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Statement of
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before the

Subcommittee on Space and Aeronautics
Committee on Science, Space, and Technology
U. S. House of Representatives

Chairwoman Horn, Ranking Member Babin, and Members of the Subcommittee, thank you for the opportunity to appear before you today to discuss NASA's progress on our Exploration Systems Development (ESD) programs. NASA is charged with landing American astronauts near the South Pole of the Moon by the year 2024 and importantly, doing so in way to drive ourselves toward a more sustainable exploration enterprise. NASA is committed to this challenge. To meet the 2024 objectives, we continue to accelerate development of the systems required to ensure initial success including the Space Launch System (SLS) heavy lift rocket, the Orion crew vehicle, ground systems at Kennedy Space Center (KSC), the lunar Gateway spacecraft, and commercial human lander systems for transiting humans from the Gateway to the lunar surface. To achieve long-term sustainability of the enterprise, we have focused on reducing costs and incentivizing more innovation through different acquisition models to increase competition and partnerships, planning our exploration architecture to utilize advances in the commercial marketplace, and refocusing investment toward technologies that will reduce costs and increase capabilities. Each of these aspects is an integral element in NASA's plans for a sustainable exploration architecture. Now, we are engaged in the safe and rapid acceleration of these plans.

NASA has adopted the name "Artemis" after Apollo's twin sister for the Agency's lunar exploration program and is part of NASA's broader Moon to Mars exploration approach. Through the Artemis program, we will see the first woman and next man step foot on the Moon by 2024, and establish a sustainable architecture with our commercial and international partners on the Moon by 2028. NASA's plans call for one SLS, Orion, and Exploration Ground Systems (EGS) flight per year after Artemis III. The actual cadence of missions will be defined based on mission needs, available resources, and operational costs. Reducing production and operations costs will be critical for enabling an ambitious exploration program. The Moon will also be a proving ground where we will demonstrate technologies and take what we learn on the Moon and enable the next giant leap of human exploration of Mars.

NASA is pressing forward toward the early Artemis missions. Artemis I is an uncrewed test flight of SLS and Orion as an integrated system. This will be followed by Artemis II, a mission that will bring a crew around the Moon aboard SLS and Orion. In 2024, Artemis III will send the first crew to the Gateway in lunar orbit where the crew will transition to a commercial human landing system for transport to and from the lunar surface.

The fiscal year 2020 Presidential budget amendment requests an increase of $1.6 billion above the original request of $21 billion in funding for NASA. This budget amendment is the down payment required to get us out of the gate to achieve the bold goal of landing American astronauts on the Moon's

South Pole by 2024. We would appreciate your immediate help and bipartisan support. Together we will invest in America's future, inspire the Artemis generation in science, technology, engineering, and mathematics (STEM) careers, create good paying American jobs, advance science, and lead our commercial and international partners as we move forward with the first woman and next man on the Moon in 2024, a sustainable lunar architecture by 2028, and on to Mars.

Space Launch System

When it launches for the first time, the SLS will be the most powerful rocket in the world and a launch vehicle that supports a new era of exploration beyond Earth's orbit into deep space. Together SLS and Orion are a backbone of the Artemis program. SLS will launch astronauts in the Orion spacecraft on the Artemis missions to the vicinity of the Moon and the Gateway on their way to the surface of the Moon.

SLS capabilities are planned to evolve using a block upgrade approach. SLS Block 1 will have the capability to carry over 70 metric tons to low-Earth orbit (LEO) and nearly 30 metric tons to orbit around the Moon. NASA is focused on the successful completion of the Artemis I non-crewed test flight, the Artemis II first crewed test flight, and the Artemis III mission in 2024 that will enable the return to the Moon. This represents a step-by-step approach to developing the initial SLS capability. Eventually, NASA will follow on with development of the Block 1B capability.

The next evolution of the SLS, Block 1B, incorporates a new upper stage, the Exploration Upper Stage (EUS), now under development, along with updates to associated cargo adaptors. The SLS Block 1B configuration enables co-manifested payloads, increases cargo capability, and enables improved operational flexibility. While upgrading the SLS to the Block 1B configuration remains an important future capability, recent performance issues and delays in SLS core stage manufacturing and design updates related to the Exploration Upper Stage requirements require that NASA concentrate all available resources in the near term on the successful completion of Artemis I, II and III, and supporting a reliable annual SLS and Orion flight cadence thereafter. As a result, we have proposed to defer SLS Block 1B development efforts to later exploration missions. Spending to date on Block 1B (which includes EUS, related flight hardware such as the upper stage adapter, related ground processing capability including the Vehicle Assembly Building (VAB) platforms, and Mobile Launcher (ML)-2) has been consistent with legislative direction. The development and manufacturing of the first EUS, based on appropriations to date, is included in the existing SLS core stages contract. Future follow-on procurement for EUS production beyond the current contract, if directed by appropriations, would follow Government procurement practices with respect to consideration of competition.

