. She noted also that there are statistical uncertainties related to the numbers. Dr. Hale and Mr. Bowersox agreed that NASA had indeed accepted these terms in its public-private partnerships.

The HEO Committee heard the status of Exploration Systems Development, wherein funding issues remain critical, especially with respect to the Upper Stage. Top accomplishments include schedule progress on the Asteroid Redirect Robotic Mission (ARRM), and the establishment of healthy test planning activities for Long Range Systems Development. Next step activities for Cis-Lunar Habitat Development were briefed to the HEO Committee as well, and were regarded as satisfactory.

While the HEO Committee submitted no findings or recommendations to the Council, the Committee concluded that current NASA plans are on track given the current budget and Administration goals. The HEO Committee believed that NASA should partner with FAA/Aerospace Technology (AST) and ASTM in developing standards for space flight. Public/private partnerships are being utilized increasingly, however development using Firm Fixed Price (FFP) contracts is problematic, as shown by some current projects. Development is messy, and cost and schedule cannot trump safety.

There was much discussion about the upcoming transition of Presidential Administrations, however the HEO Committee was not prepared to propose significant course corrections. Dr. Ballhaus commented that in the 1990s, Total System Performance Responsibility (TSPR) pushed contractors to be in charge; this is inappropriate for
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NASA, as it should be in charge of safety. Mr. Hale felt that the provider/contractor should hold the primary responsibility in that it meets the NASA requirement for safety. Everyone must agree on safety requirements: the supplier must demonstrate that they meet safety requirements, while NASA provides the review and judgment. Mr. Bowersox stated that, ultimately, NASA makes the decision on crew safety. Mr. Gerstenmaier verified that NASA signs off on all safety issues with regard to contractors.

Mr. Hale reiterated a primary finding from the HEO Committee’s July 2016 meeting: the Committee supports the current systematic approach to the Journey to Mars. Mr. Bowersox reminded the Council members that it had previously endorsed recommendations for the cis-lunar approach in the path to Mars. Mr. Hale added that HEO Committee believes that a technology demonstration for solar electric propulsion (SEP) and large mass handling is very important, no matter what happens with ARRM.

Mr. Bowersox thanked Mr. Hale for his report, and introduced Dr. Peterson.

Science Committee Report

Dr. Bradley Peterson, Chair of the Science Committee, presented a status report. The Science Committee’s Planetary Science Subcommittee is currently lacking a Chair. In the interim, the Science Committee as a whole will be examining subcommittee functions in light of the planned restructuring of the NAC’s science subcommittees in the future. He presented several science highlights, beginning with a 360-degree view of the Sun as provided by the Solar Terrestrial Relations Observatory (STEREO) A and B satellites. Recent imagery showed a large Coronal Mass Ejection (CME) that, had it been pointed at Earth, would have constituted a Carrington-type event. Earth science satellites have provided images of 2016’s record-breaking flooding events in Louisiana. In the discipline of Planetary Science, the Cassini mission studied a region in one of Saturn’s rings, gathering evidence that some features are recent additions, strengthening a postulate that the rings are a dynamic system that may be added to by disintegrated comets. As the rings tend to darken with ultraviolet light, some of Saturn’s brighter rings are thought to indicate an age of perhaps 100M years, quite young by Solar System standards. Rivers of hydrocarbons have also been discovered on Saturn’s moon Titan. The Hubble Space Telescope (HST) observed evidence of possible water plumes emanating from Jupiter’s moon, Europa. It may be possible to sample these plumes via a fly-by, or by remote sensing. HST also observed spectral signatures from the TRAPPIST-1 exoplanetary system, indicating they may have atmospheres similar to those of terrestrial planets. In Astrophysics, Dr. Peterson reported novel Kepler/K2 observations of the Pleiades star cluster, showing the alternating effects of strong stellar winds and magnetic fields on the rotation periods of Pleiades stars. Stars similar to the Sun tend to slow down as stellar winds reduce their angular momentum.

