



The Artemis Lunar Program Returning People to the Moon

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“God willing, as we shall return, with peace and hope for all mankind” Eugene Cernan, last man to walk on the **Moon**. (December 14, 1972)

With this remark the author begins his astonishing history and outlook on returning to the Moon. With very detailed accurateness Manfred “Dutch” von Ehrenfried describes how the bold political statements of former US Presidents morphed to the current ARTEMIS Lunar Program streamlined by politics and funding.

In his Space Policy Directive 1, signed on December 11, 2017, President Trump wrote: “This time, we will not only plant our flag and leave our footprints; we will establish a foundation for an eventual mission to Mars, and perhaps someday, to many worlds beyond.”

In 2004, President George W. Bush challenged to send humans back to the Moon, and then to Mars. The *Constellation* Program was to address the goals identified by the *Vision for Space Exploration* (VSE), developed under then NASA Administrator Sean O’Keefe. O’Keefe’s successor, Michael D. Griffin, ordered a complete review. Soon work began on a revised *Constellation* Program, which was to send astronauts first to the International Space Station, then to the Moon, Mars, and destinations beyond. That was the plan 15 years ago.

In response to the determination by the Augustine Committee in 2009 that the Constellation Program could not be executed without a substantial increase in funding, on February 1, 2010 President Barack Obama announced a proposal to cancel the program coinciding with the passage of the FY 2011 budget, but NASA was to continue developing a heavy lift rocket, then known as *Ares* and now as the *Space Launch System* (SLS), and to continue with the *Orion* spacecraft with its original design going back to at least 2006 with the Constellation Program’s concept of a *Multi-Purpose Crew Vehicle* (MPCV). But without the Moon and Mars, there was nowhere for this spacecraft to go. So how about to go to an asteroid? The *Asteroid Redirect Mission* (ARM), also known as the *Asteroid Retrieval and Utilization* (ARU) mission and the Asteroid Initiative, was proposed by NASA in 2013. Unfortunately, after searching for a few years, scientists were unable to find a suitable asteroid. Hence NASA concluded that it lacked the budget and tools to send humans to an asteroid by 2025. Studies continued for many years until this program was abandoned in 2017.

At the Johnson Space Center in Houston, mission planners with inputs from other NASA Centers, devised the *Lunar Gateway* concept. NASA already knew how to design and build a space station because one was orbiting overhead. The Gateway concept temporally solved NASA’s political and technical problems. The SLS launch vehicle and the Orion spacecraft continued to be developed and tested without a clear program for them to support, although it was evident they could only go to one place for the near future: the Moon. Their purpose has now been defined by the *Artemis Lunar Program*. Shortly after President Trump was elected, the National Space Council, disbanded in 1993, was reinstated on June 6, 2017 under Vice President Pence. The President’s Space Policy Directive 1 of December, 2017, clearly used the word “Artemis” in laying out the direction for the country’s space policy.

The Human Exploration Operations Committee (HEOC) of the NASA Advisory Council (NAC) defines the new lunar program as follows: Artemis is split into two phases with work on both phases having already begun:

Artemis Phase 1 is from 2019 until 2024 and will focus on getting systems in place to support the first human lunar surface landing in more than half a century. Phase 1 will include the first un-crewed test flights in retrograde orbit. The first launch of the *SLS and Orion* is called *Artemis 1*, and it is currently planned for late 2020 but most likely will be mid-2021.

Artemis Phase 2 comprises the capabilities necessary to establish a sustainable human presence on and around the Moon by 2028. NASA has begun to prepare for Phase 2 by focusing on surface habitation and mobility, plus In-Situ Resource Utilization (ISRU). The second mission, Artemis 2 (the former EM-2 mission) will take a *crew on a flight around the Moon*. It is currently scheduled for 2022 but if Artemis 1 slips, Artemis 2 will likely slip also. It will be the first crewed mission around the Moon in a highly elliptical orbit.

From here onwards the author launches into an encyclopedic description of all developed and planned elements like spacecraft landers, rovers and payloads, of course also the comparison of available and planned US and international launch vehicle capabilities, trajectories and landing sites and a dozen appendices handling special issues like the National Council's role in Artemis and Mars or the ESA proposed "*Moon Village*" association.

The inestimable value of this book lies in the fact that the author has taken the trouble to put all the loose ends together and conveys to the interested reader what influences a program of this magnitude is subject to - and these are by far not only just the technical problems.

The political declarations of the various presidents, based on the idea to go "to the moon and beyond" lead in a serpentine fashion to the current status of the Artemis program, although the worldwide Covid-19 pandemic has not yet been "incorporated", further delays and changes are to be expected. The "red thread" laid out by the author helps to understand what the future of human space exploration depends on and which imponderables influence important decisions.

The description of the history since 1972 is complete, the further development of the individual components modules and launch vehicles, the skillful support of private space companies under NASA's Commercial Crew Development (CCDev) and Commercial Lunar Payload Services (CLPS) programs is covered as well as the planned international relations are also factored in.

Interesting is also the discussion of the pros and cons for Artemis / Gateway versus a "direct flight to Mars", here two examples:

>On July 19, 2019, President Trump commemorated the 50th Anniversary of the Apollo 11 lunar landing with a photo opportunity in the Oval Office. Surrounded by NASA officials, some of the "Moon Walkers," and lawmakers, Trump repeatedly asked NASA's Administrator James Bridenstine why astronauts couldn't go straight to Mars instead of going to the Moon first. "To get to Mars, you have to land on the Moon, they say. Any way of going directly without landing on the Moon? Is that a possibility?" Trump enquired. Bridenstine replied, "The Moon is a proving ground for going to Mars, allowing NASA to test out technologies needed for keeping people alive for extended periods of time on the Red Planet. When we go to Mars we're going to have to be there for a long period of time, so we need to learn how to live and work on another world."

>Within the Human Exploration and Operations Committee (HEOC) the following opinions were recorded: *Mr. Gerstenmaier* said he thinks the Gateway would get us to the Moon faster. *Dr. Condon* said he had heard enough to believe that Gateway is the right way to go, but that he hadn't heard enough about the detailed plan and funding profile to get this done by 2024. *Mr. Holloway* said he believed the commercial capability would help Gateway tremendously. The HEOC concluded that NASA has been trading Direct to Moon (DTM) and Gateway concepts but is still open to DTM if these concepts include other aspects of sustained presence. The real differences appear two or three levels down into the planning.

The book is an excellent basis to understand the further struggle for human space exploration of Moon and Mars, and allows the reader to form his own well-founded opinion and to grasp the

technical problems still to be solved. All of this thanks to the miniscule research effort of the well-informed author Manfred "Dutch" von Ehrenfried.

The book is illustrated by high quality original photos or artist's conceptions, by detailed references (left) and an unusual wealth of relevant YouTube video links.

A modern electronic book that does justice to the future oriented topic of the next generation of human space exploration.

A "treat" for insiders, a reference manual for those interested in human spaceflight and an easily digestible book for laypeople.

Predicate: Highly valuable!

In particular I liked v. Ehrenfried's dedication: "**And this book is also dedicated to those in flight operations who will guide the Artemis crews to their destinations. They are the ones who will make our lunar and planetary dreams come true.**"

February 2021, Joachim J. Kehr, Editor SpaceOps News, Journal of Space Operations & Communicator
<https://opsjournal.org>