
# "IDUN" LUNAR BASE TENDER

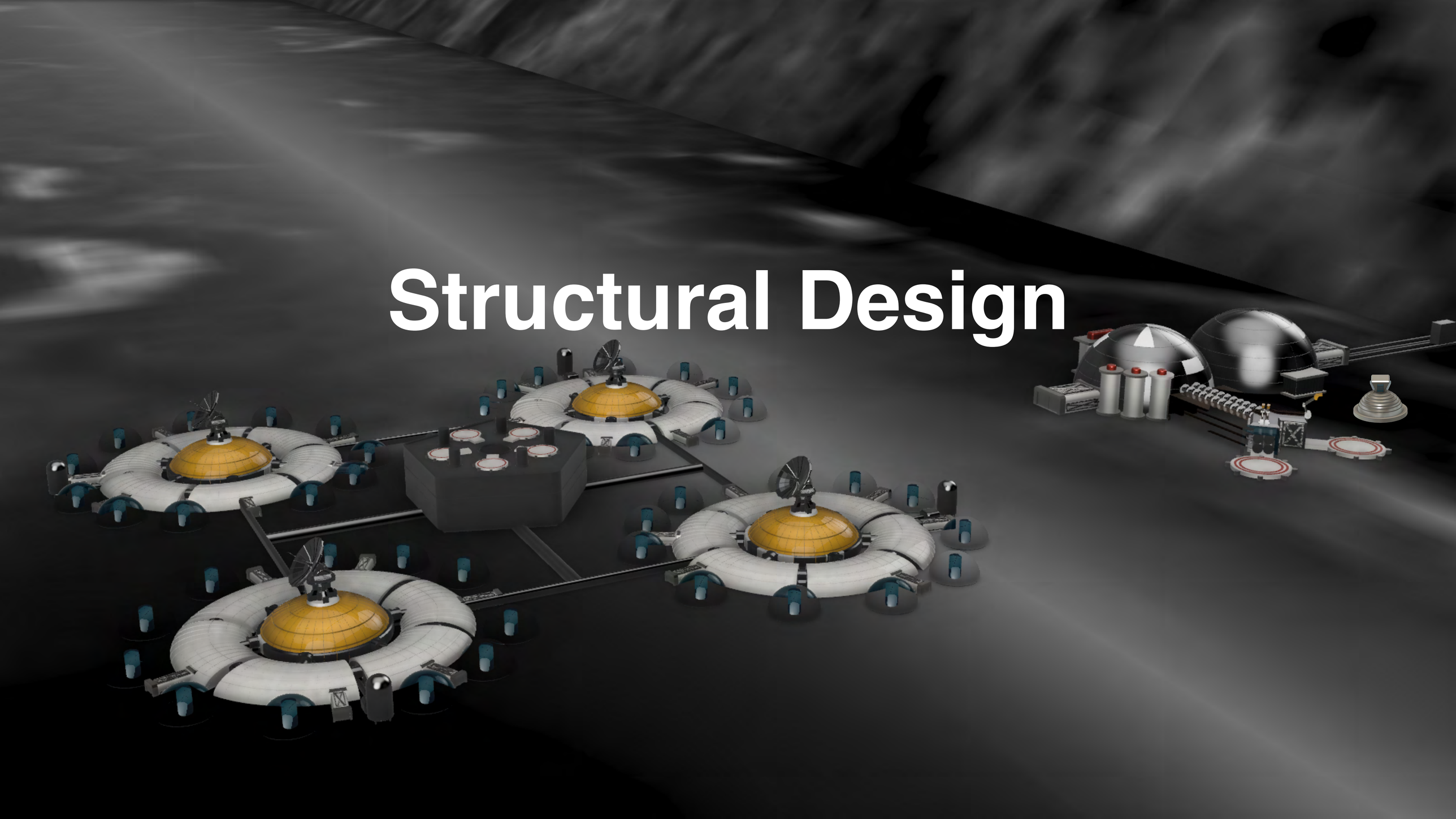
BY ARTEMIS RESOURCES

# Executive Summary



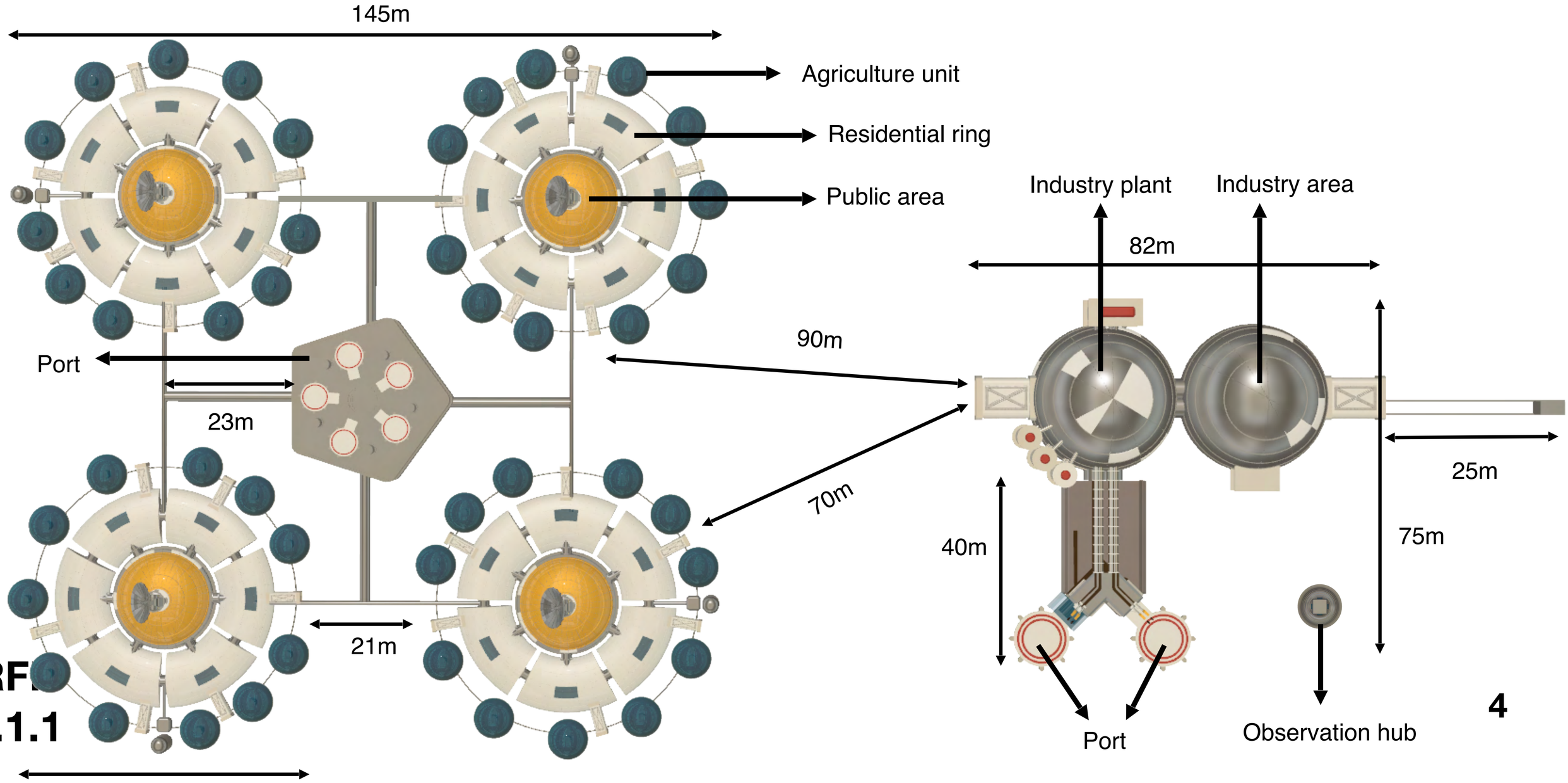
**“It is honorable for our company to present the proposal of “Idun” Space Settlement at the crater near South Pole, a well-organized, detailed space settlement design, to the Foundation Society. We have converted the very details of the request into a clear illustration of the variety of techniques we utilized. ”**