Dr. Peterson stated that NASA’s SMD has a new Associate Administrator, Dr. Thomas Zurbuchen, who is primarily a cubesat investigator. SMD and the NAC Science Committee expect to work with him very well. Overall, the SMD Heliophysics Division is doing well. The STEREO B spacecraft was lost in 2014; NASA temporarily recovered a signal in August 2016, but could not recover the spacecraft completely due to loss of attitude control. SMD is busily preparing public events for August 21, 2017, which will mark a solar eclipse that will be visible to much of the continental United States. Dr. Peterson reminded the community that the eclipse is an opportunity for natural coronagraphic science. In the Earth Science Division, two missions, CYGNSS and TROPICS, are preparing for launch. In the SMD Planetary Science Division, the OSIRIS-REx spacecraft is on its way to asteroid Bennu, an Earth-crossing asteroid. There it will perform a touch-and-go maneuver on the surface of the asteroid to collect a sample of regolith for eventual return to Earth in the 2020s. Juno, which went into Jovian orbit on July 14, 2016, has suffered an anomaly that prevented its first peri-jove maneuver; the mission will try again on December 11, 2016. A New Frontiers mission Announcement of Opportunity (AO) draft was released on August 8, 2016. In the SMD Astrophysics Division, the James Webb Space Telescope (JWST), an incredible technological advance, continues to progress toward its launch in 2018. Each of JWST’s 18 mirror
segments is as large as the Hubble Space Telescope (HST) single mirror. JWST is undergoing final tests at NASA’s Goddard Space Flight Center in Greenbelt, MD, to be followed by thermal vacuum testing in Houston, TX, and lastly, integration with the sunshield and bus. Since the 2011 JWST replan, the project has stayed on budget and schedule through good management practices.

The Japanese Aerospace Exploration Agency (JAXA) x-ray mission, Hitomi, was lost in March 2016; NASA had had a data-sharing agreement with this mission. NASA has been asked to participate in the rebuild of Hitomi, a proposal that was considered and recommended by the NAC Astrophysics Subcommittee and the Science Committee. To prepare for its next Decadal Survey (2020), the Astrophysics Division is funding four (4) three-year studies on mission concepts: a Far-Infrared Surveyor, Large Ultraviolet/Optical/Infrared Surveyor (LUVOIR), a Habitable Exoplanet Imaging mission, and an X-ray Surveyor. Science and Technology Definition Teams (STDTs) for each of these concepts have been formed. The idea is to have mission concepts be fleshed out for selection in 2020. The Science Committee also heard the results of a National Academies report on the value of NASA extended missions, which concluded that extended missions provide tremendous science return for low cost. The Science Committee concurred that extended missions are a vital part of NASA’s overall science effort.

The Science Committee has had an Ad Hoc Task Force on Big Data in operation for about a year, and has extended its terms of reference (TOR) until 2018. The Task Force has been evaluating the Agency’s high-end computing capabilities, and has found that NASA has reached its capacity. The computing facility at NASA Ames Research Center has no more physical space for computing cores. As a result, NASA has begun the process of increasing the size of the facility over the next four years. In addition, SMD efforts in Science, Technology, Engineering and Mathematics (STEM) is being restructured, and is now called SMD Science STEM Activation.

Mr. Bowersox clarified that much of the Science Committee’s prior findings and recommendations may be already covered. Dr. Peterson agreed, describing a Science Committee finding on an Office of the Chief Information Officer (OCIO)-Advanced Information Systems Technology (AIST) Cloud Computing Initiative as an observation.

Dr. Peterson stated that the Science Committee proposed to transmit to the SMD Associate Administrator a finding on “special regions” on Mars, particularly a special region induced by thermal generators or spacecraft impact. After discussion, the NAC approved the following finding:

*The planetary protection concept of “special regions” on Mars requires a comprehensive science discussion to ascertain the significance of this issue. This potentially has serious consequences for landing site selection, lander and rover operations, and sample return. The NAC Science Committee and Planetary Science Subcommittee suggest that a workshop of experts be co-organized with the Planetary Protection Subcommittee to better define naturally occurring special regions and also assess the potential of “induced special regions”:

a) through landers or rovers creating a local environment that would be heated and contain aqueous fluids that have sufficiently high water activity and that could persist long enough to plausibly harbor life, and,

b) whether this should prevent further exploration of that site or the return of samples from the vicinity.*

Such a workshop could also include Ocean Worlds in order that the planned Europa and other potential missions can be designed with due diligence to planetary protection.

Dr. Peterson stated the Science Committee proposed to transmit to the SMD Associate Administrator a finding on the NASA Deep Space Network. Mr. Gerstenmaier offered to provide more complete Deep Space Network statistics to the Science Committee. After discussion, the NAC approved the following finding:
The NAC Science Committee and Planetary Science Subcommittee (PSS) appreciate the summary presentation provided to the PSS on the performance and management of the Deep Space Network (DSN) by NASA Space Communications and Navigation (SCaN). However, the Science Committee and PSS are concerned that plans to decommission the 34-meter stations in Canberra, Australia, and Goldstone, California, in 2016 and 2017, respectively, will remove an existing redundancy to the aging 70-meter stations, which are essential for communication with NASA’s most distant assets in the Solar System such as Voyager, New Horizons, and future missions. In particular, New Horizons, now in its extended mission to encounter a Kuiper Belt Object in 2019, has its longest view periods at Canberra. We also remain concerned about the shrinking DSN budget and we urge the NASA Planetary Science Division to resolve this with the NASA Associate Administrator for the Science Mission Directorate.

