

# 14 – The International Lunar Base

## SUMMARY

During the Initial Crew Phase, cargo landers would deliver components of the International Lunar Base. As international astronauts explore the Moon, many of them will remain behind in a growing international base to represent their nations. Besides continuing to explore, they will also work to set up the International Base and develop ISRU to make the base increasingly Earth independent. The International Base may have three internal time zones to keep the residents roughly in touch with their home countries. English will likely be the common second language.

## TRANSITION FROM THE INITIAL CREW

During the six to twelve months that the Initial Permanent Crew make history, Starships would be landing cargo on the Moon in preparations for the International Lunar Base (ILB). For interest's sake, perhaps the Crew could set up one of the habitats but mostly, it would be professional astronauts who would do that.

## STARTING THE BASE

### American Habitats

Because America has its greater space budget and international leadership, it seems likely that it would be the country to set up the first habitats of what will eventually become the ILB. The initial collection of habitats could therefore constitute an American base but, with the addition of specialty hubs from other nations, the American base would then simply become the American section of the ILB.

The American base probably needs to have a certain set of functions to ensure that it can operate as a complete base. As such, it may be that the specialty hubs making up the American base will have not just one but two or more functions within each specialty hubs. As later, single-function specialty hubs from other nations arrive, the American hubs can transition to more efficient, single-purpose hubs.

## **Intergovernmental Agreement**

The ISS Intergovernmental Agreement (IGA) is a successful example of how this can be done. This agreement is a treaty signed in 1998 by the US, Russia, ESA member states, Japan, and Canada and does a good job regulating ownership, jurisdiction, responsibilities, and cooperation. Something like this would ensure that the base operated well.

There is, however, the need for the agreement to have one different aspect to it compared to the ISS treaty. Namely, it should be anticipated that the ILB will eventually grow to be a settlement that is mostly privately owned. Rather than establishing government-only rules that inhibit the growth of the private sector, it should be recognized, encouraged, and enabled for private settlement and private companies to establish their footholds at the ILB.

## **MASTER PLAN FOR THE ILB**

There needs to be a practical master plan for the ILB. This can't be some bespoke, conceptual design bordering on science fiction. Function needs to take priority over form and the master plan needs to assume near-term likelihoods such as Starship payload capacity, ease of Earth-based manufacturing, that the time, energy requirements, and safety of in situ (e.g. 3D printed) means that these won't be near-term probabilities. The master plan shouldn't show just the end state but also include the plan for how the base can meet its needs at every stage of growth and an estimated timeline given assumed transport capability from heavy lift fleets.

If you, the reader, are into space architecture, facilitating other architects to develop this master plan would be a valuable contribution to the cause of lunar development.

## **ASSEMBLING THE BASE**

### **Solar Power**

Power production needs to scale as the base grows as part of the master plan. Rather than a large field as shown in SpaceX's illustration of Moonbase Alpha, the base would more likely be located at the lunar south pole with long lines of vertical Solar Drapes localized at high points of the topography. Wires would connect the Solar Drapes to American and then International Base.

## **Corridors**

A key component on the International Base would be the corridors that connect everything together into a single base. There are different ways that this could be done including:

- Set out the entire corridor first and then attach specialty hubs one by one.
- Add segments of the overall corridor as the base grows in size.
- Each specialty hub could also have its section of the corridor integrated with it

The first approach of inflating the entire corridor first means that the base would have its skeleton visible for years while the specialty hub "meat" is being added on. Functionally that would be fine but aesthetically, the base would look unfinished for a long time. Perhaps an approach where the tubular corridors were folded in on itself (folded intussusception) could solve that problem. We do want to try and minimize the number of mechanical connections, each of which can pose a risk of breach.

Although the amount of time spent in the corridors would be less than that spent within specialty hubs, it would still be necessary to shield them against solar particle events (SPEs). Above ground, with regolith poured between outer walls is an easy solution from the aesthetic and practical standpoints.

## **Attaching Specialty Hubs**

The master plan would describe the sequence and steps for how arriving specialty hubs would be attached to the corridors. This would need to include how utilities would be connected such as electricity, air, water, sanitation, and industrial liquids. Testing would be necessary to confirm that all is safe before inhabitation and usage.

# **COMMERCIAL COMPETITION**

## **International companies**

It is here proposed that the specialty hubs and services needed by the International Base be provided by private companies and not by governments. Unlike the ISS, the plan for the ILB is that it would eventually become primarily a private settlement. Given the general inefficiencies, high costs, and non-enlightened, governmental politics the approach should be for each country to fund its own companies to design and develop that specialty hub that the country has chosen will be their

contribution. After the R&D is completed, the intellectual property becomes that of the company, and the company operates largely independently with the hope that a small commercial ecosystem will be established at the ILB. This ecosystem will then be available to private customers at (hopefully) reasonable price so that private settlement can really take off.

### **Coopetition**

This is a fun term combining cooperation and competition. In the last couple of decades, America's space program has been emphasizing and experimenting with various forms of so-called "commercial space". It is a mix of straight purchases where the commercial sector has a product or service to buy all the way to where NASA provides most all of the development and operational funding, but where it is hoped that it will ultimately lead to the companies being able to serve other customers thereby placing NASA as being just one of several customers. This approach has had mixed results but has certainly been better than the old "all government all the time" approach.

