

**NASA Advisory Council Recommendation  
Lunar Plans  
2019-01-01 (HEOC-01)**

**Recommendation:**

The NASA Advisory Council recommends that the current planning for human spaceflight to the Moon continue along the lines of the recent planning study to include long-term sustainability features including reusability, refueling, and in situ resource utilization at a “gateway” or reusable aggregation point.

**Major Reasons for the Recommendation:**

NASA has been doing trade studies on how to return to the Moon for decades and the recent acceleration study included the results from all previous trade studies. To ensure the long-term viability of human spaceflight, efficient and affordable measures must be taken to reduce costs and enhance flexibility. Having a rally point or aggregation node with human shelter capability appears to be the best way to minimize long-term costs and provide flexibility. The Council concludes that a dash to the Moon without including infrastructure for the longer term would not lead to a sustainable program of deep space human exploration. Near-term focus on rapid lunar missions should not distract from the long-term objectives.

**Consequences of No Action on the Recommendation:**

A higher cost program with limited scope and decreased long-term viability would most likely result from a different approach. The intent of Space Policy Directive-1 (SPD-1) would not be met.

**NASA Response:**

NASA concurs. An aggregation point or “gateway” in lunar orbit not only enables sustainable lunar surface exploration, but is also critical for longer-term objectives such as human missions to Mars as directed in SPD-1.

Utilizing the Gateway as an aggregation point in lunar orbit enables the development of a sustainable, reusable human to lunar surface architecture. The first missions to the lunar surface are currently envisioning four crew out to the Gateway in Orion. The crew will transfer the required logistics, e.g., consumables and Extra-Vehicular Activity (EVA) suits, from the Gateway to the ascent element. Furthermore, by having the Gateway as the aggregation point, the crew can perform a checkout of the lander to ensure it is ready to operate. If there are issues identified in the checkout, the crew can potentially resolve the issues and wait on the Gateway until the next available window. If the lander is operationally ready, two of the crew will transfer into the lunar lander and depart the Gateway to perform the lunar surface mission lasting up to a week. The two crew remaining on the Gateway will help perform command and control functions for the lunar surface mission. The Gateway will provide the necessary consumables for the lunar orbit activities.

If the Gateway was not present, the crew could not transfer logistics (including EVA systems) into the ascent element which would then require the ascent vehicle to carry the logistics,

making the ascent element much larger to accommodate the extra mass required (e.g., propellant and associated dry mass). This extra mass required could likely exceed the Trans Lunar Injection capabilities of the available commercial launch vehicles. This would result in higher costs as larger launch vehicles (e.g., Space Launch System) would be required to launch the larger systems. This would require additional development of ground systems to support the higher flight rate associated with the additional launches.

The Gateway will also support the lunar surface missions as they increase in length and complexity. The Gateway will continue to provide the aggregation of logistics for the lunar surface missions as well as the lunar lander vehicle checkout. The Gateway will also provide longer-duration habitation for the two crew in orbit as the surface missions expand in duration with the crew of two. Once the surface missions expand to a crew of four, the Gateway will provide the stationkeeping of Orion and ensure that Orion is ready for the return trip to Earth once the surface mission has been completed.

As the lunar surface missions progress, it is envisioned that elements such as the ascent element will become reusable, thereby reducing the cost of missions. The Gateway will provide the stationkeeping (power and propellant) for the ascent element between surface missions, thereby greatly reducing the mass of the ascent vehicle. To enable the reusability of the ascent vehicle, the Gateway can act as the aggregation point for the refueling from at first a refueler from Earth and then potentially using propellant from the lunar surface in-situ resource utilization.

If the Gateway is not available for these longer, more complex missions, there would be no infrastructure to enable reusable elements that would fit on available commercial launch vehicles. The elements would have to be designed with additional power and propellant required for stationkeeping which would greatly increase the mass of the elements.

As we look at the SPD-1 objectives (“... return of humans to the Moon for long-term exploration and utilization, followed by human missions to Mars and other destinations”), we see that past studies have shown the Gateway in lunar orbit is an enabling element. It can be used for capability development and deep space testing as well as an aggregation point for assembly, outfitting, and checkout of the Mars Transit Vehicle. There are several Mars Transit Vehicle shakedown cruise concepts that have been studied that also show the need for the Gateway as a repair, servicing, and refueling port.

In summary, the Gateway will be a critical part of the NASA human exploration infrastructure serving as an aggregation point for upcoming lunar surface missions as well as the longer-term missions to Mars.

Enclosure