Dr. Peterson stated that the Science Committee proposed to transmit to the SMD Associate Administrator a finding on “observing in the archives.” After discussion, the NAC approved the following finding:

The NAC Science Committee and the NAC Ad Hoc Task Force on Big Data find that there is an increased scientific use of archival data of NASA missions as measured by the number of published papers. Several archive sites report that over half of new scientific papers are “observing in the archive” rather than relying solely on new observations, thus doubling the scientific productivity of the missions.

Dr. Peterson noted that this “archive” finding would likely be elevated to a formal recommendation in the near future.

Dr. Peterson related, as an informational item, that he had received a recommendation from the Science Committee’s October 2016 meeting, supporting a cloud computing demonstration on exoplanet data processing, which will undergo further discussion. Mr. Bowersox mentioned that NASA was looking for ways to promote synergy on astronaut-serviceable missions at the Earth-Sun Lagrange Points, indicating a possible NAC Science Committee collaboration with the NAC Human Exploration and Operations Committee on possible missions. Dr. Peterson agreed that this could be a fruitful discussion, as there are some proposed Astrophysics missions at Lagrange Point 2 that would require regular changing out of components.

Mr. Bowersox thanked Dr. Peterson for his report, and introduced Ms. Blakey.

Aeronautics Committee Report

Ms. Marion Blakey, Chair of the NAC Aeronautics Committee, presented results of the Committee’s most recent activities. She noted the Committee included an interesting mix of people with expertise in unmanned aerial vehicles (UAVs), unmanned aerial targets (UATs), and unmanned aircraft systems (UAS). The Aeronautics Committee’s last meeting at NASA Ames Research Center in California included some interesting UAV demonstrations. The NASA Computational Fluid Dynamics (CFD) Visions 2030 Implementation Plan was a major topic for discussion for the committee, in light of its new funding model. The plan addresses facets of CFD that jibe well with NASA interests, such as physics-based and predictive modeling techniques. Some facets of CFD will require orders of magnitude improvements in high-end computing from the Department of Energy and the Department of Defense. The Visions 2030 document is to be updated every five years, and thus will need constant surveillance. NASA has had great success with challenges and prizes, which may fit well with CFD Vision goals. The Aeronautics Committee believes that CFD is a critical area, and proposed an observation directed to the Aeronautics Research Mission Directorate (ARMD) Associate Administrator. Dr. Ballhaus stated that the observation spoke to a previous definition of technology that had excluded CFD, and thought it appropriate for NASA to keep an eye on the subject through the transition. Mr. Bowersox suggested to make the observation a finding and send it to the ARMD Associate Administrator, which was agreed upon. After discussion, the NAC approved the following finding:
The NAC Aeronautics Committee understands the importance Computational Fluid Dynamics (CFD) has played in the development of efficient aerodynamics for airplane structures and turbine engine development. The CFD project has good project planning. Given the length of this project, the Committee suggests that the project define the current state of the art, what specific problems are being solved, gaps to solve these problems, and develop clearly defined milestones on a frequent basis to measure progress throughout the project.

Ms. Blakey addressed the Aeronautics Committee’s posture on the Vision for NASA’s Aerosciences Ground Test Funding Model, the idea of which was that NASA would begin to support the fixed cost of key facilities such as wind tunnels, beginning in FY 2017. The Aeronautics Committee believes that the new model is important from both an applied science and budgetary view. Ms. Blakey presented another observation for the ARMD Associate Administrator. Mr. Bowersox suggested that this observation become a Council finding for the NASA Administrator, to which Ms. Blakey and the Council agreed. Dr. Ballhaus offered an anecdote about the difficulties surrounding the F-35 program at a time when most of the testing was being done in Europe. The situation underscored the need for major unique facilities to be facility-funded in order to maintain critical national capabilities. Ms. Blakey said it was also important to note that some facilities should be retired. Dr. Ballhaus noted that at one time, NASA did not charge time for testing to the Department of Defense or Department of Energy for critical capabilities. Following discussion, the NAC approved the following finding:

Wind tunnel testing continues to be an important part of air vehicle and engine development. The cost associated with extensive testing sometimes inhibits facilities use, leading to insufficient testing and sometimes a lack of full usage of the tunnels. The Council agrees with this new approach of funding the non-recurring wind tunnel costs. Given the dynamics of influencing usage using a new cost model, the Council suggests that the results of this new model be evaluated frequently and adjusted if necessary.

