II. Back to the Moon for Good

Civilization Sprouts on the Moon

by Michael James Carr

> "This year, American astronauts will go back to space on American rockets."
>
> —*President Trump in his 2019 State of the Union Address*

March 16—The successful conclusion of the NASA/SpaceX Demo-1 flight of the Dragon 2 spacecraft on March 8, portends an imminent change in both the status of America's manned space program and the outlook of Americans toward space settlement and development in general.

Rather than review the sordid history of decades of sabotage of the American space program, here we shall concentrate upon the future and simply say that after the successful conclusion of that flight, the possibility of American astronauts travelling to and from the International Space Station (ISS) this year in American spacecraft has gone from a possibility to a likelihood. As that likelihood comes to the consciousness of Americans more and more, minds will open to think more about the long-term destiny of civilization in space and every aspect of what this will mean for humanity.

The Dragon-2 Spacecraft

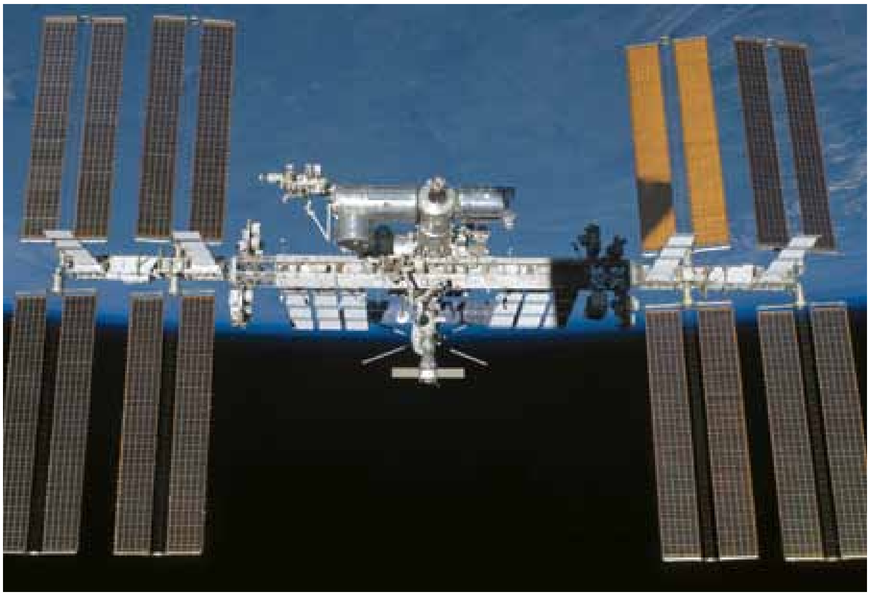
The first unmanned flight of the NASA/SpaceX Dragon-2 spacecraft, March 2-8, demonstrated its ability to safely carry seven crew members from Earth to the ISS and back to Earth. While there was not much doubt about the launch phase, docking with the ISS was the first autonomous docking with the ISS done by an American spacecraft.

A second important area needing demonstration was the effect of the unusual external shape of the vehicle upon the reentry process. Unlike the NASA/Boeing CST-100 Starliner or the NASA/Lockheed-Martin Orion spacecraft, the exterior shape of the Dragon 2 is quite different from the proven Apollo configuration. Unlike these shallow, conical spacecraft, the Dragon-2 uses eight pusher rockets attached to the sides of the vehicle. These rockets enable the spacecraft to safely abort to Earth at any point in its mission. The launch escape system is never jettisoned, as it is in the case of tractor-rocket escape systems.

This attempt to increase crew safety led to concerns about the effects the unusual bumpy shape might have on the dangerous process of reentry. The March 8 splashdown proved the unusual design would work. One more flight test of the Dragon-2 in a simulated maximum dynamic-pressure launch abort is scheduled in June, before its first crewed launch scheduled for July. Dragon-2 vehicles will be reused as cargo ships for ISS resupply after their human missions. Astronauts will only fly on the new Dragon-2's.

NASA TV

Dragon-2 spacecraft docked to ISS.



NASA

International Space Station (ISS).

Beyond that, 2019 and the years in the immediate future hold a prospect of completely unprecedented space activity. So much is happening that it is difficult to keep tabs on everything. Next month, April 2019, will see the landing of the Indian Chandrayaan-2 Lunar lander and rover as well as a tiny Lunar lander built in Israel—Beresheet.