# Structural Design



# Exterior structural design (out of the crater)

Artemis

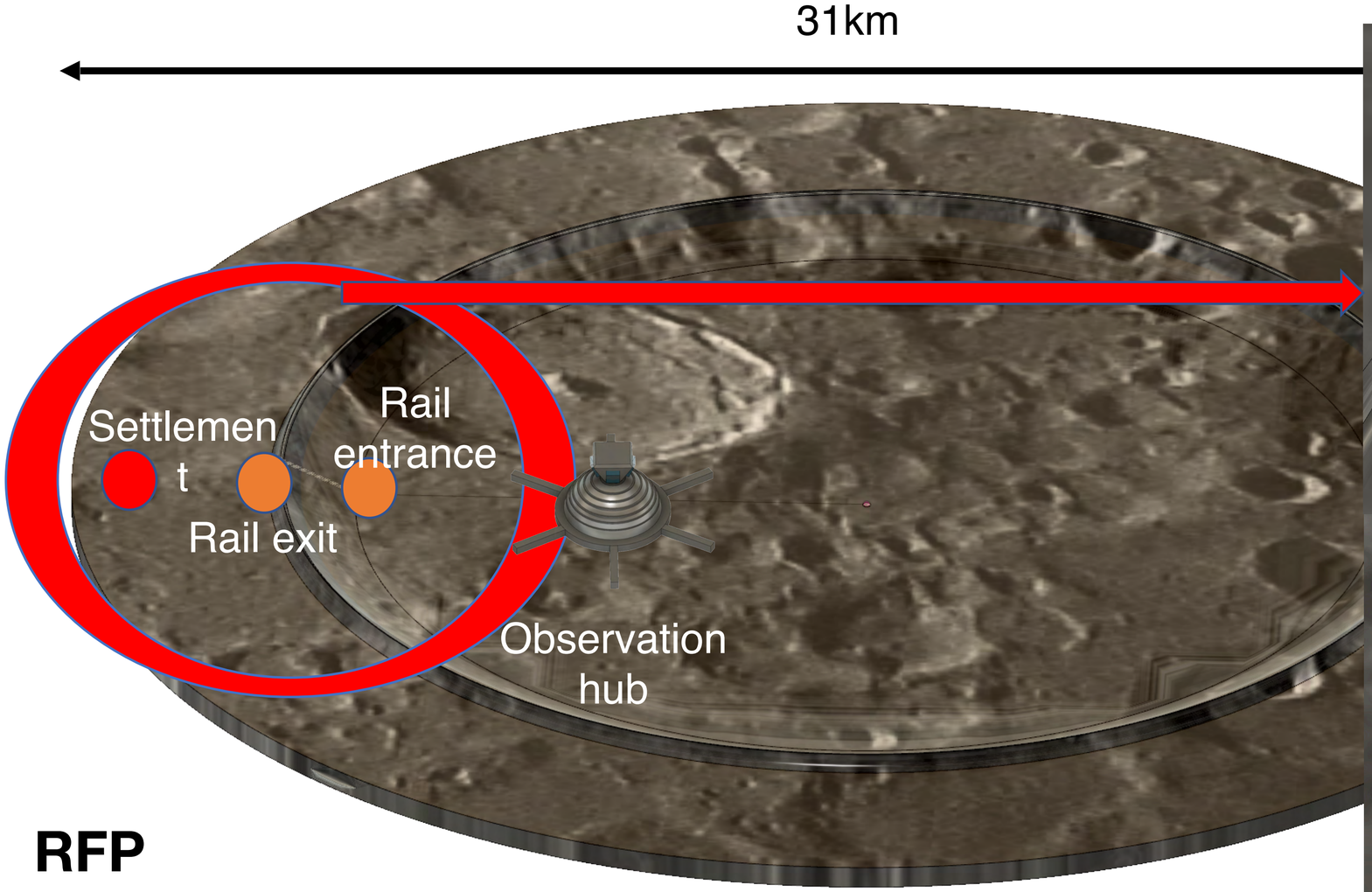


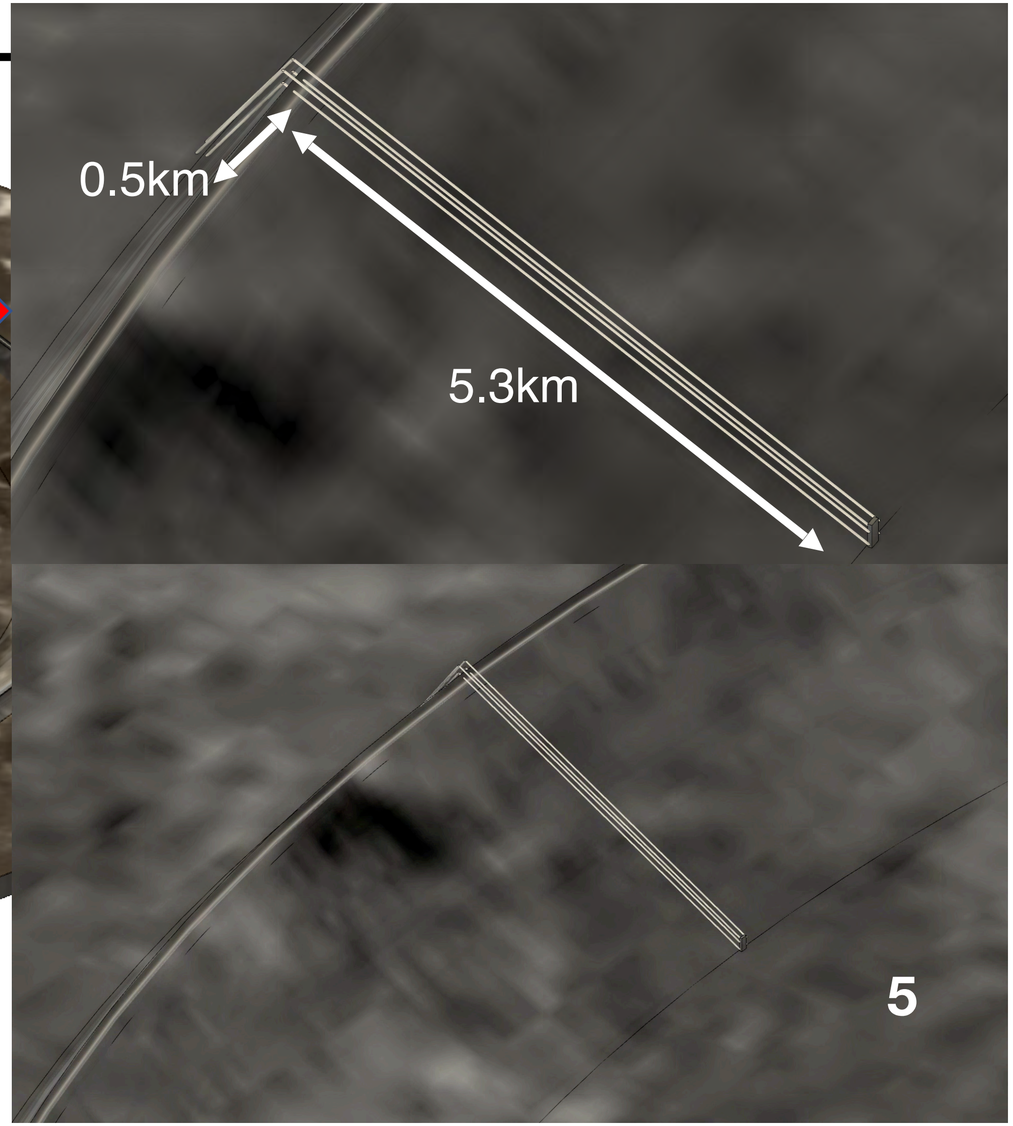

RF

2.1.1

# Exterior structural design (in the the crater)

Artemis

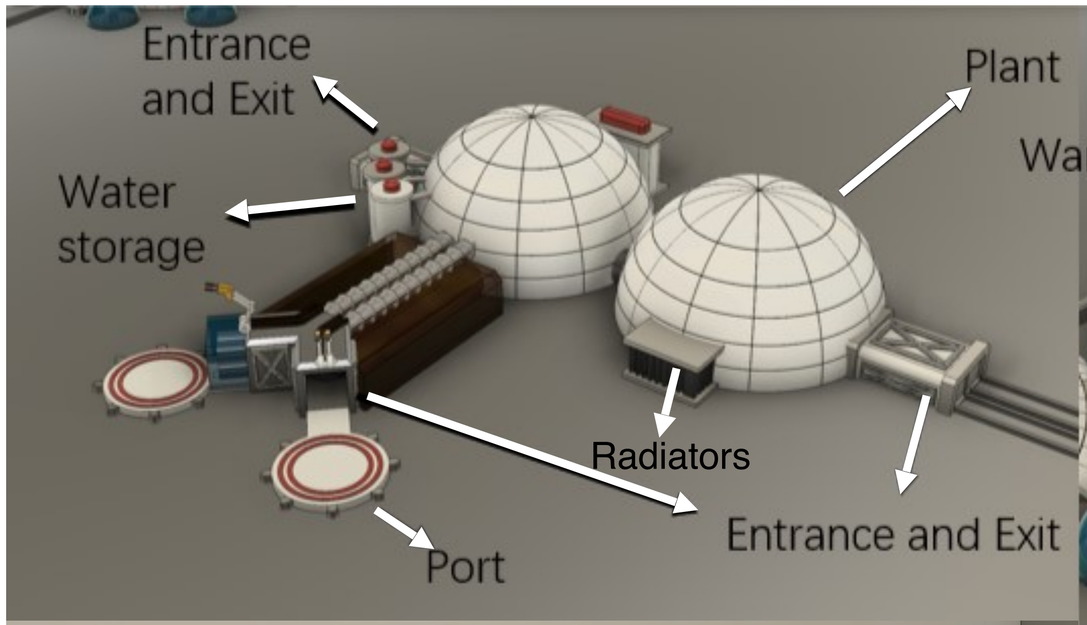


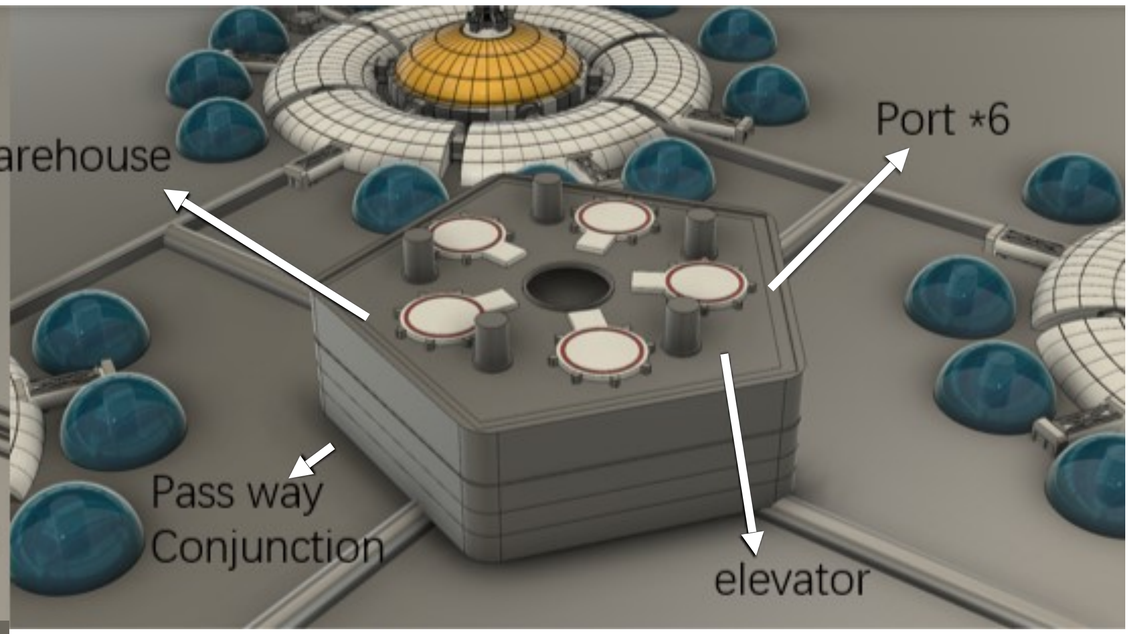



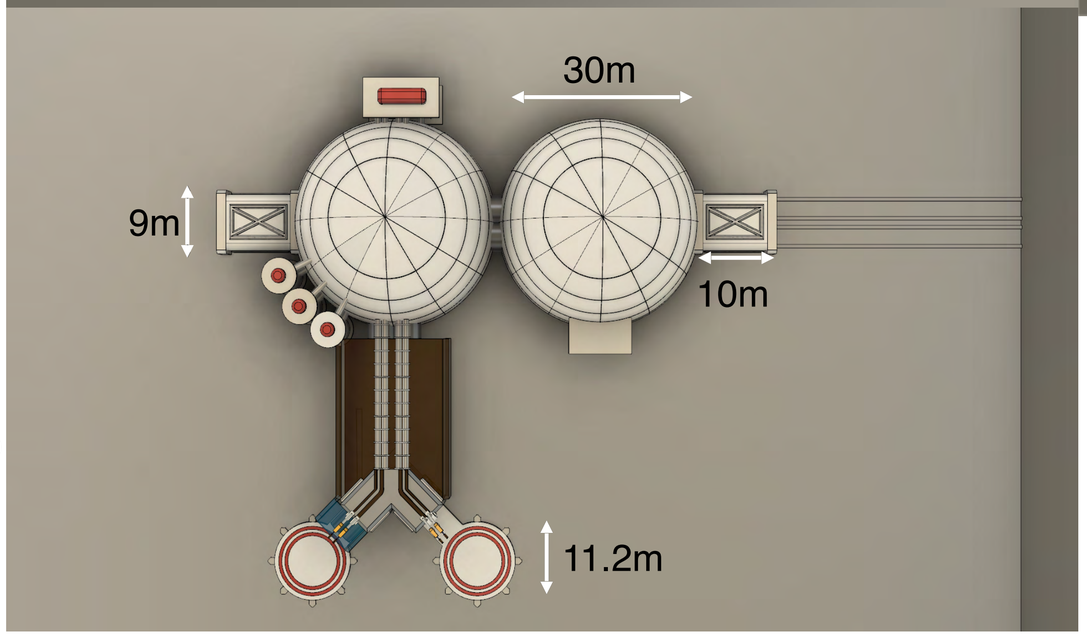

RFP
2.1.1

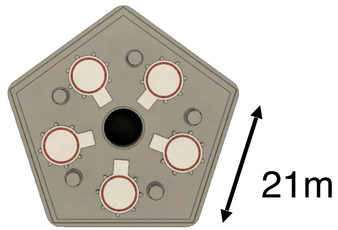
# Exterior Structure Designs（industry & ports）