Ms. Blakey briefly reviewed strategic planning for advanced aviation operations, adding it was worth noting that all the roadmaps covering this effort are complete and posted on the Web. ARMD has tasked the National Academy of Engineering’s Aeronautics and Space Engineering Board (ASEB) to perform an in-depth study on real-time system-wide safety assurance. Areas of interest include leveraging the growing sources of aviation data, and spending more time on monitoring, prediction and prognostics capabilities. Cybersecurity is going to need some serious partnerships in this area, as well as advances in machine learning and computational power.

ARMD is also producing a set of roadmaps for each of the six Strategic Thrusts, one of which is looking at autonomous systems. Autonomy is required to enable a long-term aviation vision, where anyone can safely fly any time and anywhere. Small UAVs are expected to proliferate, increasing the number of vehicles that must be considered in air safety. Roadmap elements include technical verification and validation techniques, strategic partnerships, expected step changes, and iterative mission products. The Autonomous Systems project will be in formulation through 2017, and will to go to operations in 2018. The Aeronautics Committee has formulated a full recommendation on autonomous systems. Mr. Bowersox suggested that the recommendation be limited to the last five lines with some minor reformattting. Following discussion, the NAC approved the following recommendation:

*Given the importance of this area to the U.S. and NASA, the NAC Aeronautics Committee recommends that the NASA Unmanned Aircraft Systems (UAS) Traffic Management (UTM) project be expanded and accelerated. In addition, the Committee recommends that the new Autonomous Systems project include a focus on autonomous air vehicles and address the gaps not being funded by industry such as autonomous verification and validation.*
Ms. Blakey concluded her remarks with a brief status of the Aeronautics Committee’s 2016 Work Plan. All items have been completed except for two (i.e., advanced composites and review of ARMD UAS strategy), which will be moved to the 2017 Work Plan.

Mr. Bowersox thanked Ms. Blakey for her report, and introduced Dr. Ballhaus.

**Technology, Innovation and Engineering Committee Report**

Dr. William Ballhaus, Chair of the Technology, Innovation and Engineering Committee, presented the proceedings from its November 2016 meeting. Three Committee members were absent. He reported on the In-Space Robotic Assessment (IRMA), which is managed by the Technology Demonstration Mission (TDM) program for NASA’s Space Technology Mission Directorate (STMD). Three contracts were awarded by the TDM program to demonstrate robotic manipulation of structures and remote manufacture of structural strusses. The companies are putting in about 25% of the firm-fixed price (FFP) investment. The first project is Made in Space by Archinaut Technology Development, which will involve manufacturing a truss in space. The second is Commercial In-Space Robotic Assembly by Orbital ATK, which will demonstrate robotic reversible joining methods for mechanical and electrical connections. The third is Dragonfly by Space Systems/Loral, which will demonstrate stowage techniques for larger than traditional solid reflectors. All projects will collaborate with NASA Centers. The Committee also received an update from Mr. Ralph Roe, NASA Chief Engineer, on a Technical Capability Assessment that is being carried out by NASA Technical Fellows and their Capability Leadership Teams. The Committee felt it was a good success story, and hoped the Agency would continue the approach.

Dr. Ballhaus reported briefly on a study by the Institute for Defense Analyses on a focus for STMD’s small satellite program, which had been initiated in response to a NAC recommendation in March 2016. Some preliminary findings indicate where STMD is investing in the right areas. The study has yet to conduct some interviews and expects to wrap up in February 2017.

The Committee heard an update on cryogenic fluid management (CFM) technology, with key CFM Technology Readiness Level (TRL) assessments. Some of these technologies will require flight demonstrations in the microgravity environment. Mr. Gerstenmaier said HEOMD would be willing to fly low-TRL demonstrations that do no harm to mission objectives; Mr. Ballhaus agreed to pursue this activity.