SLS leverages over a half-century of experience with launch vehicles, including Saturn and Space Shuttle, along with advancements in technology since that time, including model-based engineering, additive manufacturing, high-fidelity computational fluid dynamics capabilities, new composite materials and production techniques, and large-scale self-reaction friction stir welding. Initial flight units use components already procured during the Space Shuttle, such as RS-25 engines and boosters. More efficient methods are under development for manufacturing these components, including new NASA investment in expendable RS-25 engines for the SLS Core Stage with the goal of achieving a lower per-unit cost than the original reusable RS-25s used as the Space Shuttle Main Engines. NASA continues to identify affordability strategies for missions beyond Artemis II. Reducing overall costs of the systems will be critical to achieving a successful and sustainable exploration capability.

During FY 2019, SLS continued to progress towards Artemis I while concurrently building flight hardware for Artemis II:

- Artemis I launch vehicle stage adapter will complete assembly and check out and will ship to KSC in Florida in preparation for integration. The adapter serves as the interface between the SLS Core Stage and the Interim Cryogenic Propulsion Stage (ICPS), the latter of which has already been delivered to KSC.
- In August 2019, at the Michoud Assembly Facility (MAF), we completed work on the engine section, the most challenging part of the SLS rocket, for Artemis I. The engine section is now ready to be integrated with the core stage.
- The four completed RS-25 flight engines are at MAF ready for integration into the Core Stage for Artemis I this fall.
- The Artemis I Core Stage components including RS-25 engines, the engine section, hydrogen tank, inter-tank, and oxygen tank are more than 80 percent complete. Horizontal mating of the engine section and RS-25 installation will begin in September 2019.
- Once both the engine section and RS-25 engines are integrated with the Core Stage for Artemis I, the rocket will be shipped from MAF in New Orleans, LA to Stennis Space Center (SSC) in Bay St. Louis, MS for Green Run testing, scheduled for mid-December of this year.
- Flight software and related avionic components continued testing in the software integration laboratory at Marshall Space Flight Center.
- All of the Artemis I booster components including aft skirt assemblies and forward assemblies are complete and will be delivered to KSC.
- SLS is making strides towards finishing Artemis II flight components including completed Core Stage solid rocket booster segments and significant progress on Core Stage-2, ICPS-2, and other elements.
- Work continued on developing the new RS-25 engines for future missions, achieving a 33 percent cost reduction with innovative and advanced manufacturing methods.

The Artemis I flight will be preceded by a Green Run test campaign scheduled for FY 2020. Planning dates for Green Run test execution are under review. The Green Run test campaign consists of a number of critical engineering tests, including a modal structural test and a cryogenic commodity loading and unloading test, followed by a test fire. For the test fire the liquid Core Stage will be loaded with liquid hydrogen fuel and liquid oxygen oxidizer in the B2 test stand at SSC and all four RS-25 engines will be fired to demonstrate the Core Stage performance prior to launch day. Upon the successful completion of the Green Run test campaign, the Core Stage will ship to KSC and complete vehicle certification.

When all Artemis I SLS hardware is delivered to KSC, the SLS team will effectively hand off all the launch components to the Exploration Ground Systems (EGS) team in Florida and the SLS program team focus will shift to Artemis II and III production for those flights. Fabrication and testing of elements of Artemis II will continue, to include the Core Stage, shipment of the solid rocket booster components, and additional flight elements. Additionally, the SLS team will continue efforts to restart RS-25 engine manufacturing to support Artemis IV+ missions.

Orion

NASA's Orion spacecraft builds upon more than 50 years of spaceflight research and development. It is uniquely designed to carry astronaut crews to deep space, provide emergency abort capability, sustain crew during space travel, and provide safe reentry at the high-Earth return velocities typically needed to come home from missions beyond low Earth orbit. Orion is capable of supporting a crew of four astronauts for periods of up to 21 days. It is designed to provide communications, navigation, power, and propulsion to carry people and cargo in the harsh environment of deep space and, with a planned mission kit, dock with the Gateway. Through modification and with the support of other new deep space

elements, most of the Orion systems could be capable of operations in deep space for periods of time up to 1,000 days. The Orion will also be able to provide key initial life-support and abort capabilities to and from Gateway. Additionally, the Orion systems are designed to operate in a contingency mode to augment life support systems in other space transport systems.