**Artemis**

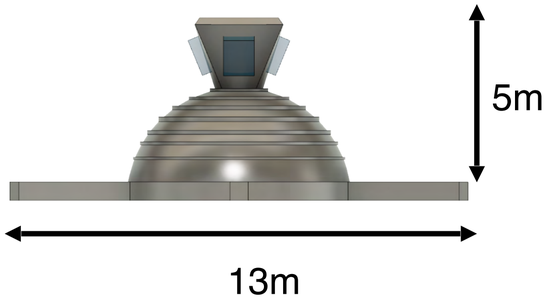


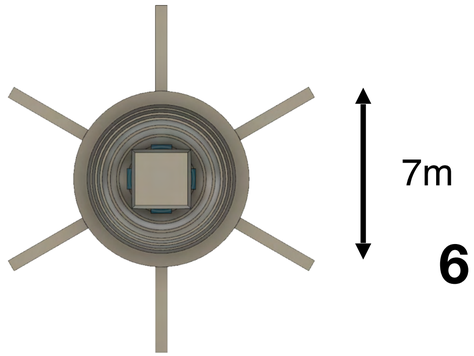





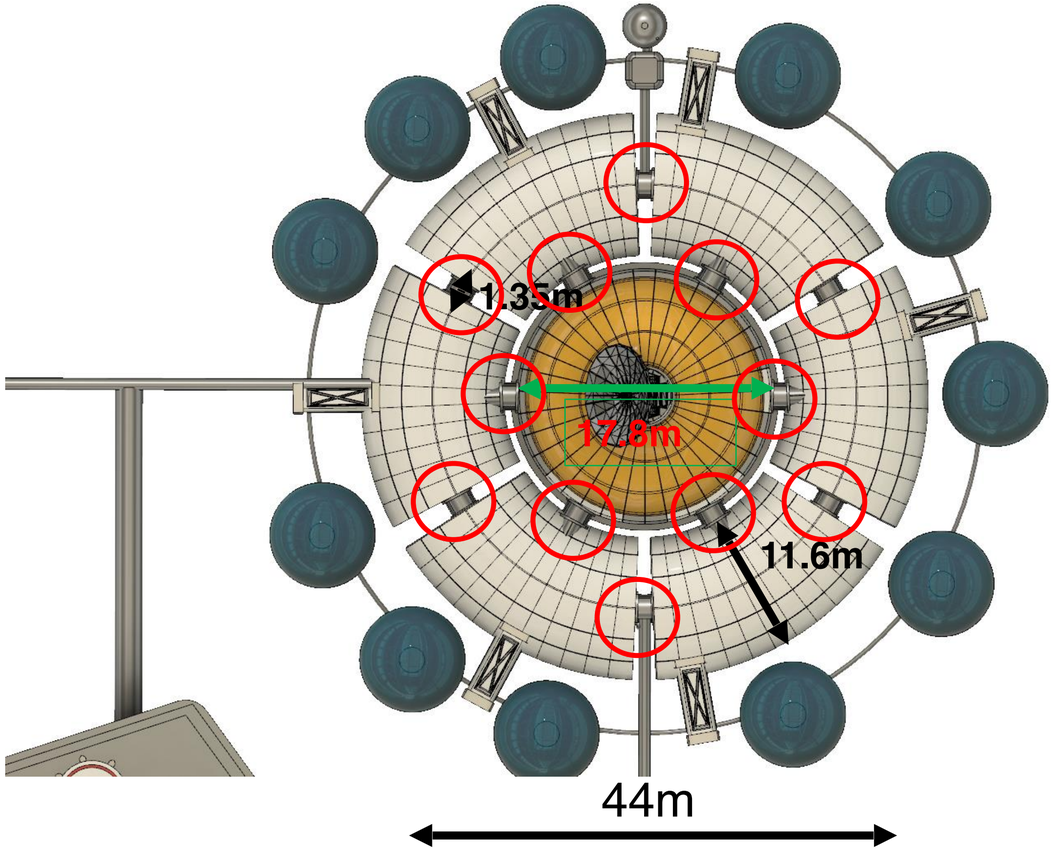


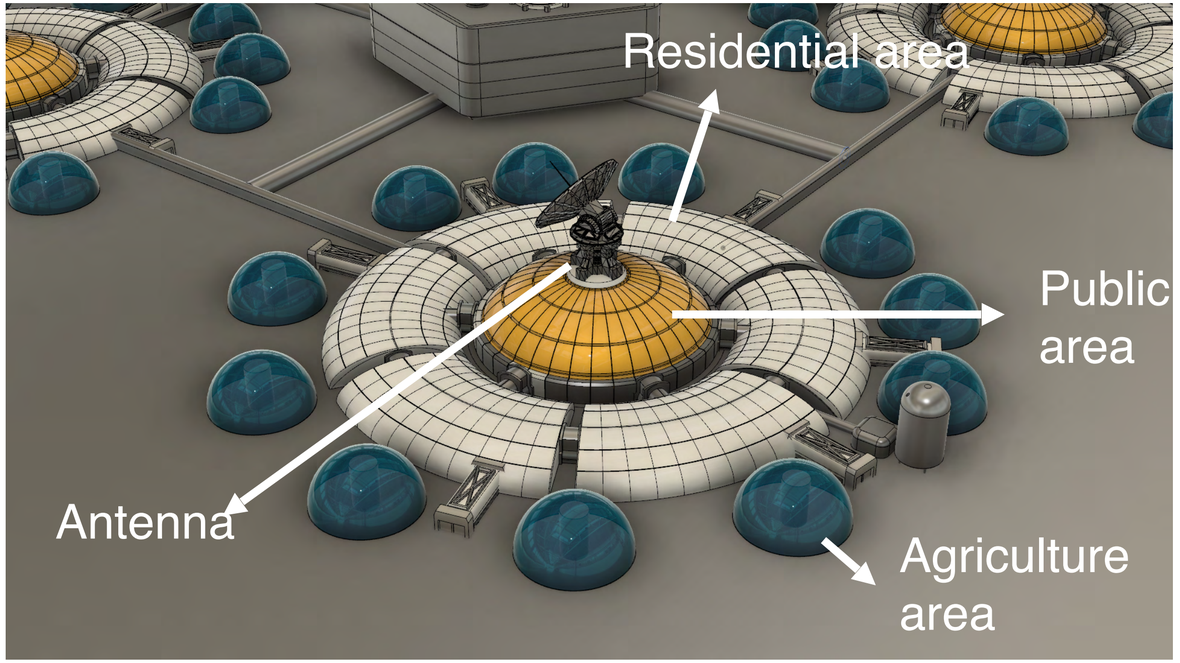

**RFP 2.1**

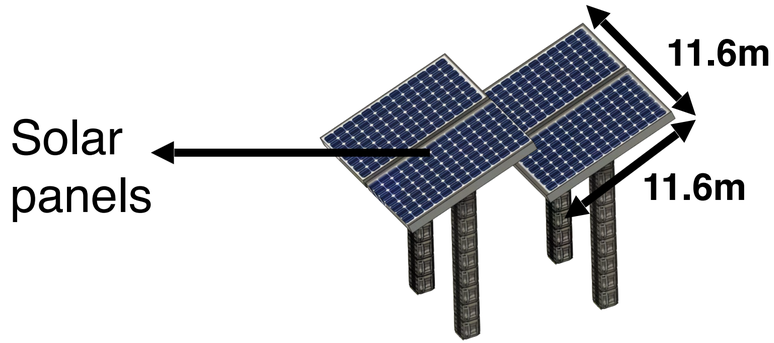
# Exterior structural design(residential)