Dr. Ballhaus summarized a series of Committee observations from its July 2016 and November 2016 meetings. He highlighted NASA’s need to continue to develop cutting-edge technologies to undertake its missions. Budget cuts had decimated technology investments, which were partially reversed by establishing the Office of the Chief Technologist (OCT) in 2010 and STMD in 2013, rebuilding the crosscutting technology program as well as made focused investments. The Committee believed that NASA had done a great job of formulating the technology program and executing it, within annual budget constraints. STMD has reengaged the academic community in engineering research. However, the Committee remains concerned about conflicts with Congressional priorities, NASA priorities, and an increasing Small Business Innovative Research/Small Business Technology Transfer (SBIR/STTR) mandate within a flat budget environment. Frequently, the consequence is a number of cancelled or deferred programs. NASA must find a way of institutionalizing the way it will deal with the technology budget. In addition, there are a number of thrust areas requiring additional investment, namely lightweight structures and manufacturing, space power and propulsion, autonomy and space robotics systems, and advanced life support and resource utilization, for which STMD must maintain early-stage investment (10% of the STMD portfolio). In particular, technology will need to support HEOMD’s Proving Ground missions for the human exploration of the Solar System.
Dr. Ballhaus commented on Committee observations on NASA’s Technical Capability Assessment for promoting innovation in the Agency. The Committee is concerned that some NASA engineers are spending 50% of their time writing proposals; this is a tremendous waste of their time. NASA needs to give technology branch or division chiefs a discretionary fund to support its engineers. NASA has also experienced an erosion in laboratory facilities, which constitute a barrier to innovation. Senior staff at OCT and STMD remember a time when NASA had more flexibility in these areas; they will come back to the Committee in spring 2017 to work on this further, which may lead to findings and recommendations. The Committee believes there is still a lack of investment in foundational engineering sciences and research at NASA. The new NASA Chief Technologist may want to look at the balance of technology investment and engineering methods. The Committee believes however that the Technical Capability Leadership will enable improved collaboration among centers, with a set of standardized engineering tools across centers.

The Committee made some observations on IRMA and important STMD milestones in FY 2017, expressing approval of NASA’s incentivizing of technology demonstrations on competitively selected science missions (e.g., deep space optical communications). The Committee encouraged the continuation and enhancement of these incentives to support tech demonstrations on future science missions. The Committee also commended NASA and STMD for maximizing returns to NASA, and for improving support for small business.

Dr. Ballhaus concluded his report by noting that some Committee observations are being developed as potential findings in the future.

Mr. Bowersox thanked Dr. Ballhaus for his report, and introduced Ms. Schmoll.

Institutional Committee Report

Ms. Kathryn Schmoll, Chair of the Institutional Committee, provided a briefing on the Committee’s 2.5-day meeting in November 2016, during which members worked on developing a one-year Work Plan, including playing an advisory role on the “Deep Dives” on various aspects of the NASA Business Services Assessment (BSA) activity. Ms. Schmoll commended the BSA effort, and said she was pleased to see that many walls on the management support side in NASA have started to crumble. There has been more collaboration and streamlining of tasks. Senior leadership has been very involved, which has been essential to keeping staff engaged and implementing in their particular organizations. She felt it important not to waste this information going forward through the transition.

BSA activities are currently in the implementation phase in the areas of Information Technology (IT), Procurement, and Human Capital. BSA activities in the area of Facilities are just starting. BSA activities in the areas of Budget/Program Planning and Control, and in Education/Outreach are in the assessment phase. The Institutional Committee has found some examples of success to date. These include a NASA Office of the Chief Information Officer (OCIO) faster network, streamlining of Procurement tools, and multiple-award contract sharing across NASA Centers to improve effectiveness and efficiency. Ms. Schmoll presented a number of findings for the NASA Administrator. Mr. Bowersox asked that the findings be combined into one finding, with multiple points. After Council discussion, the following finding was approved:

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The Council found that the NASA Business Services Assessment (BSA) process is working exceptionally well. The progress since the last briefings to the NAC Institutional Committee is very impressive. All of the BSA teams appear to be maintaining high levels of energy, discipline and engagement while moving from the Deep Dive Decisions to Implementation. The teams heard from during the Institutional Committee meeting held November 2-4, 2016 – Human Capital, Procurement, and Facilities – are mindful of schedules, including project management tools; showing flexibility as appropriate; and approaching their efforts with a focus on transparency and staff involvement across the Agency. There
Ms. Blakey raised the question of how NASA might share BSA success stories and make them interesting. Ms. Schmoll described an All Hands meeting that was full to overflowing and encouraged NASA Center visits to employ a similar type of engagement, at a time when the level of interest is very high. The Institutional Committee recognized that Source Evaluation Boards (SEBs) are large “time sinks,” and in some cases are made part of people’s performance evaluation plans. Dr. Ballhaus commented that centralization often results in the centralized organization’s becoming an entity in and of itself. Ms. Schmoll described some of the efforts as a virtual centralization; staff still has “somebody down the hall” to talk to. Dr. Ballhaus, citing his experience at Lockheed-Martin, felt that the system had to enforce accountability to provide service. Mr. Hale agreed that centralization can deteriorate performance. Ms. Schmoll said she was referring to centralization of certain specific functions, as with those subsumed by the NASA Shared Services Center (NSSC), which is still getting high marks. Dr. Peterson felt that centralization for low-demand services can work well.