New Systems to Support the ISS

Also in April, Boeing's Crew Space Transportation (CST)-100 Starliner spacecraft is scheduled to make its first unmanned test flight to the ISS. The current launch schedule calls for transporting astronauts to the ISS in July for SpaceX's Dragon-2 and August for the Starliner.

The article, "Moon-Mars Crash Program Under a Four Power Agreement," in the October 26, 2018 issue of *EIR* provides a review of the proper long-term perspective for the American space program as the leading edge of unified colonization of space, in cooperation with all interested nations and public and private entities.

Here we will review a few of the other recent and

CST-100 Starliner Spacecraft

The NASA/Boeing CST-100 Starliner spacecraft builds upon the experience Boeing has gained as the prime contractor for the Mercury, Gemini, Apollo, Skylab, Space Shuttle and ISS manned spacecraft, while adding new 21st Century technologies. Like the Dragon-2, the Starliner uses pusher rockets to achieve a full Earth-to-orbit abort capability, but in this case, the pusher rockets are attached to the service module instead of the capsule itself. Also, the Starliner is designed to land on airbags on land in the American West instead of the Dragon-2's splashdown in the Atlantic. Like the Dragon-2, the capsule is fully autonomous with the ability of the pilot to manually override and control the vehicle. With its weldless design, it is intended to be reusable 10 times. Both vehicles are designed to be able to transport 7 people and to be able to be parked at the ISS for 10 months at a time.

An artist's rendering of the CST-100 Starliner showing the pusher rocket engines attached to the service module.

imminent steps being taken toward the future we seek.

On December 11, 2017, President Trump issued Space Policy Directive 1 which directed NASA to—

> lead an innovative and sustainable program of exploration with commercial and international partners to enable human expansion across the solar system and to bring back to Earth new knowledge and opportunities. Beginning with missions beyond low-Earth orbit, the United States will lead the return of humans to the Moon for long-term exploration and utilization, followed by human missions to Mars and other destinations. . . .


ISRO

Opening of the Human Space Flight Centre in Bengaluru, India with a model of the Indian Space Reseach Organisation's (ISRO's) Gaganyaan crewed spacecraft in the background.

Still in his first year as NASA Administrator, Jim Bridenstine has been working hard to unleash previously suppressed talents, resources and capabilities from across the United States and around the world, to put Space Directive 1 into action. Since scientific progress has always been an international pursuit, sometimes suppressed or undermined by imperial machinations, once the machinations are removed, the scientific and engineering folks say, "Great, finally we get to do what we've always wanted to do." Agencies, universities, and companies are stepping forward to take up several of the challenges to permanent settlement and development of the Moon—and further down the road, Mars.

As we will show below, the project to develop the Moon is pulling civilization together around an idea of a better future. It is a process parallel to the unifying impact of the growth of Xi Jinping's Belt and Road Initiative (BRI) on Earth.

Meanwhile, as NASA focusses more attention on deep space, many routine, or repetitive, aspects of operations in Low Earth Orbit (LEO), will be handed over to private contractors under NASA supervision. In this area, NASA will be performing a function similar to that performed by the Federal Aviation Administration (FAA) in regulating aviation; although, in this case, NASA will also be a leading customer.

New Low Earth Orbit Systems

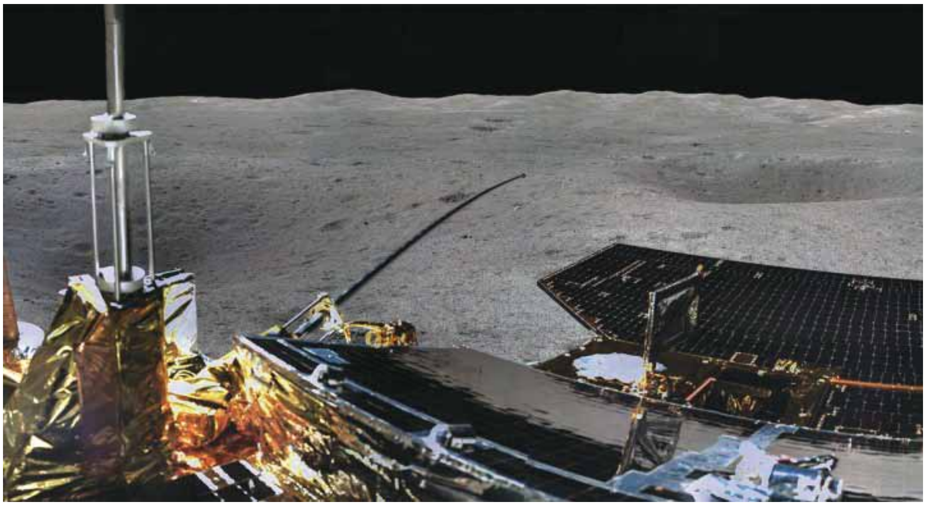
LEO is also becoming busier. This year, the China National Space Administration (CNSA) is scheduled to launch the first module of its own space station, Tiangong-2 (Heavenly Palace-2).