Orion's Crew Module (CM), Spacecraft Adapter (SA), and Launch Abort System (LAS) incorporate numerous technology advancements and innovations. Orion's LAS can activate within milliseconds to carry the crew out of harm's way and position the module for a safe landing. The spacecraft's propulsion, thermal protection, avionics, and life support systems will enable extended duration missions beyond Earth orbit and into deep space. Its modular design will be capable of integrating additional new technical innovations as they become available.

The European Space Agency (ESA) is partnering with NASA to provide the European Service Module (ESM) for Orion. ESA is providing the ESMs to partly offset its International Space Station (ISS) financial obligations. The ESM will provide the Orion spacecraft with propulsion, electrical power, water and thermal control, and maintains the oxygen and nitrogen atmosphere for the crew.

The Orion Program made progress during FY 2019 on both Artemis I and II:

- The Orion Program conducted Propulsion Qualification Module (PQM) firings with active control of the pressurization system on the ESM. This includes the recent successful completion of the most stressful test case, called an Abort to Orbit at White Sands Test Facility near Las Cruces, NM.
- Following the functional tests, the ESM was mated with the Crew Module Adaptor (CMA) to complete the Service Module (SM) assembly. The completed Service Module was joined to the Crew Module, resulting in the combined Crew and Service Module (CSM) earlier this year. This work was performed at KSC and marked the first time all three major elements were integrated.
- The Orion program will ship the integrated Artemis I CSM to Plum Brook Station in Sandusky, OH, for thermal vacuum and electromagnetic interference testing which is a crucial step towards launch readiness. Once completed, the mated CSM will be returned to KSC for final launch processing.
- Continuing the manufacturing efforts for Artemis II, the program completed the Crew Module primary structure and is on track to complete the CMA primary structure at the Operations and Checkout (O&C) Facility at KSC.
- ESM-2 integration has begun in the Bremen, Germany clean room. Long-lead activities, such as welding of high-pressure valves and engine manufacturing, are underway.
- The Ascent Abort-2 test, which successfully demonstrated the ability to safely separate the Crew Module from the SLS during an ascent abort scenario, was carried out at Cape Canaveral from Launch Complex 46 on July 2, 2019.

In preparation for Artemis I, Orion will complete the Orion Structural Test Article (STA) configuration test in Denver, CO, and then ship it to Langley Research Center (LaRC) in Virginia for subsequent water impact testing. This is the last action in the series of tests that will complete the test campaign on the full-scale Orion STA. These tests are conducted to ensure the space-bound vehicle is ready to withstand the pressure and loads it will endure during launch, flight and landing. NASA will also stack and integrate the LAS in the LAS Facility and mate it to the CSM for Artemis I at KSC. After the mating, it will be delivered to the EGS team at KSC for final preparation and stacking in the VAB.

In preparations for Artemis II, Orion will finish outfitting the CM Pressure Vessel at KSC's O&C building. From FY 2020 through early FY 2021, the Orion program will install the Environmental

Control and Life Support Systems (ECLSS), the core avionics that provide overall spacecraft command and control, and the heatshield, which protects the vehicle and crew from the extreme temperatures of re-entry. Once installed, Orion will conduct a series of power-on, leak, functional, and proof pressure tests to ensure the health of the CM. In addition, the production of the Artemis II CMA will be completed. To prepare for mating to the ESM-2, the CMA will undergo proof pressure and leak tests followed by subsystem installations, harness testing, and Developmental Flight Instrumentation testing. ESA will complete manufacturing of ESM-2 and deliver it to the KSC O&C facility. Once the ESM-2 is delivered and functional tests are performed, it will be mated to the CMA. After mating, the Artemis II ESM will undergo functional, pressure and leak tests in preparation for integration with the CM-2 planned for crewed flight.

The Orion Program has initiated long lead material purchases for future Artemis missions, which will enable the program to meet an annual flight rate to support lunar exploration. In addition, the Orion Program will initiate production activities in FY 2020 for Artemis III, targeted to transport the crew for landing on the Moon in 2024, and will begin the production process to support annual exploration flights as planned in the Agency Moon to Mars enterprise. These missions represent United States commitment to – and a core piece of NASA's infrastructure for – exploration. Essential to building a sustainable exploration strategy will be finalizing development and reducing production and operation costs.