Artemis




= airlock

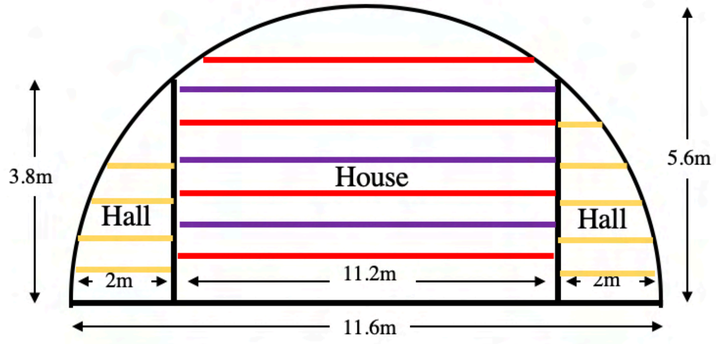



**RFP 2.1**

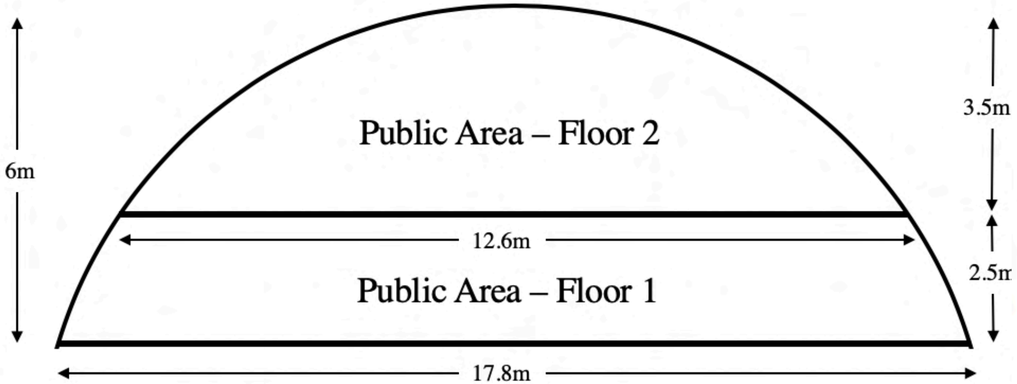
# Interior space distribution design

**Artemis**



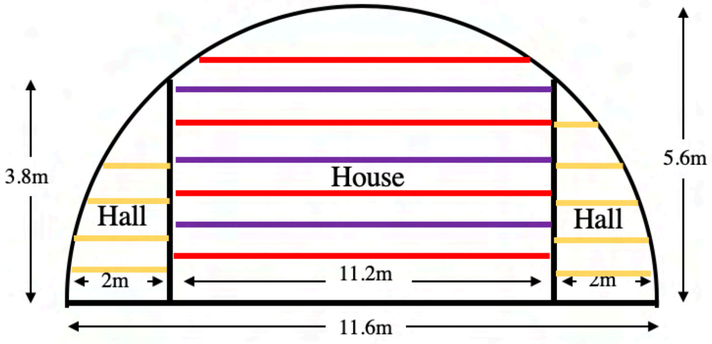

*Floor Area of living area:
2250m^2

*Thickness of the shell: 0.3m




*Floor area of public area:
375m^2

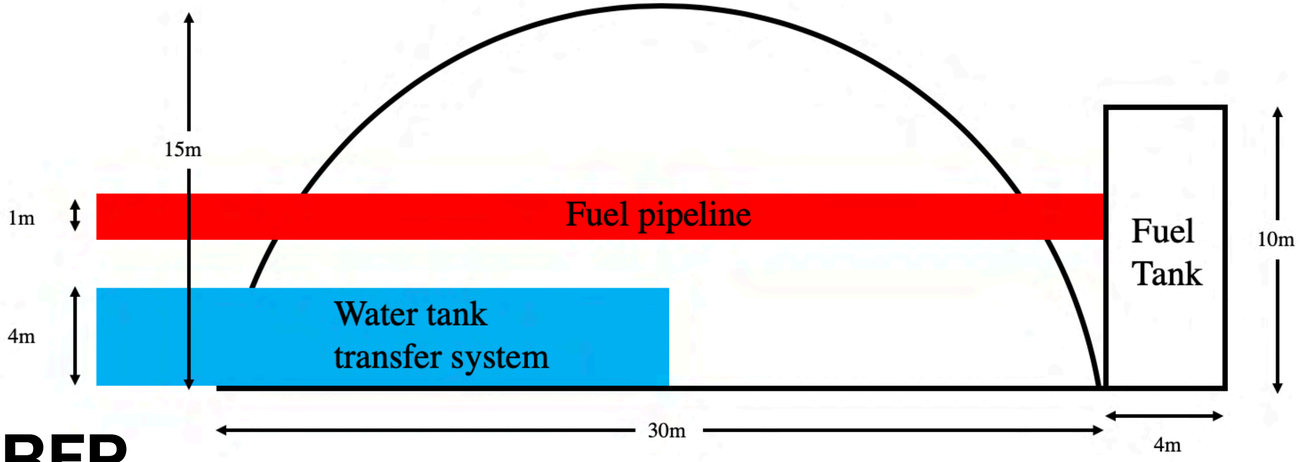
*Thickness of the shell: 0.3m



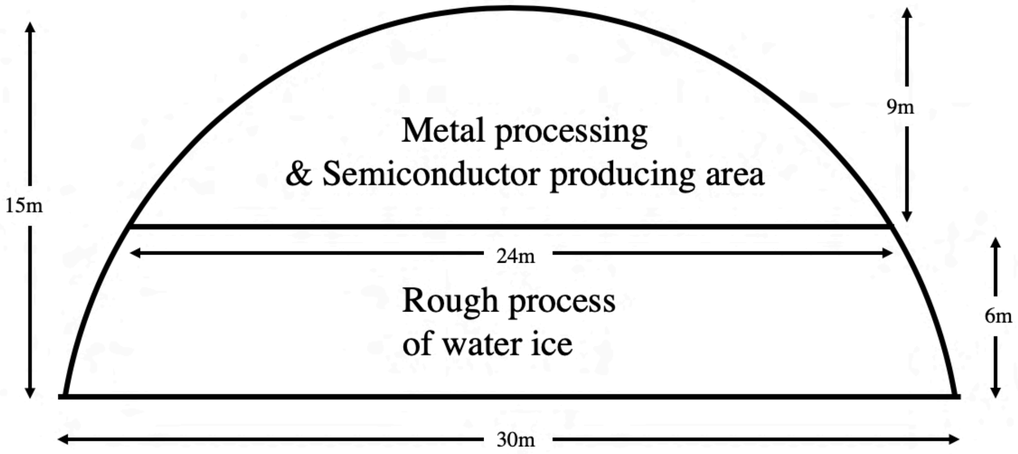

*Floor Area of living area:
2250m^2

*Thickness of the shell: 0.3m

Industry Plant




Industrial Area



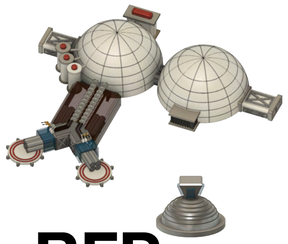

**RFP 2.2**

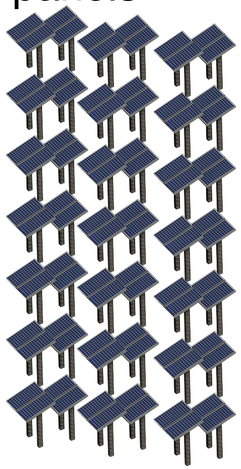
# Construction sequence

1

Construct industrial area and staff residence of 20 people

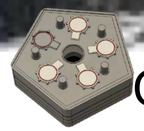
2 Construct industry plant, raw material transfer system, observation hubs, and 1/3 solar panels



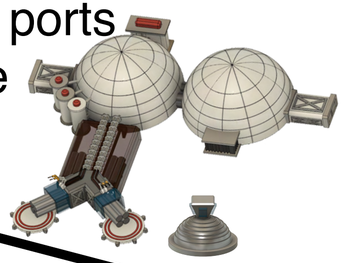


**RFP 2.3**

3



Construct the two ports and cargo storage



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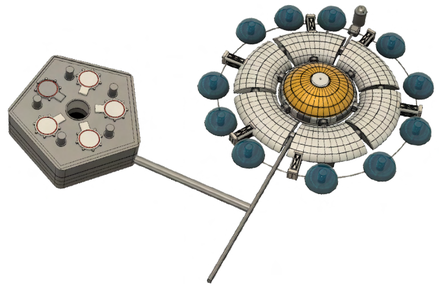
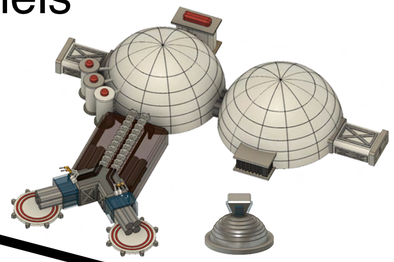


Construct one residence Community and 2/3 solar panels



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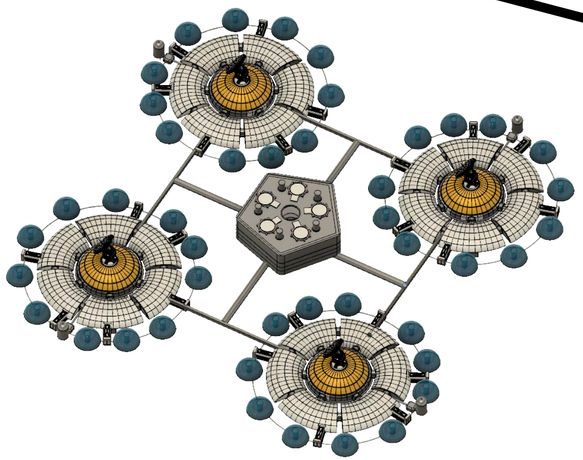
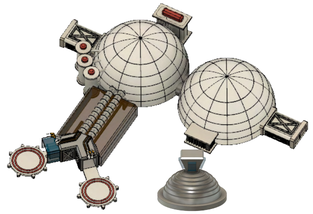
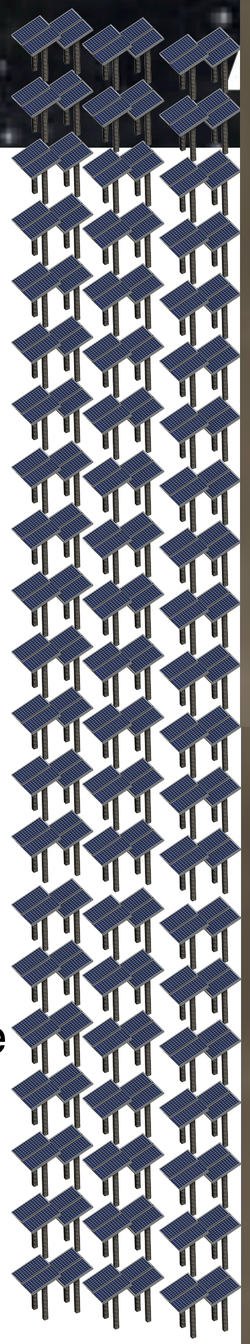


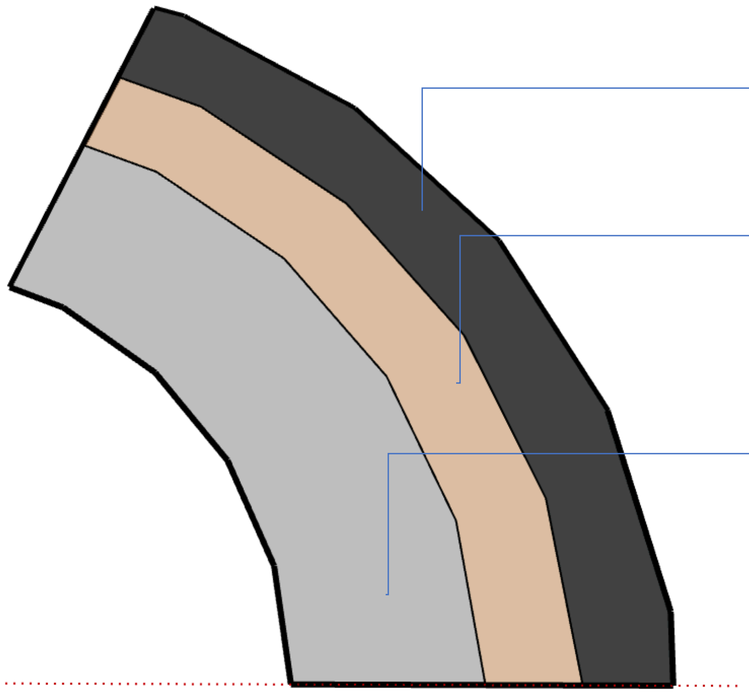
Construct three residence communities and the rest communities