In December 2018, India's Union Council of Ministers agreed to pursue Prime Minister Modi's Gaganyaan (Orbital Vehicle) project to build a manned spacecraft and put three Indian astronauts into orbit by 2022.

At the same time that work is ongoing to develop heavy-lift capabilities for deep space operations, in LEO, the continuing miniaturization of satellites has opened up a market for small-scale launch vehicles. Last year, 461 satellites were launched globally, 271 of which weighed less than 100 kilograms (220 pounds). In 2017, India launched 104 satellites via a single Polar Satellite Launch Vehicle.

According to a survey by Northrop Grumman reported in *Aviation Week* (Feb. 25-March 10, pp. 70-73), 39 small launch vehicles are in active development, with another 44 under study or design. This is a boom, like the fiber optics boom or the dot-com boom of the 1990s; much of it will come crashing down, but the best ideas from these efforts will persist and become assets in the overall spread of civilization into deep space.

Meanwhile, in December 2018, the British-based



CNSA

The first panoramic image sent back by the Chang'e-4 after landing on the far side of the Moon.

aerospace manufacturer, Reaction Engines Ltd., delivered its SABRE (Synergetic Air-Breathing Rocket Engine) pre-cooler to the just completed Test Facility 2 near Watkins, Colorado, which will test the pre-cooler's ability to cool incoming air to allow the cooled air to be used instead of liquid oxygen at speeds up to around Mach 5 in a rocket engine. *Aviation Week* reports that the rocket core design has now passed a preliminary design review by the European Space Agency (ESA) and the UK Space Agency. (See my article, "Breakthrough Heralds Dawn of the Age of Single-Stage-to-Orbit Spaceplanes," *EIR*, June 8, 2018, for more information on the SABRE technology.)

The Gateway and Settlement of the Moon

On January 3, 2019, CNSA landed the Chang'e-4 lander and Yutu-2 rover on the far side of the Moon. Among the notable accomplishments of that ongoing mission was the first sprouting of Earth seedlings on another heavenly body. Also, the CNSA communications relay satellite, used to communicate between the Earth and the far-side spacecraft, is now available for use by other endeavors on the far side and has become a part of the long-term human infrastructure of Lunar development.

By the end of 2019, China is expected to land its Chang'e-5 mission on the Moon and return regolith samples to Earth.