Exploration Ground Systems

The EGS team is preparing KSC to process and launch the SLS rocket and Orion spacecraft on Artemis missions. To achieve this transformation, NASA is developing new ground systems while refurbishing and upgrading infrastructure and facilities to meet tomorrow's demands, including those of the Artemis Program. This modernization effort is designed to maintain maximum flexibility in order to also accommodate a multitude of other potential Government and commercial space customers. Drawing on five decades of excellence in spacecraft processing and launch, KSC continues to work toward serving as a multi-user spaceport, as was envisioned post-Space Shuttle retirement.

During FY 2019, EGS has made significant progress:

- The program performed multiple successful launch pad water deluge tests using the Ignition Overpressure Protection and Sound Suppression system at Launch Pad 39B.
- In June, the Mobile Launcher, atop Crawler-Transporter 2, made its final solo trek from the Vehicle Assembly Building (VAB) to Pad 39B at KSC. The Mobile Launcher will remain at the pad over the summer, undergoing final testing and checkouts.
- NASA conducted several umbilical tests on the Mobile Launcher, including the first high speed retraction test on the Orion Service Module Umbilical (OSMU) that verified umbilical arm alignment, rotation speed, and latch back systems; a drop test of the Tail Service Mast Umbilicals (TSMU) to ensure that the umbilicals will disconnect before launch of the SLS; and a swing test of the Core Stage Inter-tank Umbilical (CSITU) on the Mobile Launcher.
- EGS engineers conducted Underway Recovery Test-7 (URT-7) off the coast of San Diego, CA, using a mock Orion Spacecraft capsule. These tests verify and validate procedures and hardware used to recover the Orion spacecraft after it splashes down in the Pacific Ocean following deep space exploration missions.
- EGS began construction for a new liquid hydrogen sphere for Launch Complex 39B at KSC. The storage facility will hold 1.25 million gallons of the propellant.
- The ESM for Artemis I arrived at KSC in November 2018 and underwent a host of tests and integration work before being connected to the Orion crew module.

- EGS continued ground systems development efforts, including efforts for Mobile Launcher structural modifications, installation of ground support equipment necessary to service the rocket and spacecraft, Vehicle Assembly Building High Bay platform work in high bays 3 and 4 necessary to access the over 30-story-tall rocket and spacecraft, and completion of environmental control system upgrades necessary to maintain proper working environment in the massive facility.
- EGS conducted the first formal terminal countdown simulation inside Firing Room 1 in the Launch Control Center at NASA's Kennedy Space Center.
- Consistent with provisions in the FY 2018 Consolidated Appropriations Act (P.L. 115-141), as well as the NASA Administrative Provision in P.L. 115-141 pertaining to the Agency's Operating Plan, NASA awarded a contract in June 2019 to start building the second Mobile Launcher platform. NASA does not have plans to utilize the second Mobile Launcher in the near term, and a final Block 1B design has not been set. NASA is deferring these activities until needed but allowing core design and construction of the platform to continue while awaiting a decision on the upper stage configuration for future missions.

In FY 2020, the EGS Program will complete software development efforts and Multi-Element Verification and Validation of the ground systems to support timely Artemis I rocket and spacecraft processing when the flight elements arrive in CY 2020. Spacecraft processing operations for Orion will take place at the Multi-purpose Payload Processing Facility, followed by SLS flight hardware assembly, SLS/Orion integration, and integrated testing at the VAB to support Artemis I. The program will complete URT 8 and 9 to ensure safe recovery of the Orion crew module after the Artemis I mission. EGS will complete ground processing operations in support of an Artemis I integrated launch.

In addition, the EGS Program will continue ground systems development efforts in support of future mission requirements, including the first crewed flight on Artemis II. This includes modifications to the pad and VAB Environmental Control System, upgrades to the Converter Compressor Facility, modifications to the Mobile Launcher to support crew missions, as well as continuation of Liquid Hydrogen Sphere Construction activities at launch pad 39B.

Artemis I

Artemis I will be the first integrated test of SLS, Orion, and EGS. The first in a series of increasingly complex missions, Artemis I will be an uncrewed flight test that will provide a foundation for human deep space exploration and demonstrate our commitment and capability to extend human existence to the Moon and beyond. During this flight, the spacecraft will launch on SLS and travel 280,000 miles from Earth, or some 40,000 miles past the far side of the Moon over the course of about a three-week mission before returning to Earth. Orion will stay in space longer than any ship for astronauts has done without docking to a space station and return home faster and hotter than ever before.