The Institutional Committee also proposed a recommendation after conducting an independent assessment of the NASA BSA Human Capital Implementation Plan and the specific business case regarding the classification and staffing. Mr. Bowersox felt the recommendation should be a finding directed to the NASA Mission Support Directorate (MSD) Associate Administrator, and should also be made available to the NASA legal team. Ms. Schmoll agreed, adding that the Institutional Committee is trying to set a standard for what the business assessment case would look like, and felt it would also be valid to add more data to the assessment. Mr. Hale suggested tabling the recommendation. Mr. Bowersox agreed to hold the finding while acknowledging that the work is done. The recommendation was tabled to the next meeting of the NAC in March-April 2017 timeframe. Mr. Bowersox asked Ms. Schmoll to work together with Dr. Paté-Cornell to evaluate the BSA approach to cybersecurity.

Mr. Bowersox thanked Ms. Schmoll for her report, and introduced Dr. Kennedy.

Ad Hoc Task Force on STEM Education Report
Dr. Aimee Kennedy, substituting for the Chair of the Ad Hoc Task Force on STEM Education Chair, Dr. Anita Krishnamurthi, re-presented the finding and recommendations from the Task Force’s July 2016 meeting. The finding reflected the Task Force view that the NASA Office of Education staff could benefit from engagement with the broader STEM “ecosystem,” such as the alliances, communities of practice, and other grant-making agencies to help keep up with the field as it evolves. The Council members discussed the implications of this finding with respect to how NASA might take action on it. As an example, Ms. Kennedy noted that she had ties with four different STEM groups of which NASA had not been part. Ms. Blakey asked what the NASA Office of Education staff might do in response to this finding: attend more conferences, work more on the issues? As an example, Dr. Kennedy mentioned the “100K in 10” effort, which will train 100,000 STEM teachers over the next 10 years; NASA staffers could attend this national conference, and meet other funders who are looking for grantees. Mr. Hale noted that there are many STEM organizations; it may be that NASA is already engaged with those in which the Task Force is not aware. Dr. Kennedy was asked if the Task Force had conducted an inventory of all the STEM organizations with which NASA is currently engaged. If not, it was encouraged to do so, in order to establish a common baseline of information. Mr. Bowersox suggested altering the language of the finding to reflect specific groups with which NASA should engage.
Dr. Kennedy re-presented the recommendation from the STEM Task Force’s July 2016 meeting, proposing that NASA determine a strategic focus for each solicitation cycle, and then direct the majority of non-directed discretionary funds of the total NASA Education budget to support that strategy. Mr. Hale observed that such a recommendation could be demoralizing for the NASA Education program, which is already quite underfunded.

Dr. Kennedy re-presented the recommendation from the STEM Task Force’s July 2016 meeting, proposing that the NASA Education programs should contribute to the larger knowledge base of best practices in STEM education. All NASA grantees should be encouraged to publish their final reports and share their findings widely in public presentations beyond NASA audiences; and NASA should create a public database or participate in an existing one such as the www.informalscience.org website to share NASA Education program results and findings with the larger STEM education community.

After considerable discussion, it was decided to table STEM Task Force’s finding and recommendations until a future meeting of the NAC.

Mr. Bowersox thanked Ms. Kennedy for her report.

Council Discussion and Wrap Up

In concluding the NAC Public Meeting, Mr. Bowersox opened the floor for final discussion comments from the Council members. Mr. Hale stated that he believed that the NAC one-day meeting “experiment” was a bit much, and preferred having an overnight period with which to digest all the findings and recommendations and do any “homework” that may be needed. He recommended that future NAC meetings take place for 1.5 days. He also stated that he missed having the “Early Career” presentations by members of the NASA workforce on the agenda. Dr. Paté-Cornell suggested that perhaps the NAC presentations could be shorter and more focused, and stated that she looked forward to working with Ms. Schmoll on cybersecurity. Dr. Peterson stated that there is value to having “meatier” slides in the presentations. He said he enthusiastically supported bringing together the Science and Exploration programs, and looked forward to working with Mr. Hale on this. Ms. Blakey commented on the excellent discussions, and thanked Mr. Gerstenmaier for being present at the NAC meeting throughout the entire day. Mr. Hale said he was troubled by the lack of public input when offered in real-time during the NAC meeting, and asked that the NAC consider why it was not getting public feedback. Mr. Bowersox noted that the NAC format was not optimal. Mr. O’Brien suggested that perhaps that NAC should try web video-streaming, or Facebook Live. He also thanked Mr. Bolden and Mr. Gerstenmaier for personally participating in the meeting. Ms. Schmoll stated she agreed with Mr. Hale’s suggestion that a 1.5 day meeting would be preferable. Dr. Ballhaus pointed out the need to resolve audio communications issues, and thanked the NASA Deputy Administrator, Dr. Dava Newman, for establishing a policy that enabled NAC committee members to receive the NAC committee presentations several days in advance of the NAC committee meetings. However, in the case of the Council, such a policy would be difficult to implement, since the NAC Committee Chairs are often assembling their own Committee Report presentations to the Council immediately after their own Committee meetings adjourn, i.e., on the day immediately preceding the Council meetings. Ms. Kennedy thanked the Council for the opportunity to participate in the meeting.

