Lunar Alpha Base

Technical Report

Shaheer Alam

Virginia Aerospace Science and Technology Scholars

Abstract

The Lunar Alpha Base (LAB) will be described in detail, primarily for the purpose of a possible settlement site on the moon. The base itself and its location, equipment, etc., are all hypothetical, not exclusively guaranteeing the construction of the base. The paper will be under the assumption that the mission is universally accepted and some of the legal issues will be briefly discussed. The location, operational concepts, personnel required, activities, and sovereignty will be discussed. A timeline will also be provided, detailing the dates and events of the base construction. The viability and success rate of this base is not necessarily going to be one-hundred percent, however, an optimistic view on its functionality will take place in order to gain a better understanding of how the base could potentially function in global efforts for space exploration.

*Keywords*: Lunar Alpha Base (LAB), location, operational concepts, personnel, activity, timeline, viability, sovereignty

Lunar Alpha Base

Technical Report

Contemporary times themselves almost require some level of space exploration of celestial bodies. Earth’s moon has long been hypothesized as being an ideal location for a base, mostly because of its close proximity to the Earth. Building a lunar base is only one necessary step in the long-term process of conquering space; from the Moon to Mars, humans are going to eventually spread their influence across the cosmos. The Lunar Alpha Base (LAB) is a possible plan of action in order to achieve a better understanding of the universe. This base will serve multiple purposes, such as being a refuel station, but most importantly, it would be the amalgamation of global efforts towards some scientific goal.

**Timeline**

|  |  |
| --- | --- |
| **Event** | **Date(s) (Dates subject to change)** |
| Launch of Construction Materials Day 1 | November 5, 2021 |
| Launch of Construction Materials and Construction Personnel | December 4, 2021 |
| Construction Period | December 8, 2021 -- December 2022 (Approximately one year) |
| Full Personnel and Technology/Equipment Launch | December 2022 |
| Base Fully Operational | February 2023 |

**Location**

The LAB’s location may be subject to change but an ideal scouted location is the lunar south pole, specifically, near the Shackleton Crater. The lunar south pole is at (90.0 S, 0) with the Shackleton Crater in close proximity at (89.0 S, 0). The base is to be as close to the mathematical point of the south pole as possible due to the advantages of the south pole location. For one, it is almost always in sunlight throughout the year; this is a great condition for solar power (Dunbar). The sunlight also keeps the south pole comparatively warm to the rest of the moon (Dunbar). Due to this virtually constant sunlight, there is also constant shadow in some areas, such as in the Shackleton Crater, where water-ice has built up (Cain). These permanently shadowed regions (PSRs) are also not dangerous to land in if the spacecraft has some form of a lidar or radar system; the topography is not any more rough than the rest of the lunar surface (Robinson). That ice, among other volatiles, is extremely valuable for both human consumption and rocket fuel (Cain). Those materials could also be used for scientific purposes, examining the movement of such materials and elements through space over time (Dunbar). There are some other environmental conditions that will later be discussed under the “Activities” section. The south pole-Shackleton Crater area is overall a good investment for a possible lunar base.

**Operational Concepts**

The most important tangible goals for LAB are to serve as a refueling station for missions to Mars and possibly a repair station for spacecraft. The manufacturing and processing unit is perhaps the most important to the base because that is where the ice would be taken to be converted to hydrogen gas and cooled down to liquid hydrogen. The ice would be retrieved from the Shackleton Crater using modified lunar roving vehicles. There would be a road connecting the crater to the base, facilitating retrieval and wasting less fuel for the vehicles. The manufacturing and processing unit would also serve to help repairs for spacecraft for smaller parts. The utilities and equipment on the base would constantly be changing due to the required needs of the science team. The observatory would help to serve the base’s purpose of being a stoppage point for spacecraft, allowing for adjustable flight courses. The rocket facility would be the main place for creating new rockets to be launched from the launch pad, either to allow for personnel to leave the base or for a flight to Mars or beyond.

**Personnel**

A sizable amount of personnel would need to man LAB; roughly around 70-80 would need to be on the base, with occasional additions for repairs or rocket construction. At least 5-10 people would be assigned to units such as the science team and power team. Dust, radiation, muscle atrophy, and bone density reduction are just some issues that could compromise the health of the personnel (Dolgin). These factors make a medical team an absolute necessity. A couple general doctors could be employed, with more medical doctors specialized in treating radiation, physical therapy, or lungs also to be employed. A large portion of the personnel would consist of engineers, making up roughly 40% of everyone on the base at any given time.

**Activities**

All other activities that do not directly contribute to mission goals are important to consider too. The base would have to constantly be maintained to avoid cracks in the base since the entire base is an enclosed system. This is because the Moon, although not a complete vacuum, has very little atmospheric pressure and does not contain a breathable atmosphere (Dolgin). Power is also a concern, though solar panels would achieve a fair portion of the power needs throughout the lunar year. Nuclear power would be used because it is extremely efficient in energy output and could dramatically increase the amount of activities using electricity that could be done. Solar panels are generally not strong enough so nuclear power would fill in the gap. A health and wellness center, complete with a basketball court, would be used to maintain the personnel’s health and eliminate the threat of muscle atrophy and bone deterioration. This would also help maintain international relations because the personnel would be enjoying themselves despite the work pressures they may face. A communication center is crucial and would be placed next to the satellite station, increasing the range of communications.

**Sovereignty**

The issue of governing the base could potentially be an issue but a resolution seems to be achievable. No nation would hold official sovereignty over the base, although the United States would be the initiator of the mission through NASA. Under the Outer Space Treaty of 1967, no country can have sovereignty over any part of space (Kimball). This eliminates the possibility of LAB being American soil. It is important to note that the Moon Treaty does not apply because many space-faring countries did not ratify it, including the United States. LAB should be governed by multiple countries under similar jurisdiction to the International Space Station.

**Conclusion**

LAB is merely a step in humanity’s goal towards achieving a better understanding of the universe, but it is a necessary step. Refueling, along with repairs and scientific function, is extremely important to any space-traveling nation. A lunar base is important in general but the south pole remains an ideal location for an international lunar base. If this mission were to be undertaken, a greater understanding of science would surely occur. LAB will be costly but ultimately, it is one giant leap for mankind, allowing further space exploration and scientific understanding.

References

Cain, F. (2019, July 30). Why Is The Moon's South Pole So Important? It's All About Water. Retrieved February 29, 2020, from https://www.universetoday.com/143036/why-is-the-moons-south-pole-so-important-its-all-about-water/

Dolgin, E. (2019, June 27). Moondust, Radiation, and Low Gravity: The Health Risks of Living on the Moon. Retrieved March 1, 2020, from https://spectrum.ieee.org/aerospace/space-flight/moondust-radiation-and-low-gravity-the-health-risks-of-living-on-the-moon

Dunbar, B. (2019, April 15). Moon's South Pole in NASA's Landing Sites. Retrieved February 29, 2020, from https://www.nasa.gov/feature/moon-s-south-pole-in-nasa-s-landing-sites

Kimball, D. (2017, August). The Outer Space Treaty at a Glance. Retrieved March 1, 2020, from https://www.armscontrol.org/factsheets/outerspace

Robinson, M. (2018, February 1). Lunar Reconnaissance Orbiter Camera. Retrieved February 29, 2020, from http://lroc.sese.asu.edu/posts/993