# Construction material



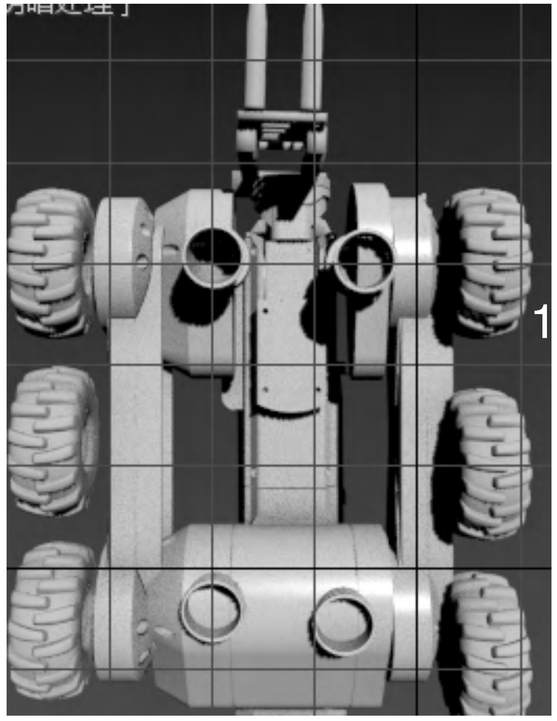


| Material | Composition | Quantity | Thickness | Source |
|---|---|---|---|---|
| **Aigis material** | --- | 1213t | 0.10m | LX-1 |
| **Nano-porous silicon material** | SiO2 Aerogel | 10t | 0.05m | Earth |
| **Ti-Fe alloy** | Fe-30%<br>Ti-70% | 3300t<br>+<br>7700t<br>=<br>11000 | 0.3m | Moon |

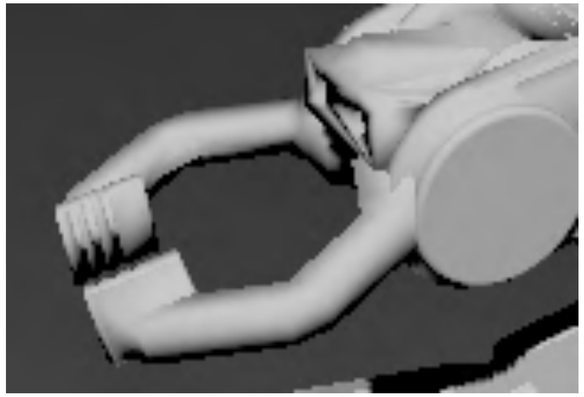
**RFP 2.4.1**

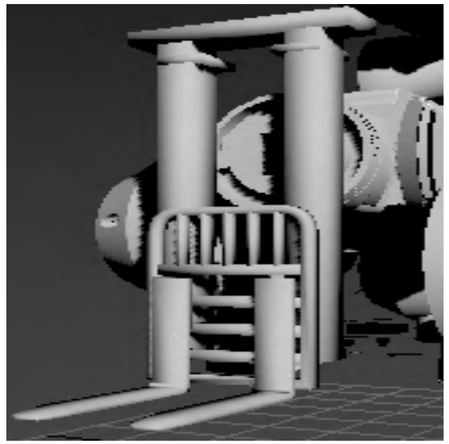
## Modular Design

Main Bottom Module

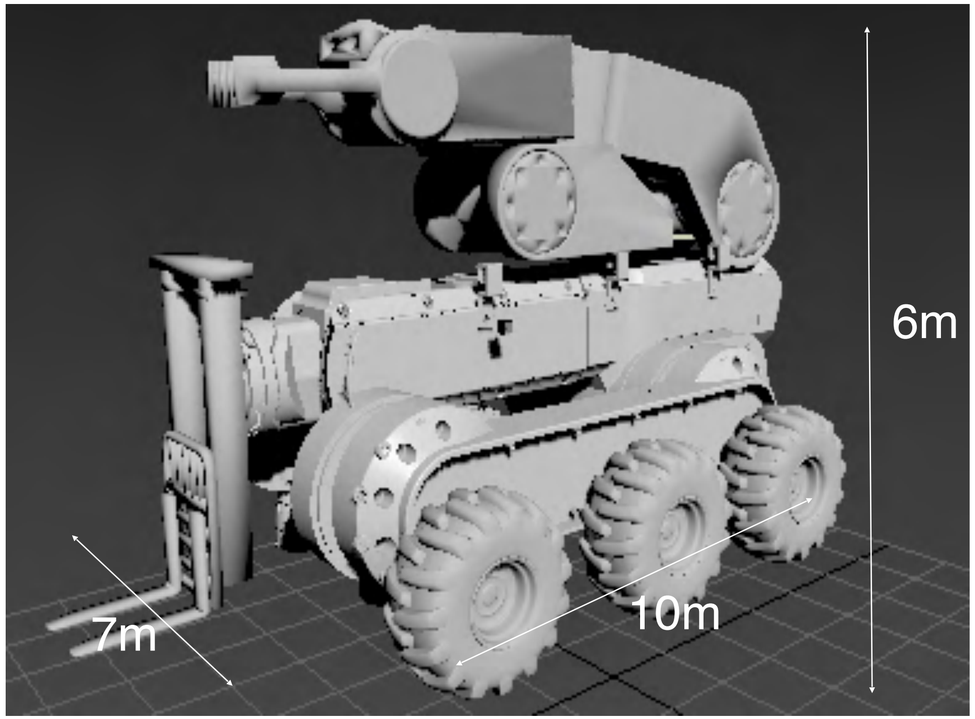


Grappling fork module





Low-level construction robot



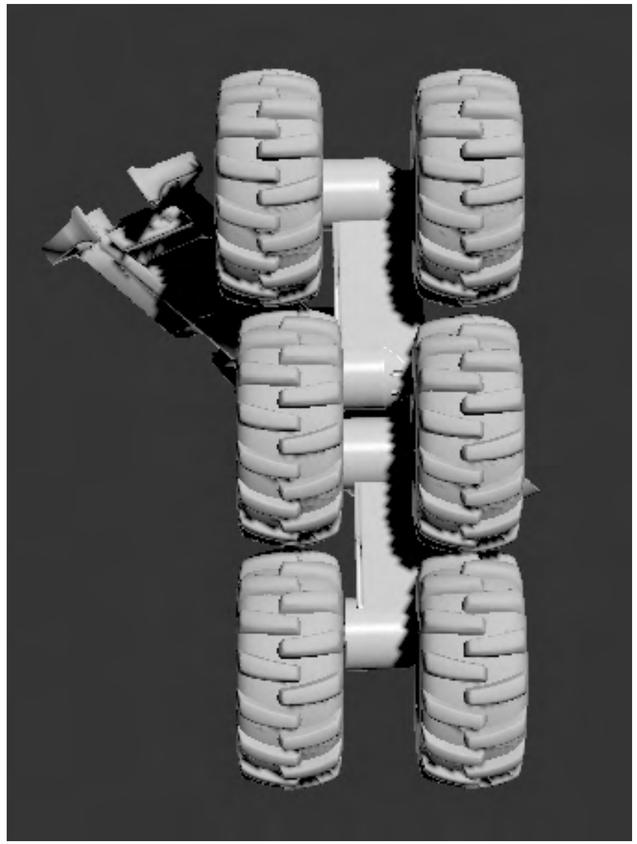

**RFP 2.4.2**



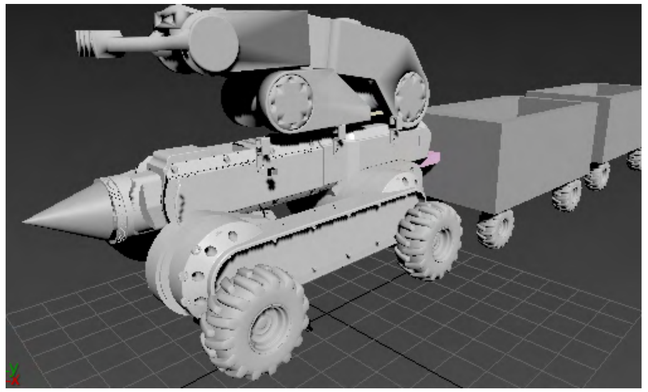
* https://www.cg009.com/models/detail/26955.html

## Modular Design: Able to reduce cost and recycle

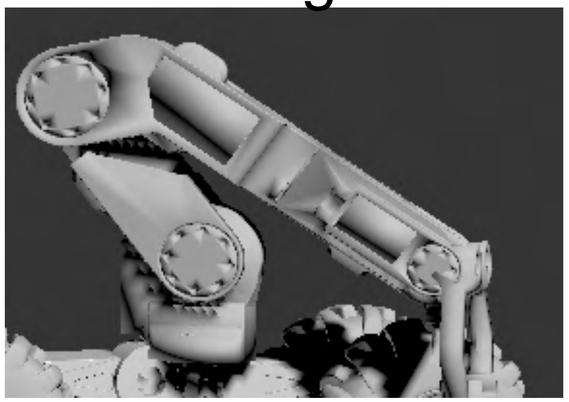
Main Bottom Module



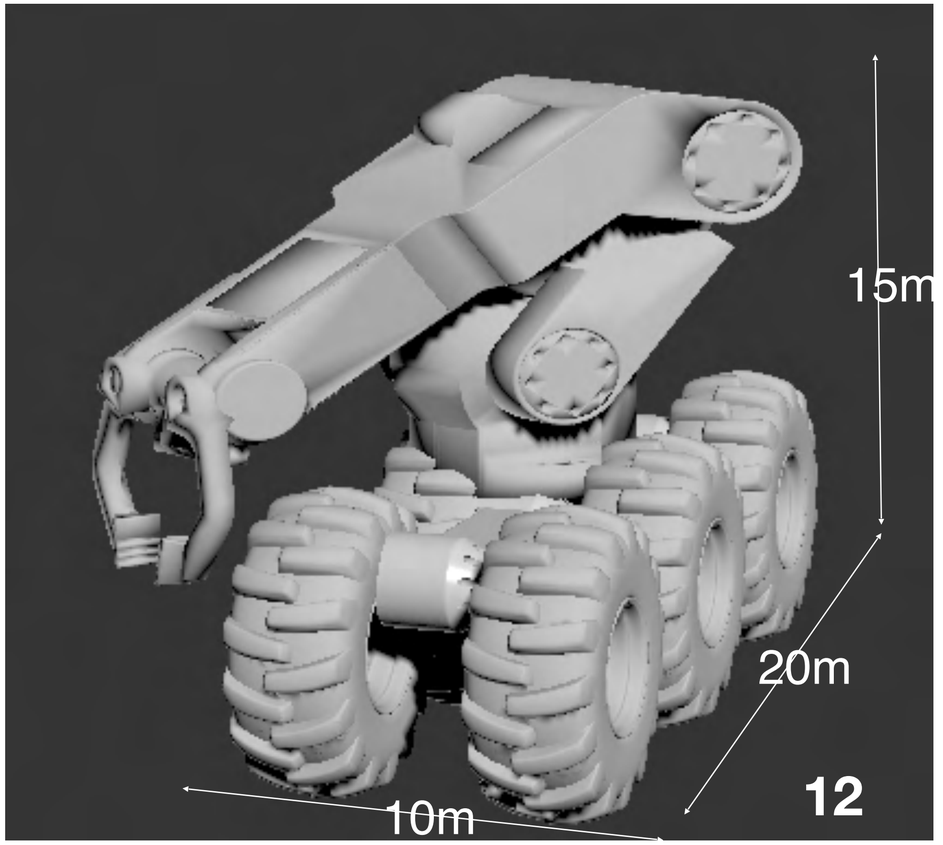
transportation



Grabbing hook



High-level construction robot(15m+)