The outbound trip to the Moon will take several days, during which time engineers will evaluate the spacecraft's power, propulsion, cooling, communication and navigation systems and, as needed, correct its trajectory. Orion will fly about 62 miles (100 km) above the surface of the Moon and then use the Moon's gravitational force to propel Orion into a distant retrograde orbit, rotating opposite the direction the Moon orbits the Earth, some 40,000 miles (70,000 km) from the Moon. The spacecraft will stay in that orbit for approximately one week to collect data and allow mission controllers to assess the performance of the spacecraft.

For its return trip to Earth, Orion will do another close lunar flyby that takes the spacecraft within about 60 miles of the Moon's surface. The spacecraft will then use another precisely timed engine firing of the

ESM in conjunction with the Moon's gravity to accelerate back toward Earth. This precision maneuver will set the spacecraft on its trajectory back toward Earth to enter our planet's atmosphere traveling at 25,000 mph (11 kilometers per second), producing temperatures of approximately 5,000 degrees Fahrenheit (2,760 degrees Celsius) – faster and hotter than Orion experienced during its 2014 flight test – proving the heatshield design is ready to carry astronauts on the next flight test. After about three weeks and a total distance traveled exceeding 1.3 million miles, the mission will end as the spacecraft makes a precision landing in the Pacific Ocean within eyesight of the recovery ship off the coast of California. Following splashdown, Orion will remain powered for a period of time as divers from the U.S. Navy and operations teams from NASA's EGS team approach in small boats from the waiting recovery ship to perform an initial safety inspection. Orion will then power down to support retrieval of the capsule for post-flight engineering assessment.

Schedule performance by the SLS and Orion Programs is critical to achieving a human return to the Moon by 2024. The preponderance of SLS, Orion, and EGS development and production work is focused on Artemis I, and work is underway to prepare for the first flight of crew on Artemis II. While progress on these programs has been substantial, NASA, its contractors, and international partners have faced challenges with first-time design, assembly, and test. NASA has been working to address these development issues. Earlier this year, the Human Exploration and Operations Mission Directorate (HEOMD) completed an assessment of alternate approaches for hardware processing and facilities utilization for key components with the goal of maintaining an early as possible Artemis I launch date. The NASA Office of the Chief Financial Officer performed a schedule risk assessment of the Artemis I launch date, including the integrated schedule and associated risk factors ahead of Artemis I. NASA plans to establish a new launch date for Artemis I, after replacements are officially named for the previous HEOMD Associate Administrator and ESD Deputy Associate Administrator.

Artemis II

NASA is also moving forward on Artemis II, making progress on the SLS and Orion vehicles that will be used for that mission. Astronauts on their first flight aboard NASA's Orion spacecraft will travel farther into the solar system than humanity has ever traveled before. Their mission will confirm all of the spacecraft's systems operate as designed in the actual environment of deep space with a flight crew aboard. NASA's first Artemis mission with astronauts will mark a significant step forward on NASA's plans to return humans to the Moon for long-term exploration and future missions to worlds beyond, including Mars. The plan for the Artemis II flight is built around a profile called a hybrid free return trajectory. Orion will perform multiple maneuvers to initially raise its orbit around Earth and eventually place the crew on a free return trajectory from the Moon.

After launch, the spacecraft and upper stage of the SLS rocket will first orbit Earth twice to allow enough time for the team to assess the spacecraft's performance, including key life support systems, before committing to proceed with flight around the Moon. Orion will reach a circular orbit at an altitude of 100 nautical miles and last 90 minutes. Following the first orbit, the rocket's ICPS will perform an orbital raise, which will place Orion into a highly elliptical orbit around our planet. This is called the partial translunar injection. This second, larger orbit will take approximately 42 hours with Orion flying in an ellipse between 190 and 60,000 nautical miles above Earth. Once the integrated vehicle completes these two orbits, the ICPS will separate from Orion and the crew will do a unique test of the spacecraft's critical systems. They will gather and evaluate engineering data from the nearly two-day-long Earth orbit before using Orion's SM engine to complete a second and final propulsion move called the translunar injection (TLI) burn. This second burn will put Orion on a path toward the Moon. The TLI will send crew some 3,000 nautical miles past the far side of the Moon where they will ultimately execute a figure-eight-shaped orbit before Orion returns to Earth. Instead of requiring propulsion on the return, the spacecraft

will purposefully use the Moon's gravitational pull like a slingshot to bring Orion home, which is the free return portion of the trajectory. Crew will fly thousands of miles beyond the Moon, which is an average of 230,000 miles from the Earth, setting a new record for human distance traveled from Earth. It will take a minimum of ten days to complete the mission.

