

Hearing of the House Committee on  
Science, Space, and Technology  
Subcommittee on Space and Aeronautics

“Developing Capabilities for NASA Space  
Exploration: Beyond Lunar Orbit”

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Chairwoman Horn, Ranking Member Babin and Committee Members, thank you for this opportunity to address the current state of NASA Exploration beyond low Earth orbit. I have had the opportunity to testify before this subcommittee and the full Committee many times over the past 50 years. I have always applauded this Committees continued bipartisan support and guidance over the years to insure the United States has strong world leadership in space exploration.

This year, we are celebrating the 50<sup>th</sup> Anniversary of the Apollo Program and the Anniversary of Apollo 11's first landing on the moon. Numerous lessons from Gemini, Apollo, Space Shuttle, Space Station, and Exploration Programs come to mind that should be heeded as we prepare to return explorers beyond low Earth orbit, first to the Moon and then to Mars.

Discussions today will be about the current status of the exploration program. I am reminded of the words of the great writer George Santayana, "Those that ignore the lessons of history are doomed to repeat them."

Hopefully NASA will be successful in carrying out the space policy of the Administrations Exploration Program of returning to the Moon and eventually an expedition to Mars.

I joined NASA with the 2<sup>nd</sup> group of nine astronauts in 1962 who flew majority of the Gemini and Apollo flights. I served as backup pilot of the first Gemini flight, then flew as pilot of Gemini VI that performed the first Rendezvous in space and validated the techniques that would prove the key maneuver in the Apollo program of landing on the moon. I then flew as Commander of Gemini IX and flew three different types of rendezvous, one of which would be standard for the lunar missions. I then served as backup Commander for the first Apollo flight, Apollo VII and then commanded Apollo X which included the first flight of the lunar module to the Moon. The lunar module was too heavy to land when I descended to nine miles of the moon. I photo mapped, radar mapped and visually surveyed the potential lunar landing site and then performed the first rendezvous around the Moon. On the return to the Earth, with my crew, set the all-time world human speed record of 24,791 MPH or Mach 36.

After Apollo X, I replaced Alan Shepherd as Chief of the Astronaut Office and after several years there became Deputy Director of Flight Crew Operations. I then served as Commander of the Apollo-Soyuz test program, the

first International rendezvous and docking with Soviet Cosmonauts. This mission laid the foundation for Shuttle-Mir program and international flight cooperation with other countries and now the International Space Station program. I have served since 1995 as Chairman of the International Space Station advisory task force to review safety and operational readiness of the program.

In 1989, on the 20<sup>th</sup> anniversary of Apollo 11, President George H.W. Bush gave a speech on the steps of the Smithsonian Air and Space Museum. He set the human space policy for returning to the Moon- “Back to Stay,” and a “Manned Mission to Mars.” This began what came to be known as the “Space Exploration Initiative.” He reactivated the National Space Council with Vice President Dan Quayle as Chairman. After several small studies by NASA and the NRC, Vice President Quayle asked me if I would volunteer to form a study group that could outline the steps that could better carry out President Bush’s space vision in a way that was faster, better, safer, and at a lower cost. I assembled a group of forty-five individuals from NASA, DOD, DOE, Industry with experience in the area of space exploration. I had a second group headed by the Commander of USAF Space

and Missiles Organization that consisted of 150 members from all three branches of the DOD to support our effort. We also had the RAND Corporation that had an 800 number that would take ideas from all over America and sort the viable ones that their opinion did not violate the laws of physics and could have a potential positive input to the study. All the aerospace in the USA and other interested industrial firms could make presentations to us on their approach on what they could contribute to the goal of returning to the Moon and going on to Mars. Also, had a Senior Steering Group headed by Dr. Robert Seamans of M.I.T. that checked our progress and critiqued our findings as we progressed in the study. These members included Dr. Christopher C. Kraft and Dr. Max Faget of NASA/JSC. Our charter was to produce two or more architectures and the technology priorities to carry out President Bush's Space Exploration Initiative.

At the end of eleven months, in June 1991, Vice President Quayle and I had a joint press conference at the White House press room and unveiled the findings of the study titled "America at the Threshold." I outlined the four potential architectures and the supporting technologies to carry out the architectures. The number

one of the supporting technologies identified was the reinstatement of a heavy weight launch vehicle that was larger than the Saturn V. The synthesis group then gave NASA eighty-three boxes of data it had collected on the various subjects we had investigated, and the synthesis group was dissolved.

The Bush Administration started to implement the Space Exploration Initiative. When Bill Clinton became President in January 1993, he terminated the Space Exploration Initiative.

President George W. Bush in 2004 outlined his Space policy which was termed "Vision for Space Exploration" which was followed by the NASA Authorization Act of 2005. To carry out this policy over 300 people from the NASA centers produced an extensive study called Exploration Systems Architectural Study. One of the major factors that enabled this architecture to be feasible was a heavy lift launch vehicle constructed of parts from the space shuttle program and other entities. It resulted in a booster that would deliver 410 thousand pounds into low Earth orbit which would produce a

translunar injection mass of approximately 136,600 pounds. It will also have a large shroud that could encompass habitats, rovers and other elements of infrastructure that would be required for a potential permanent lunar base. The program to carry this out was termed the Constellation program. This was supported by the Congress until the inauguration of President Obama in January 2009 and an immediate 20% reduction in the budget by the OMB. A study was started under the leadership of Mr. Norm Augustine, former Chairman of Lockheed Martin which outlined their findings which stated the present program was unsustainable at that budget level. There was no place in the study that recommended cancellation of the program. However, in February 2010, the Obama Administration cancelled the program. Immediately a bipartisan letter signed by 29 members of the House and Senate stated that none of the contracts by the Constellation program should be terminated. The NASA Authorization Act of 2010 authorized the development of a heavy lift booster termed the Space Launch System which would deliver a minimum of 70 metric tons to LEO to start with and grow to a minimum of 130 metric tons to LEO and also authorized the development of a space craft capable of

flying both to the Moon and eventually to Mars and could encompass a crew of up to 6 people. It was termed the Orion spacecraft. The Appropriations Committees funded the booster and spacecraft using in excess of what was requested under the President's budget from this time to the present.

In 2014, the National Research Council of Aeronautics, Space, and Engineering Board produced a study that reviewed the exploration of Space beyond low Earth orbit. It outlined the fact that what is required is a heavy lift booster to provide the transportation from Earth to the Moon and Mars.

In 2019, a team at the NASA Marshall Space Flight Center conducted a study on the choice of the human lunar mission balance of launch vehicle manifesting and the schedule realities. It determined that SLS is essential for architecture and mission closure.

- Only SLS can lift the Orion Spacecraft
- SLS cargo significantly simplifies the mission



- SLS Block 1B opens up trade space and provides robust architecture

President Trump set a goal of returning to the Moon by 2024. NASA will have to make bold decisions and utilize a lot of the management techniques used during Apollo program. The leadership capability at NASA must be augmented at headquarters and at the applicable centers. The execution of a large complex program will require adequate systems engineering, integration and an appropriate budget to carry this out. The Congress will also need to produce adequate legislation to support this effort. Utilizing NASA and the aerospace industry as implementations capable of achieving this noble goal.

Thank you and I welcome your questions.