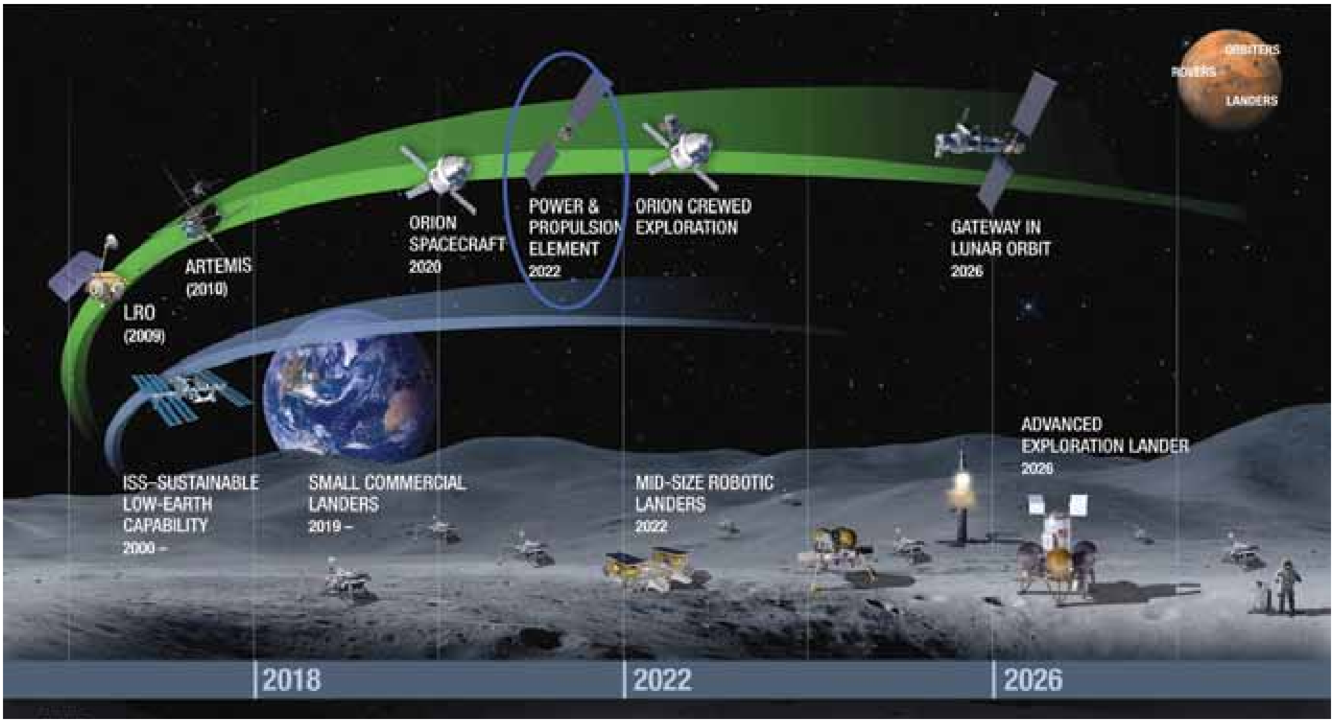
In late 2018, NASA announced plans to explore and develop the Moon via the construction of a small, modular, human-tended Lunar-orbiting space station, known as the Deep Space Gateway, from which robotic and manned landers and potentially a Lunar base would be staged. While much of the technology involved will be built using NASA's most powerful ever Space Launch System (SLS) heavy launch vehicle, building a staging base in Lunar orbit enables smaller rockets from other countries or from private companies to launch smaller modules and supply missions to the Gateway.

In particular, NASA is looking at Lunar landers to be composed of two or three separate, reusable modules that could be separately launched upon smaller-capacity commercial launchers, assembled together at the Gateway and then deployed to the Lunar surface on repeated missions from the Gateway.

Alternatively, a large, single-stage vehicle could be launched while empty and fueled at (or near) the Gateway. There are many ways to break up the masses for ease of transport and then assemble the final spacecraft's constituent modules in orbit for Lunar surface

NASA

An artist's view of a launch of an SLS/Orion rocket from Launch Complex 39B at Kennedy Space Center, Florida.



NASA

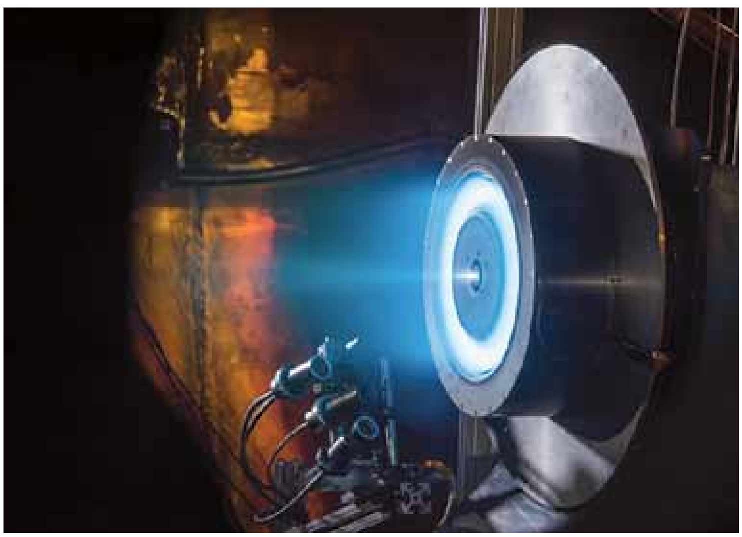
NASA's Lunar timeline of exploration.

operations. Although bidding is underway now on one or more crewed landers, not much detail is available. NASA intends to begin human operations on the Lunar surface in the 2026-2028 timeframe.

Similarly, the Gateway is conceived as a staging area in which to assemble missions that would head out to Mars. But that is further down the pike.

