Outpost: V-001

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SPAC-7410 - Thesis Defense
The aim of this project is to explore architectural options presented by the Venusian atmosphere and, by proxy, bring sex appeal back to space travel by emphasizing the purpose of having a human out on the frontier, not in an aluminum can. Parking a work derrick at 54 km (+/- 4 km) above the surface of Venus provides environment where this can be achieved. Currently, the majority of programs and projects dictate a robust pressure vessel (aluminum can) to provide habitable volume for people. As demonstrated by the Vega probes, there is just over 1 bar at 40°C at an elevation of 50 km on Venus and this tapers off to .1 bar at -13°C at 67 km. This alone sets the environment, and therefore the design solutions, apart.

A manned work derrick suspended on the surface of the cloud deck is the spot for humanity’s first step into the solar system. The planet provides many intriguing challenges; while initially very hostile, the atmosphere conceals a veritable oasis for human activity relative to anywhere we can get to that is not Earth.

The lack of surface contact creates a demand for a sustained human presence. Humans are the original HUMVEE, we are specialized to generalize and that makes us the perfect meat servo to solve most of our exploratory woes.
The Venera Program

Venera 13, lasted 127 minutes on the surface. To be fair, it was only designed to survive 32 minutes before succumbing to the heat and pressure.
The Vega Program

In 1986 the Vega program included two balloons that caught a ride to Venus and survived for their entire battery life, bobbing between 53 and 57 km of elevation.
What is known

Venus Atmospheric cross section

- Surface temperature 735K: lead, tin, and zinc melt at surface, with hot spots with temperatures in excess of 975 K
- Atmospheric pressure 96 Bar (1300 PSI); similar to pressure at a depth of a kilometer under the ocean
- The surface is cloud covered; little or no solar energy
- Poisonous atmosphere of primarily carbon dioxide, with nitrogen and clouds of sulfuric acid droplets.

- With a lifting ratio of **0.6kg:1m³**, it would take 3,383,333 m³ of air to float the Shuttle at 54km of elevation
- Helium can be used as an emergency spiking gas if the airship begins to sink. The lifting force is nearly triple that of standard air and would buy valuable repair time

- CO₂ ~ 1.8 kg/m³
- Air ~ 1.2 kg/m³
- He ~ .18 kg/m³

- Venus travels around the sun in 225 days
- A Venusian day is 243 days long
- The planet spins in retrograde, sun rises in the west
- 584 day Synodic Period with Earth (Mars is 687)

- Receives 40% more solar energy than the Earth
- 75% of that is then reflected off the surface of the upper cloud deck

- Planet has an induced magnetosphere, this provides protection from solar particle events and GCR
- Winds travel the cloud deck at 360 kph, this would propel a craft around the equator in 5 days
- The winds are slower on the night side, night relative to a suspended craft would be roughly 65 hrs
- Day would be roughly 55 hrs (low # of data points)
Material Pallet

Worried about all that Sulfuric Acid?

PTFE has got you covered, literally. The O2 Arena in London, has a tensegrity structure spanning 80,000 m2 made from PTFE coated fiberglass panels. The structure weighs less than the volume of air it encompasses. The O2 is one of many structures including airports and sporting arenas that are covered with PTFE fiberglass reinforced fabric.

This apparatus effectively all that is required to survive the atmosphere at 54 km elevation.

Combined with any fluoropolymer clothing (Think GorTex), EVA prep will take the same time as prepping for a SCUBA dive.
Assumptions & Considerations

• Cis Lunar Economy
• LEO Construction
• Nuclear Power in Space
• Sea Dragon Type Rockets are Revived
• Medium, Single Stage to Orbit Lift Vehicles
• Terminal Class Space Stations

We are able to develop foresight from hindsight
In Order to Go, We Have to Leave

Step 1, Comms and Tracking Constellations

Step 2, Probes and Orbital Terminal Setup

Step 3, Short Shot of Cargo & Skylons

Step 4, Cloud Deck Operations Begin

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<th>Name</th>
<th>Size</th>
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<th>Arrival</th>
<th>Duration</th>
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Cloud Deck Prep

Sea Dragon Faring
Interplanetary Transport
Skylon

Venusian orbit cargo transfer
Cloud Deck Deployment

Skylon, single stage to orbit

Skylon decent & aero braking

Skylon pneumatic payload ejection & drogue shoot deployment
Drone Deployment

Skylon payload fairing separation

Wings Deploy

FRONT

SECTION
Spine Deployment w/ Lifting Body Airship

Spine arrives inside a Skylon payload fairing

Deploys by unfolding & inflating the lifting envelope

Landing Lights

SECTION

35m

65.5m

21.9m
Habitation Layout

65.5m

Main Volume

25m

43m

Flight Deck

Sub Systems Access

Medical
Crew Quarters
WCS
Galley
Translation Path
Rec Area

Aft Deck
Mechanical
Critical Maintenance
Sub Systems Access Panels

Compressed Gas Storage
Emergency Gas Reserve
Compressors, Batteries, Equipment
EAVs

Entry & Assent Vehicle capable of ferrying up to 9 crew between orbit and the cloud deck

Deploys Hook
We have done that before
Farms

These farms are standalone, automated aeroponic units.

As these farms draw 95% of their requirements from the Venusian environment, they only require the slightest replenishment.

A secondary function stems from this, the farms can act as life boats.

- Suck in CO₂ plants produce O₂, a lifting gas
- They will require Nitrogen as a nutrient, this too can be collected from the atmosphere

The Farms will require harvesting
Leaving this up to the Venussians will create a living, breathing oasis in the clouds.
ISRU

Collecting resources on Venus will require a different outlook:

- You are mining gas
- Carbon is your friend

Initial ships will be outfitted with “pilot plants,” to decrease mass and increase on the job flexibility.

There are two main resource groups:

- Ambient gas
- Condensate

Ambient Gas Collection
- Large Airships that gather primarily CO₂ and N₂
- Provide filtration, extraction, refinement and storage
- Primary Resources: O₂, N₂, and Carbon filament

Condensates
- Smaller, faster drones collecting H₂SO₄ and H₂S
- Drag collection devices through the cloud deck
- Primary Resources: H₂O, S, O₂
The Future

Rendezvous mission to Venus

Venus (Solar System Exploration)
- SPK ID: 299
- Orbit Condition Code: 0
- Semi-major axis: 0.723 AU
- Inclination: 3.39°

Trajectory Itinerary

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<td>Venus Arrival</td>
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46-day total mission
- 9.89 km/s post-injection ΔV

Solar range: 0.72 - 0.98 AU
Earth range: 0.33 AU

* ΔV to a C3 = 0 km²/s² local planetary orbit.