For the ILB, it is important to have at least two companies providing each good and service. In case one company fails, has poorer quality, or higher price, purchasers will still be able to choose. But the ILB will start as governments being the customers and with a pretty small market. So, we need to be realistic. This won't be a pure, mature commercial marketplace.

## **THE INTERNATIONAL LUNAR BASE**

As the American base is being set up, the ILB will grow with probably the typical ISS partner countries. There will probably be the ESA, Japanese, Indian, etc. sections growing over time. Individual smaller countries will contribute their specialty habs perhaps as part of interstitial international areas.

### **Time Zones**

The Moon is tidally locked with the Earth such that one side always faces the Earth. As a result, the Moon rotates on its axis only once a month meaning lunar days (and nights) last for about 14 Earth days. So, the Moon's sunlight will be a very poor way of dealing with people's sleep cycle. Rather, the moonbase will need to use its own artificial lighting to set the base's day/night cycle. As such, it will undoubtedly be on a 24.0-hour cycle.

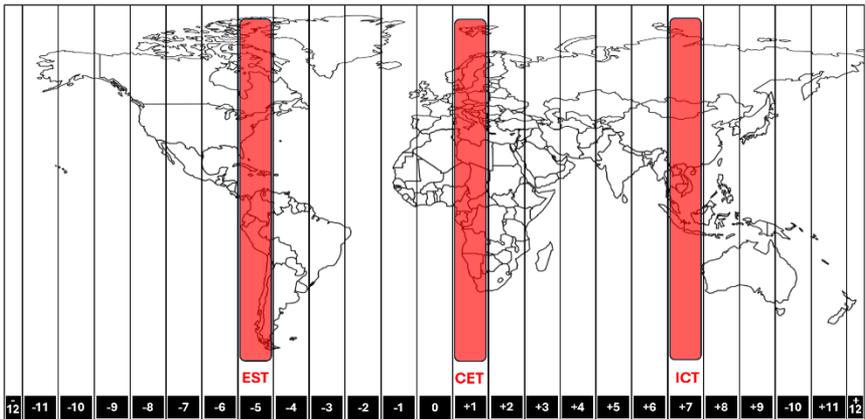
But what Earth time zone should the base be in?

The Moon is only 2.6 light seconds round trip to the Earth. So, residents on the Moon will likely remain in contact with friends, family, and colleagues from their home country. As a result, they will probably prefer to live within the approximate time zone of their home country. Yet they will be within a base with residents whose home countries have different time zones. What to do?

Probably, the ILB should have three time zones. The midpoint between California and Rio de Janeiro is about Eastern Standard Time (EST) and so lunar citizens of countries in the Western Hemisphere can live with that time zone.

Western and Eastern European, African and the Middle Eastern countries can probably agree to live within the Central European Time zone (CET). When the entire base wants to get together, probably noon CET would be a good time to do so.

Eastern Asia is a bit more challenging since India is a large population but then so is China and Japan. A reasonable compromise would be Indochina Time (ICT).



*Proposed time zones for a lunar base covering most of the world.*

## Languages

As is common in the world, English would probably be the choice for the common language in the base. But as you walk past each section, you will probably mostly hear that language being spoken. But on-person, local AI translation will probably help people communicate with each other verbally because, especially among private settlers, not everyone will know English as the common language.

# EXPERIENCING THE BASE

## Design

Walking through the mature International Base will be quite something. Designed with aesthetics in mind, the architectural designs will be pleasing. Interior decorators will have figured out numerous, creative elements using space, form, line, light, color, and textures. Well selected plants will help the base not be so technically sterile. Ambient music and nature sounds will please the ear. Perhaps thought could be applied to what smells one might experience in different sections. And when it comes to sound and smell, some of this might be remedial given the environment such as that on the ISS.

## International Experiences

As one walks through the base's different areas, you would find yourself passing by the Indian section, then the African section, then the Australian section, etc. Each will have its own styles, sounds, and smells. Would you like some Hawaiian BBQ? You know that you can go to the south pacific section! You want to go to the Samba party tonight? Let's head over to the Brazilian section. You will have the opportunity to meet very interesting people from all over the world. Certainly, life in the ILB will be nothing short of very interesting.

## Work Environments

To your right, you are walking past the GardenHab. To your left there is the MedHab. And up ahead is the life SupportHab. You see workers going into the FabHab producing equipment from local resources. There are new specialty habs arriving, being set up, and with their "grand openings". It will be an active, industrious environment.

## Religion

People will bring their religious faith with them so there could well be a section of the base with very beautifully constructed religious houses of worship. Initially they may share meeting places with the ability to transform the trappings between services. But eventually there will be a

church, mosque, temple, etc. Prominent ministers will be broadcast from Earth. Special services (e.g. Christmas program) might be of general interest with the residents having greater opportunity to be exposed to religious activities than they probably had on Earth.

### **Community Activities**

And finally, the base will have its own community life. In the MeetingHab, there will be musical programs, dance performances, and the latest movie releases. Conceivably, the residents could have some role in self-governance with town halls and elections.

## **CONCLUSION**

When it comes to the ILB, we need to think beyond just a government-centric, McMurdo-style science station. There will be plenty of that. But the ILB will be humanity's first, large, off-Earth community.