Artemis III

On March 26, 2019, the Vice President announced at a meeting of the National Space Council in Huntsville, AL, that, at the direction of the President, it is the stated policy of the United States of America to return American astronauts to the Moon within five years and that when American astronauts return to the lunar surface, they will take their first steps on the Moon's South Pole. The Artemis III mission will send the first crew to the lunar surface using a commercially-developed human landing system that will depart from the Gateway outpost orbiting the Moon. With the rapid development of the integrated human landing system and the Gateway, we will have access to more of the Moon than ever before. On May 13, 2019, NASA submitted a revised FY 2020 budget to Congress that would provide an additional "down payment" of $1.6 billion beyond the original budget request to achieve this objective. Our approach is to leverage and build upon our existing work to achieve these new goals.

NASA is now in the fabrication and assembly phase of developing SLS, Orion, and EGS, and is focused on bringing these capabilities together to conduct the first three Artemis missions. The Agency is incentivizing speed and drawing on commercial and international partners as it looks to land humans on the Moon within five years. NASA is completing development of the Orion spacecraft that will carry humans to lunar orbit, the SLS rocket that will launch Orion, and the Exploration Ground Systems that will support the Artemis missions.

Conclusion

NASA is going forward to the Moon and Mars. With our U.S. industry and international partners, we are building a sustainable, open architecture that returns humanity to our nearest neighbor as the next step in our goal to establish a long-term human presence on the Moon before embarking on human missions to Mars. We are moving fast; we are incentivizing speed to land humans on the Moon within five years. We are using new acquisition strategies to engage the best of U.S. industry to meet our ambitious goals. We are completing development of SLS, Orion, and EGS. We are pressing forward toward uncrewed and crewed test flights of Orion around the Moon and we are working to land U.S. astronauts on the lunar South Pole by 2024. The lunar Gateway will serve as a reusable command module, supporting repeated human missions to the surface of the Moon, enabling opportunities to access to the entire lunar surface, and supporting human missions to Mars.

A sustainable lunar presence will pay dividends across diverse areas, including American leadership, scientific discovery, technology development, expansion of the economy, and inspiration of the next generation of STEM professionals. We have asked Congress for additional resources to get to the Moon by 2024, which will enable us to get to Mars more quickly and safely. The work we accomplish at the Moon over the next decade and beyond will ensure we can send the first humans to Mars. By focusing on accelerating our near-term efforts to land the first woman and the next man on the Moon in 2024, we will not only begin to realize these benefits sooner, we'll also create momentum that will reduce the political risk of disruptive changes in direction.

Chairwoman Horn and Ranking Member Babin, I would be happy to respond to any questions you or the other Members of the Subcommittee may have.

Kenneth Bowersox, Associate Administrator (Acting) for Human Exploration and Operations

Kenneth Bowersox was named acting associate administrator for NASA's Human Exploration and Operations Mission Directorate on July 10, 2019. Before being appointed to that position, Bowersox served for over five years as the Chair of the NASA Advisory Council's Human Exploration and Operations Committee, as well as Interim Chair of the NASA Advisory Council from June 2016 to January 2017. He is a retired U.S. Naval Aviator, with over 19 years of experience at the National Aeronautics and Space Administration (NASA). Selected to the astronaut corps in 1987, he has flown five times on NASA's Space Shuttle, serving as pilot, commander and mission specialist, and once on a Russian Soyuz, where he served as the flight engineer during descent. During his five orbital missions, Bowersox has logged over 211 days in space, including five and a half months aboard the International Space Station (ISS), where he was the mission commander of the 6th expedition. He was also a crew member for the first two Hubble Space Telescope repair flights and two United States Microgravity Laboratory flights.

Subsequent to his mission aboard the ISS, Bowersox served as the director of the Johnson Space Center's Flight Crew Operations Directorate, retiring from NASA and the U.S. Navy in December, 2006. After retirement, he remained involved with the U.S. space exploration program as a member of the standing review boards for ISS, Space Shuttle, and the Constellation Program. From 2009-2011, Bowersox was the Vice President of Astronaut Safety and Mission Assurance at SpaceX. Prior to his current assignment, Ken worked as an independent technical consultant, advising clients on spacecraft design, proposal development, and providing independent assessment of technical programs.

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