Adjourn

Mr. Bowersox adjourned the meeting at 6:08 pm.
NASA ADVISORY COUNCIL

NASA Armstrong Flight Research Center
The AERO Institute
38256 Sierra Highway
Palmdale, CA

PUBLIC MEETING
November 30, 2016

Wednesday, November 30, 2016

10:30 – 10:33 am Call to Order, Announcements
Ms. Diane Rausch
Executive Director
NASA Advisory Council
NASA Headquarters

10:33 – 10:40 am Opening Remarks by NAC Interim Chair
Mr. Kenneth Bowersox
Interim Chair, NASA
Advisory Council

10:40 – 11:30 am Remarks by NASA Administrator
Mr. Charles F. Bolden, Jr.
NASA Administrator

11:30 am – 12:00 noon Council Discussion
All

12:00 noon – 1:00 pm Lunch

1:00 – 1:10 pm Public Input

1:10 – 1:40 pm Human Exploration and Operations Update
Mr. William Gerstenmaier
Associate Administrator
Human Exploration and Operations Mission
Directorate

1:40 – 2:15 pm Human Exploration and Operations Committee Report
Mr. Wayne Hale,
Interim Chair

2:15 – 3:00 pm Science Committee Report
Dr. Bradley Peterson,
Chair

3:00 – 3:45 pm Aeronautics Committee Report
Ms. Marion Blakey, Chair
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<tr>
<td>3:45 - 4:30 pm</td>
<td>Technology, Innovation and Engineering Report</td>
<td>Mr. William Ballhaus, Chair</td>
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<td>4:30 - 5:00 pm</td>
<td>Institutional Committee Report</td>
<td>Ms. Kathryn Schmoll, Chair</td>
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<td>5:00 - 5:30 pm</td>
<td>Ad Hoc Task Force on STEM Education Report</td>
<td>Dr. Aimee Kennedy</td>
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<td>(for Dr. Anita Krishnamurthi, Chair)</td>
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<td>5:30 - 6:30 pm</td>
<td>Council Discussion and Final Wrap-Up</td>
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<td>6:30 pm</td>
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<td>Interim Chair – NASA Advisory Council</td>
<td>Mr. Kenneth Bowersox, U.S. Naval Aviator (Ret.); Former NASA Astronaut</td>
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<tr>
<td>Chair – Aeronautics Committee</td>
<td>The Honorable Marion C. Blakey, President and CEO, Rolls Royce North America; Former Administrator, Federal Aviation Administration (FAA)</td>
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<td>Interim Chair – Human Exploration and Operations Committee</td>
<td>Mr. N. Wayne Hale, NASA (Ret.), Consultant, Special Aerospace Services</td>
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<td>Chair – Institutional Committee</td>
<td>Ms. Kathryn Schmoll, Vice President, Finance and Administration (Ret.), University Corporation for Atmospheric Research</td>
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<tr>
<td>Chair – Science Committee</td>
<td>Dr. Bradley Peterson, Professor Emeritus, Former Chair, Department of Astronomy, Ohio State University</td>
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<tr>
<td>Chair – Technology, Innovation and Engineering Committee</td>
<td>Dr. William F. Ballhaus, Jr., President and CEO (Ret.), The Aerospace Corporation; Former Director, NASA Ames Research Center</td>
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<tr>
<td>Member at Large</td>
<td>Dr. Wanda M. Austin, President and CEO (Ret.), The Aerospace Corporation</td>
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<td>Member at Large</td>
<td>Dr. Penina Axelrad, Professor and Chair, Department of Aerospace Engineering Sciences, University of Colorado, Boulder</td>
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<td>Member at Large</td>
<td>Dr. Elisabeth Paté-Cornell, Professor and Founding Chair, Department of Management Science and Engineering, Stanford University</td>
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<td>Member at Large</td>
<td>Mr. Miles O’Brien, Independent Journalist</td>
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<td>Ex Officio Members</td>
<td>General Lester Lyles, Chair, Aeronautics and Space Engineering Board, National Academy of Engineering; U.S. Air Force (Ret.)</td>
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<td>Dr. David Spergel, Chair, Space Studies Board, National Academy of Sciences; Chair, Department of Astrophysical Sciences, Princeton University</td>
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NASA ADVISORY COUNCIL
MEETING ATTENDEES