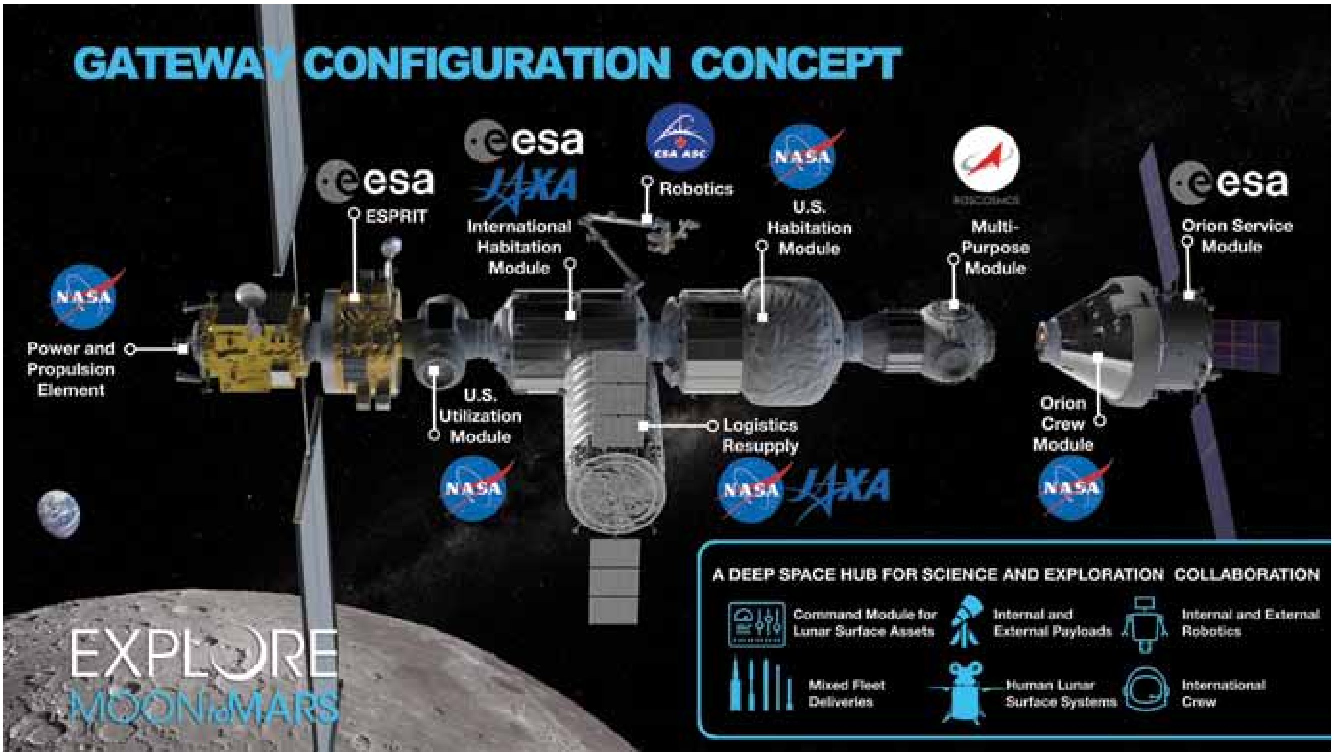
The difficulty in amassing the tonnage required for sustained Lunar surface operations, demands revolutionary breakthroughs in both Earth-to-LEO, and LEO-to-Gateway operations. NASA's 2019 budget includes $100 million for the development of a Nuclear Thermal Rocket (NTR) engine, which will be tested in space in 2024. NTR engines have so far demonstrated twice the specific impulse (measure of thrust per unit weight of fuel) of chemical rockets and could be very important for use in space tugs (spacecraft which take cargo and passengers back and forth between LEO and the Gateway). Also, the Gateway station will use four electric propulsion motors with ten times the specific impulse of chemical rockets. These electric propulsion systems also hold great promise for space tug use—including for propulsion to Mars and beyond.

With over 18 years' experience of continuous occupation of LEO by the ISS, the fourteen ISS partner space agencies aim to extend their capabilities deeper into space with the Gateway. NASA Administrator Bridenstine has made clear that besides the existing ISS



NASA

Prototype Hall thruster in testing at NASA's Glenn Research Center in Cleveland, OH. Four of these thrusters will used for maneuvering the Gateway in Lunar orbit.