RFP 2.4.2

* https://www.cg009.com/models/detail/26955.html

# Atmospheric Management

Artemis

**Main Sources:**

- Nitrogen: the Earth
- Oxygen: the Moon (ice water)
- Carbon Dioxide: Agricultural Area
- Water vapors: Agricultural Area mostly

## Industrial Area

| Gas | Concentration | Mass | Pressure |
|---|---|---|---|
| Nitrogen | 78% | 43680kg | 76.5% |
| Oxygen | 21% | 13440kg | 22.5% |
| Carbon Dioxide | 0.03% | 40kg | <1% |
| Water Vapor | 0.94 | 400kg | <1% |

## Residential Area

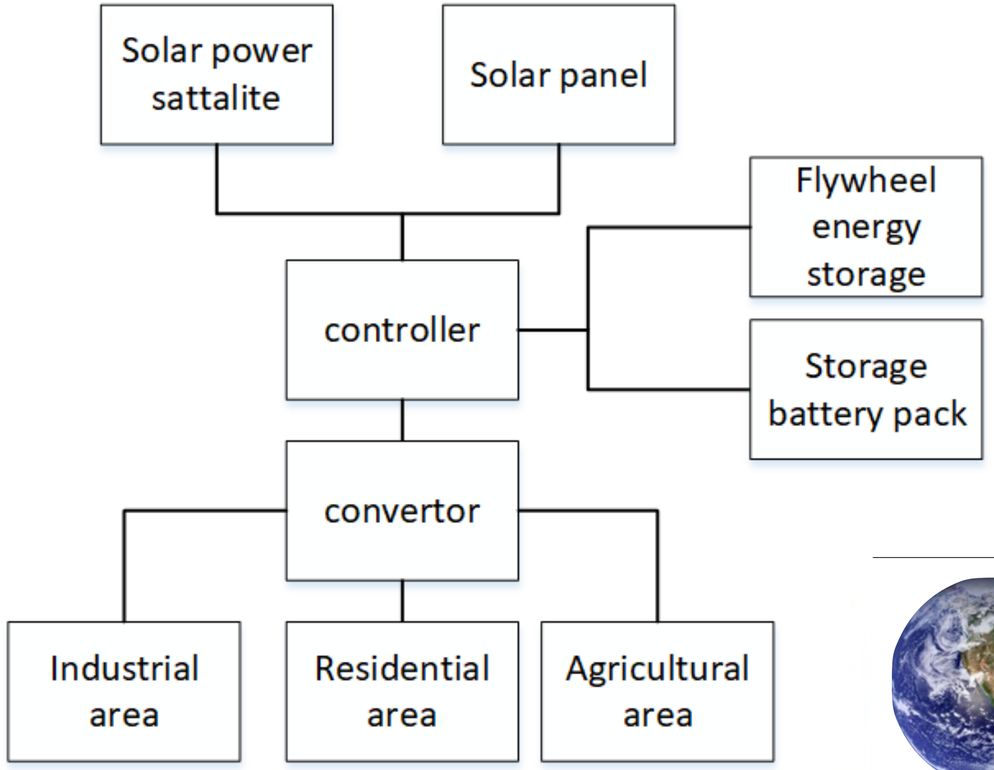
| Gas | Concentration | Mass | Pressure |
|---|---|---|---|
| Nitrogen | 78% | 21840kg | 76.5% |
| Oxygen | 21% | 6720kg (+50kg/day) | 22.5% |
| Carbon Dioxide | 0.03% | 20kg | <1% |
| Water Vapor | 0.94 | 400kg | <1% |

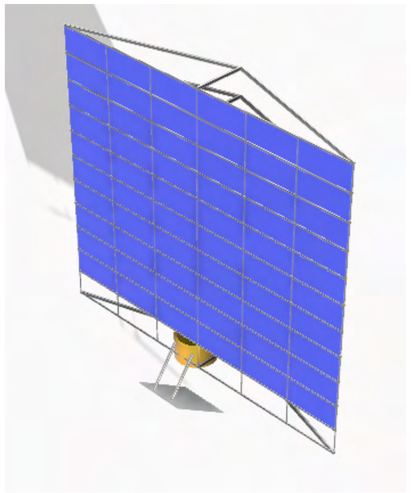
## Agricultural Area

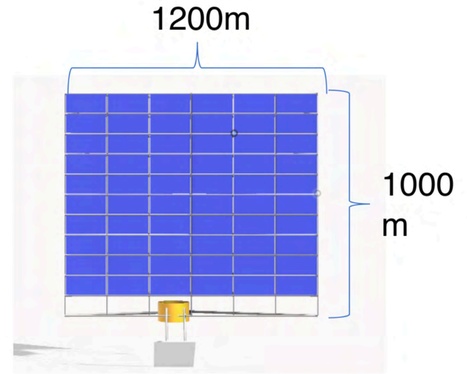
| Gas | Concentration | Mass | Pressure |
|---|---|---|---|
| Nitrogen | 78% | 21840kg | 76.5% |
| Oxygen | 21% | 6720kg | 22.5% |
| Carbon Dioxide | 0.03% | 20kg | <1% |
| Water Vapor | 0.94 | 400kg | <1% |

# Electrical Power

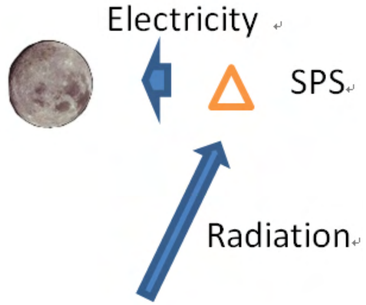
Artemis

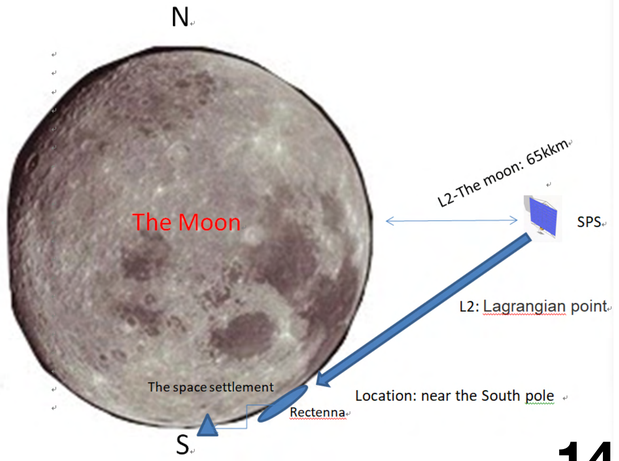





Solar Power Satellites(SPS)





**RFP 3.2**

# Electricity

Artemis

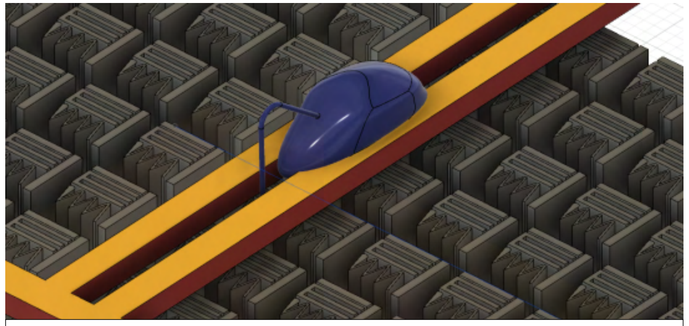
3 Storage Battery Pack(STP) totally storage 2.2*10^6 kWh

Each of the EMS is made up of small units

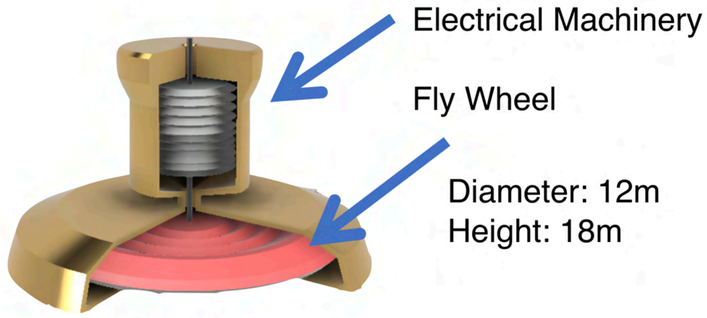
Electrochemical storage and physics storage

7 weeks necessary electricity of 2.9*10^6 kWh for emergency

STP hold ¾ and the Fly Wheels hold ¼ of the electricity.

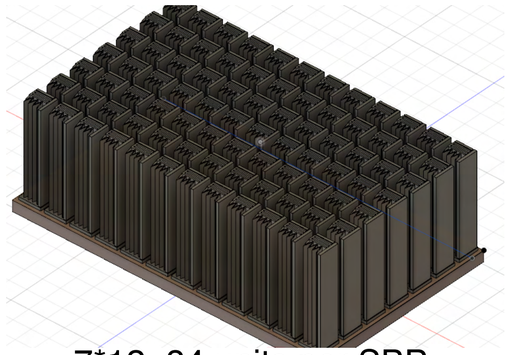


The robot is fixing the MEAMS




The Fly Wheel

Length: 2m; Wide: 2m; Height: 6m



7*12=84 units per SBP

| Sector | kWh/day |
|---|---|
| Domestic | 3067 |
| Industrial | 320000 |
| Lighting &Operation | 29000 |
| Agricultural | 11200 |
| Thermal | 58033 |
| Total | 420000 |
| Total area of the solar panel | 25k meters square |

**Estimation basis**

Industry:

We need to electrolysis 90t water, and totally produce 290t water/day

145robots needs: 11300kWh/day

Liquidation needs: 22400kWh/day

Electrolysis needs: 291000kWh/day

Total: 320000kWh/day

Agriculture: 11200kWh/day

Lighting & operation:38000kWh/day

Thermal: 58033kWh/day

Totally consumption of electricity /day: 420000kwh/day

Totally power: 420000kwh=1.5*10^12J

W=1.5*10^12/(24*3600)