NASA Advisory Council Members:
Mr. Kenneth Bowersox, Interim Chair
Dr. William Ballhaus
Ms. Marion C. Blakey
Mr. N. Wayne Hale
Mr. Miles O'Brien
Dr. Elisabeth Paté-Cornell
Dr. Bradley Peterson
Ms. Kathryn Schmoll

Ms. P. Diane Rausch, Executive Director
Dr. Patricia Sanders, ASAP Chair

NASA Attendees:
Alexander, David
Ambelis, Brian
Cendana, Donna
Denning, Elaine
Gerstenmaier, William
King, Marla
Martin, Cam
McBride, David
Rohrer, Kevin
Schmidt, Steven
Sumney, Kaitlin
Ulbrich, Ken
Valdez, Felipe
Voracek, David

Other Attendees:
Clancy, John
Floyd, Mary
Gatlin, Alison
Heinrich, Mark
Hoffman, Allen
Kennedy, Aimee
Ledford, James
Lopez, Nancy
Miguar, John
Pallon, Joe
Poole, Cynthia
Purtee, James
Reta, Carley
Rhea, Donald
Zimmermann, Joan

U.S. Navy (Ret.)
The Aerospace Corporation (Ret.)
Rolls Royce North America
Special Aerospace Services
Independent Journalist
Stanford University
Ohio State University
Kathryn Schmoll and Associates, LLC

NASA Headquarters
NASA Aerospace Safety Advisory Panel (ASAP)
(via telecon)

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NASA Headquarters
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NASA Armstrong Flight Research Center
NASA Armstrong Flight Research Center
NASA Armstrong Flight Research Center [Arcata]
NASA Armstrong Flight Research Center
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Ingienicomm, Inc.
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Battelle
Mayor, City of Palmdale
City of Palmdale
City of Palmdale
Glendale College student
Dickinson Graham
City of Palmdale
AERO Institute
Clancy JG International
Ingienicomm, Inc.
Telecon (Dial-In) Attendees:

Reis, Amy
Riley, Andrea
Clark-Williams, Angela
Verbiscer, Anne
Hale, Belinda
Siegel, Bette
Patten, Bill
Messier, Bough
Gilbert, Chris
Branscomb, Darrell
Reilly, Deann
Detroye, Diane
Dittmar, Mary Lou
James, Donald
Denning, Elaine
Morrin, Frank
Mikulka, Gene
Bloemhard, Heather
Grant, Helen
Klotz, Irene
Rodriguez, Irma
Dean, James
Pitman, Jay
Foust, Jeff
Grove, Jennifer
Lochner, Jim
Reuter, Jim
LeClere, Jon
Charlton, Jonathan
Hambleton, Kathryn
Cowing, Keith
Cantillo, Laurie
Chambers, Lin
Grush, Loren
Smith, Marcia
Borowitch, Mariel
McKay, Meredith
Tabach, Micheline
Green, Mike
Boosen, Paul
McKinney, Richard
Irving, Rick
Zimmerman, Robert
Gatens, Robyn
Barber, Sarah
Clark, Steven
Jurczyk, Steven
Splawn, William

Ingenicomm, Inc.
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Armstrong Research Center
VE Consult
NASA Consultant
Boeing Corporation
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Talking Space
American Astronomical Society
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Reuters
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Florida Today
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Space News
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Universities Space Research Association
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Science Committee, U.S. House of Representatives
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Consultant
NASA Headquarters
Symbiotek
NASA
U.S. House of Representatives
Space Flight Now
NASA Headquarters
ILC
NASA ADVISORY COUNCIL

NASA Armstrong Flight Research Center
The AERO Institute
Palmdale, CA

November 30, 2016

LIST OF PRESENTATION MATERIAL

1) NASA Human Exploration and Operations Update [Mr. William Gerstenmaier]
2) NAC Human Exploration and Operations Committee Report [Mr. Wayne Hale]
3) NAC Science Committee Report [Dr. Bradley Peterson]
4) NAC Aeronautics Committee Report [Ms. Marion Blakey]
5) NAC Technology, Innovation and Engineering Committee Report [Dr. William Ballhaus]
6) NAC Institutional Committee Report [Ms. Kathryn Schmoll]
7) NAC Ad Hoc Task Force on STEM Education Report [Dr. Aimee Kennedy]