NASA

A NASA graphic showing some of the roles ISS partners are planning to perform in the Lunar Gateway project.

partners, every space agency in the world is invited to take a part in the Lunar exploration project. There is more than enough work for all to do. It is high time that Congress removes the Wolf Amendment restrictions on cooperation with China, so that Chinese expertise can be brought into this project. We should also expect that India, South Korea, Brazil, South Africa, Nigeria, and other nations with growing space agencies will soon assume important roles in this project.

The Gateway project depends upon the successful development of NASA's new shuttle-derived, biggest-ever-built, Space Launch System and its new deep-space manned spacecraft known as the Orion Multi-Purpose Crew Vehicle, or simply Orion. The first launch and Lunar test of an unmanned SLS/Orion vehicle is scheduled for June 2020, but SLS development problems may require some massive juggling in the initial phases of the Orion test deployment, for example using more launches of existing smaller rockets with smaller modules, or empty modules, separated from other launches of fuel or internal equipment to be added later.

NASA, CNSA, Russia's Roscosmos, ISRO (Indian Space Research Organisation), KARI (Korea Aerospace Research Institute), and JAXA (Japan Aerospace Exploration Agency), plus a few private ventures, have many further unmanned Lunar operations planned for the near future. Further discussions of the initial period of manned Lunar surface operations involve building a Lunar navigation satellite system (similar to GPS, Glonass, and BeiDou on Earth), building a Moon Village, building new types of Lunar surface and supra-surface vehicles for people and instruments, and new techniques for constructing structures on the Moon.

Both the pace of discussions on these topics and the pace of physical implementation is accelerating, as is the intensity of cooperation. The process of settlement of the Moon and beyond provides a model that should be emulated in more and more political and economic spheres here on Earth. Calm discussion based upon scientific principle and mutual respect, works!

A Final Note

After a hiatus of eight years without its own human launch capability, NASA may soon have three man-rated spacecraft suitable for launch upon a number of carrier rockets. Never again should America have to endure years without a human launch capability.

NASA, as it should, is playing more and more of an international coordination role. Its role in harmonious development of space cooperation should increasingly be felt in the political realm here on Earth. In parallel with Xi Jinping's Belt and Road Initiative on Earth, President Trump's and Administrator Bridenstine's efforts in space are pushing the New Paradigm forward.

In general, the direction being pursued by NASA is exciting and commendable. However, *EIR*, with its special competence in the realm of physical economy, must point out once again that much of the technology involved in current planning is of an *evolutionary*—rather than the necessary *revolutionary* character. Second, the efforts underway assume constrained resources and a nearly-constant Federal budget allocation. NASA hopes to cut ISS costs with its Commercial Crew Program in order to redirect savings toward its deeper space objectives.

The reality of properly understood physical economy, is that an expanded Federal investment in the rapid development of an array of revolutionary technologies will more than pay for the entire program.

The technologies that need to be pushed faster, with more resources, include: (1) superconducting magnetic levitation/acceleration technologies according to the StarTram proposal for heavy-lift freight shipment from Earth to LEO, (2) fusion rocket development as under the ongoing NASA/Princeton Satellite Systems work for deep space transport, and (3) accelerated development of the Reaction Engines Ltd. proposed air-breathing rocket engine (SABRE) coupled with the development of an actual space plane for routine gentle transportation of astronauts to and from LEO. In our future multi-planet civilization, parachute landings should only be required for emergency situations—or perhaps direct returns from explorations in deep space.

EIR readers know that the only constraints upon mankind's reach are really to be found inside the mental delusions of balanced budgeting, log rolling and horse trading. Creative people exist, resources exist—it will be the imposition of LaRouche's Four Laws together with increasing cooperation among the Four Powers (Russia, India, China, and the United States) that will bring together the creativity and machinery necessary to begin to break all artificial bounds.

NASA

An artist's rendering of the Orion spacecraft.

Orion Spacecraft

The NASA/Lockheed-Martin Orion spacecraft with its ESA (European Space Agency)/Airbus service module is designed to carry four astronauts on operations around the Moon and beyond, It is currently scheduled to fly unmanned around the Moon in its first test flight aboard the Space Launch System (SLS) rocket's first test flight in June of 2020. However the SLS may not be ready in time to perform this mission in June of next year. So NASA is looking into the possibility of using 2 existing smaller rockets to separately launch the Orion spacecraft and an upper stage booster which would dock in orbit and continue to perform the June 2020 test mission around the Moon.

The Orion has a hybrid launch abort system which uses either a tractor rocket system or the second stage of the SLS. Every phase of launch to orbit should be safely abortable with this hybrid system.