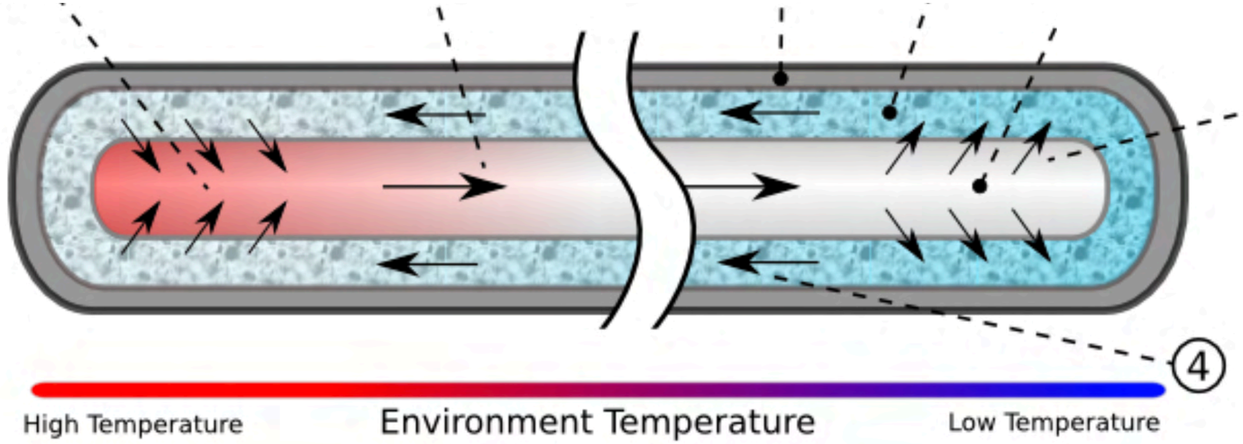
=1.7*10^7

RFP 3.2

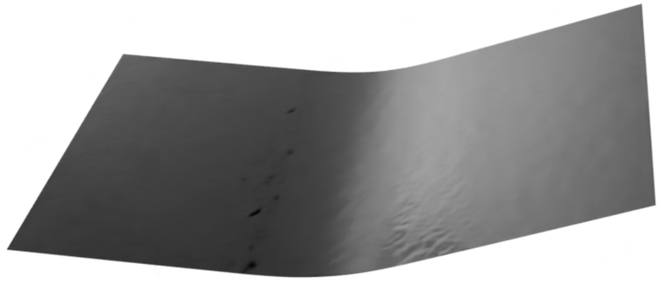
# Thermal Managements

Artemis

- Material of Radiation panel: Brass (because of the high capacity of radiation and the lower price) Covered by dark coating.
- **Area: 1.5*10^4 m^2**
- Transporter of heat: Heat Tubes
- Collecting heat in residential and agricultural area: Air conditioner's outdoor settlement.



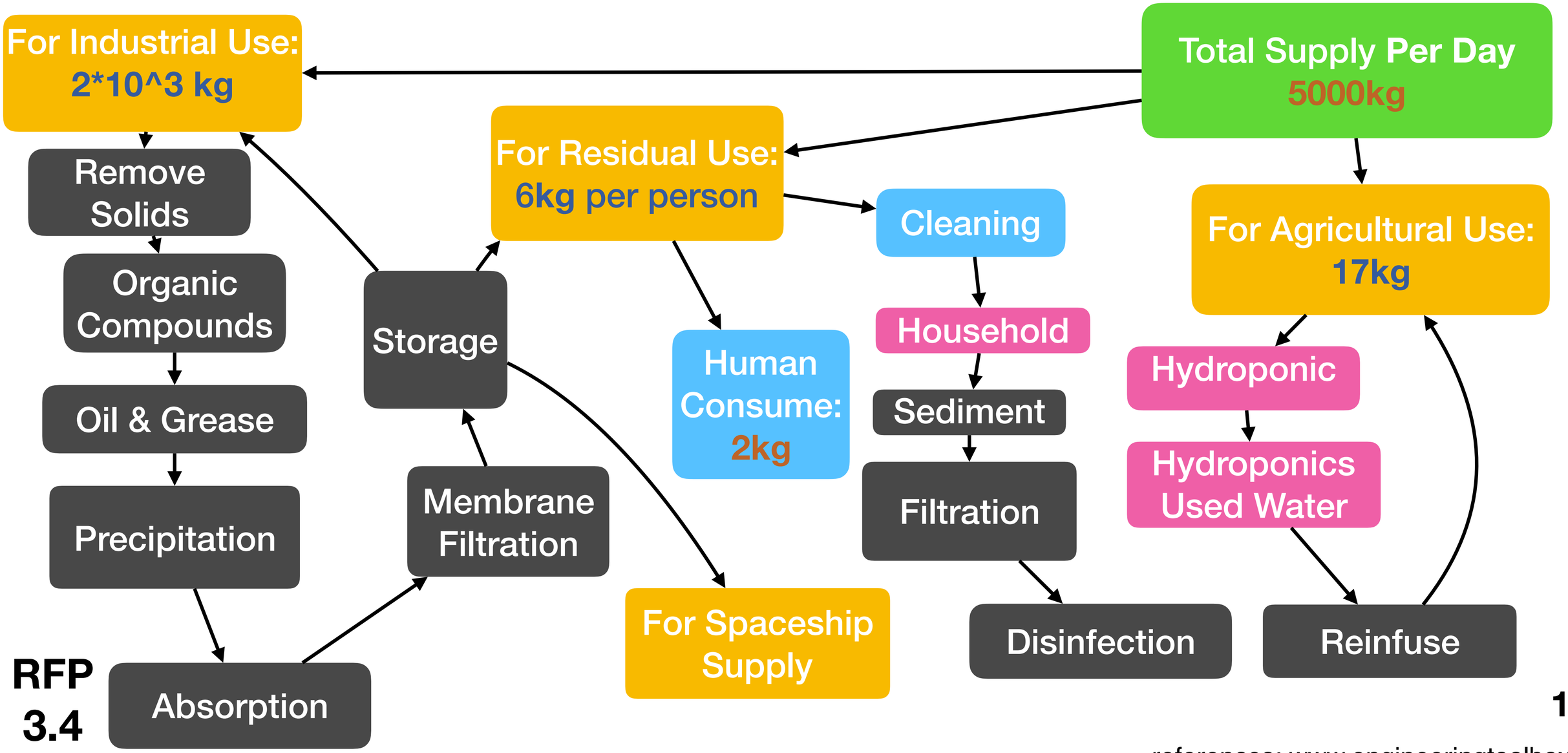

| | Required Quantity/ kWh per day | Produced/ kWh per day |
|---|---|---|
| Industrial | / | 476000 |
| Residential | 11480 initially | 99960 |
| Agricultural | 761600 initially | 1.2 |
| Total: | Initially required for 868000kWh per day, and 588000kWh per day after construction to be radiated. | |



**RFP 3.3**

# Water Management

Artemis




RFP 3.4

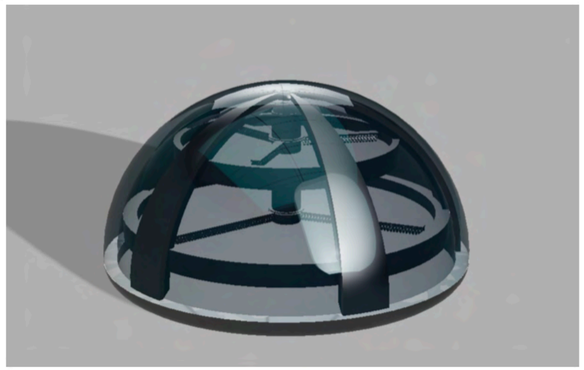


references: www.engineeringtoolbox.com

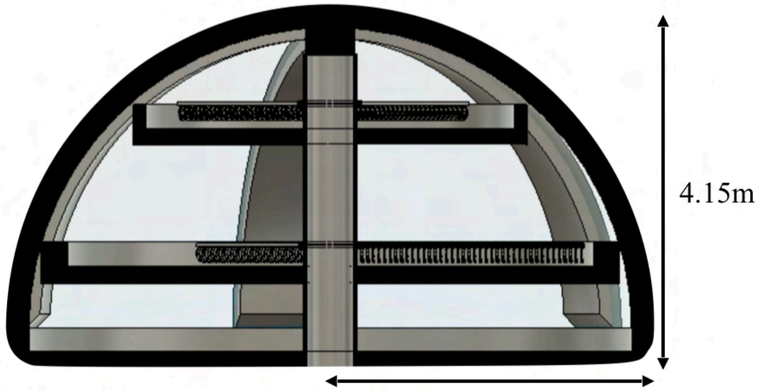
# Agricultural part

| Species | Consumption (daily) | Yield per mu | Production (per month) | Required area(basic) | Yield per module: |
|---|---|---|---|---|---|
| Wheat | 80kg | 1000kg | 0.75kg/ | 3200 | 1.5kg |
| Lettuce | 120kg | 3500kg | 6.3kg/ | 571.4 | 2.6kg |
| Chicken | 50kg | / | 8.4kg/ | 178.5 | 1.31kg |
| Tomato | 40kg | 15000kg | 39kg/ | 30.7 | 1.3kg |
| Potato | 80kg | 3000kg | 8.4kg/ | 285.7 | 2.1kg |
| Algae | 16kg | / | / | / | / |

Every layer has modularized in one specific of crops or chicken.



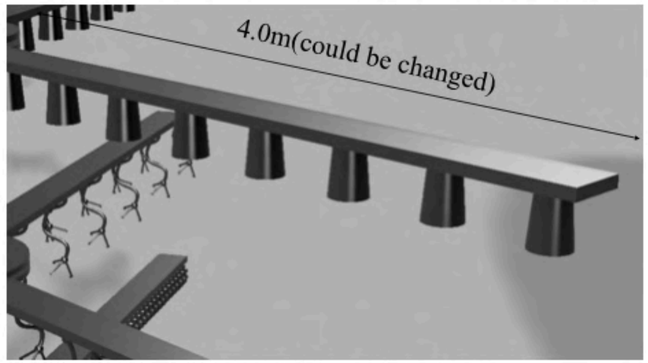
Planting modules: 38+6 (basic and storage)+(spacecraft supply)
Total: 44



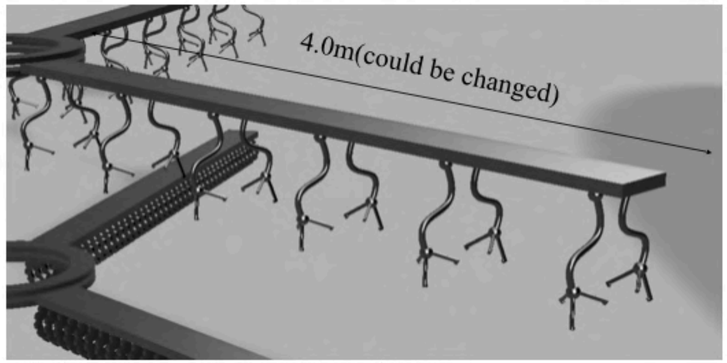

Reference： *Future yield growth in field crops: what evidence exists?* By John M. Reilly, Keith O. Fuglie
Reference: Chinese balance Dietary pagoda; British Nutrition Foundation

## Auto equipment

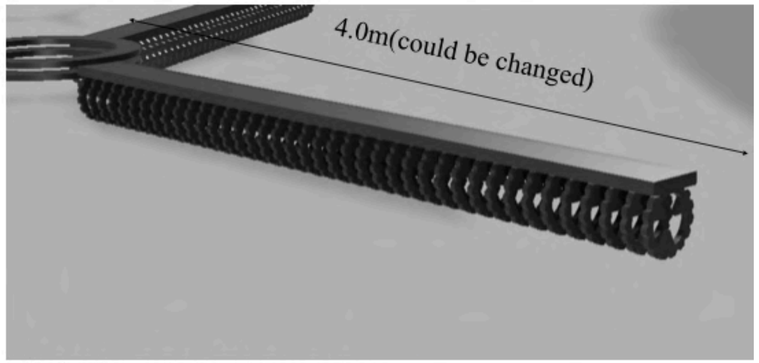
- Three kinds of robotic arms for sowing, harvesting, watering, and catching chickens



Robotic arms for sowing and watering



Robotic arms for catching chickens



Robotic arms for harvesting

## Atmospheric circulation and purify water

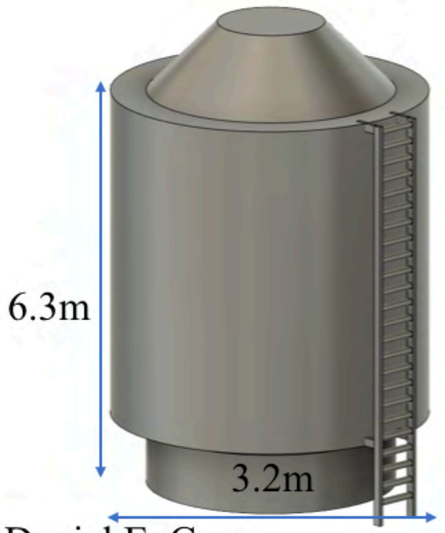
- Atmosphere circulation

| Consumption | Produce |
|---|---|
| Human: 200m³ | Crops: 309m³ |
| Chicken: 34m³ | Algae: 120m³ |
| Total: 234m³ | Total: 429m³ |

- Purify water

There will be a water tank which set the algae in it. The algae could absorb chemicals and harmful substance.

Total volume: 50m³

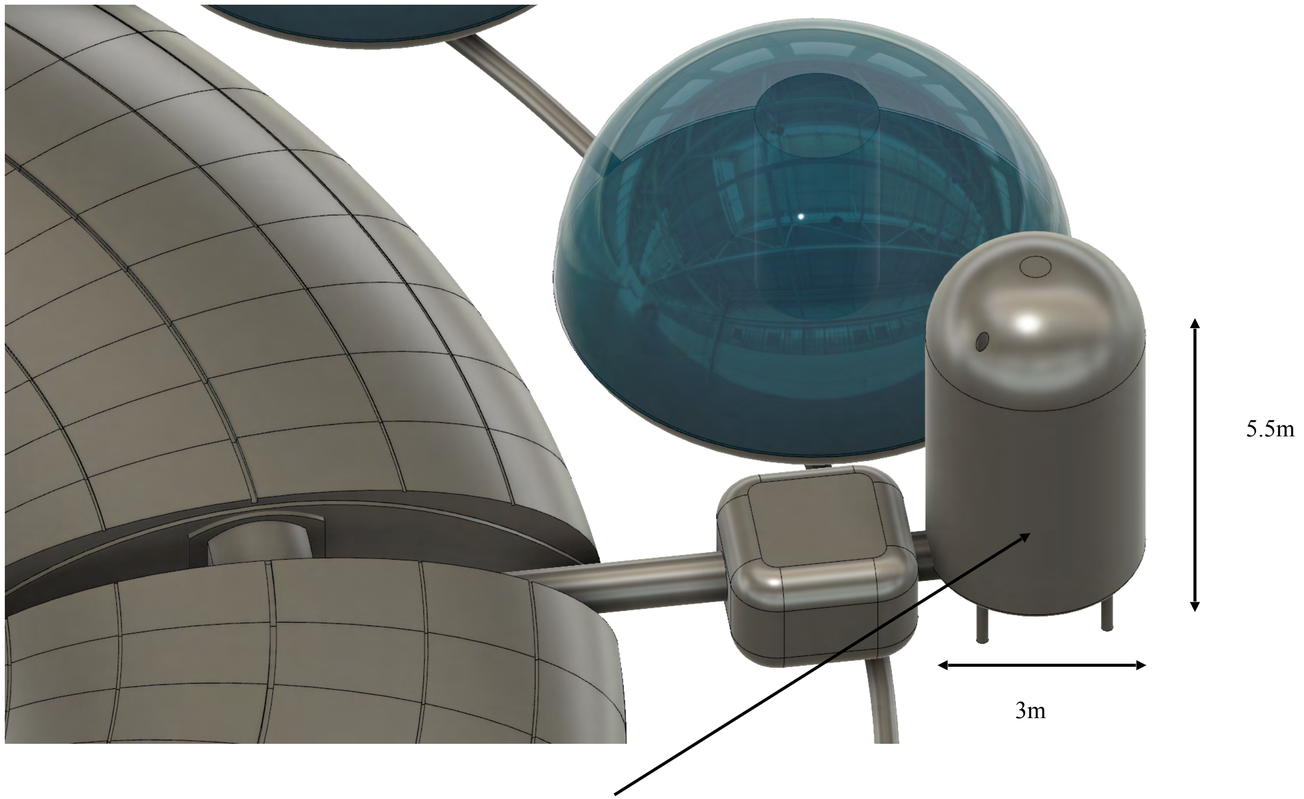



Reference: *How Much Oxygen Does One Tree Produce? By* ThoughtCo;
*Oxygen Production by urban trees in the United States. By* David J. Nowak, Robert Hoehn, and Daniel E. Crane

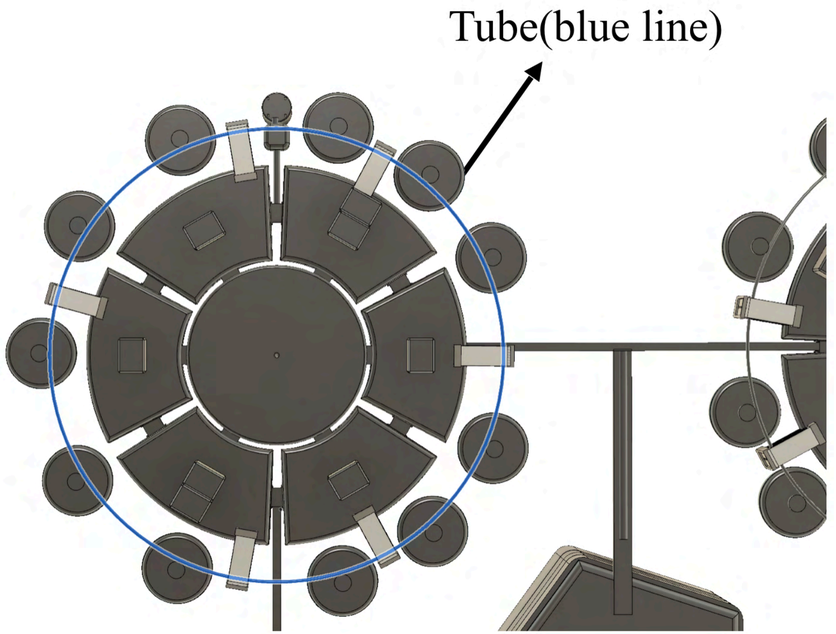
RFP 3.5

# Food Storage and Method to Transport

Artemis




There will be tubes between the planting modules that will connect them to meet the requirements of the transportation for food, water, and wastes.



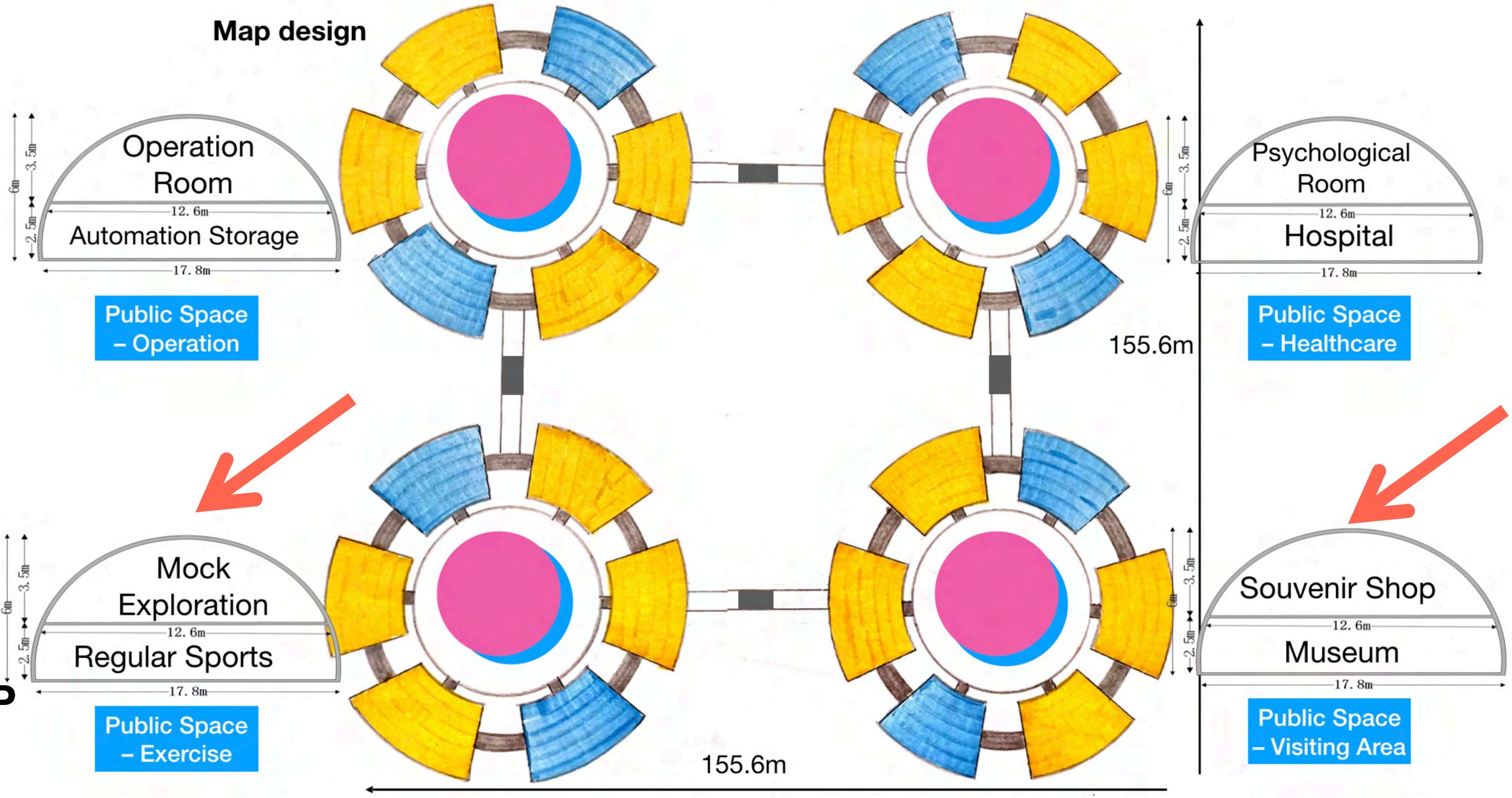

**RFP 3.5**

The food storage space is shown on the diagram.

The crops and chickens will be first process then stored in the storage place.

# Residential Space Design

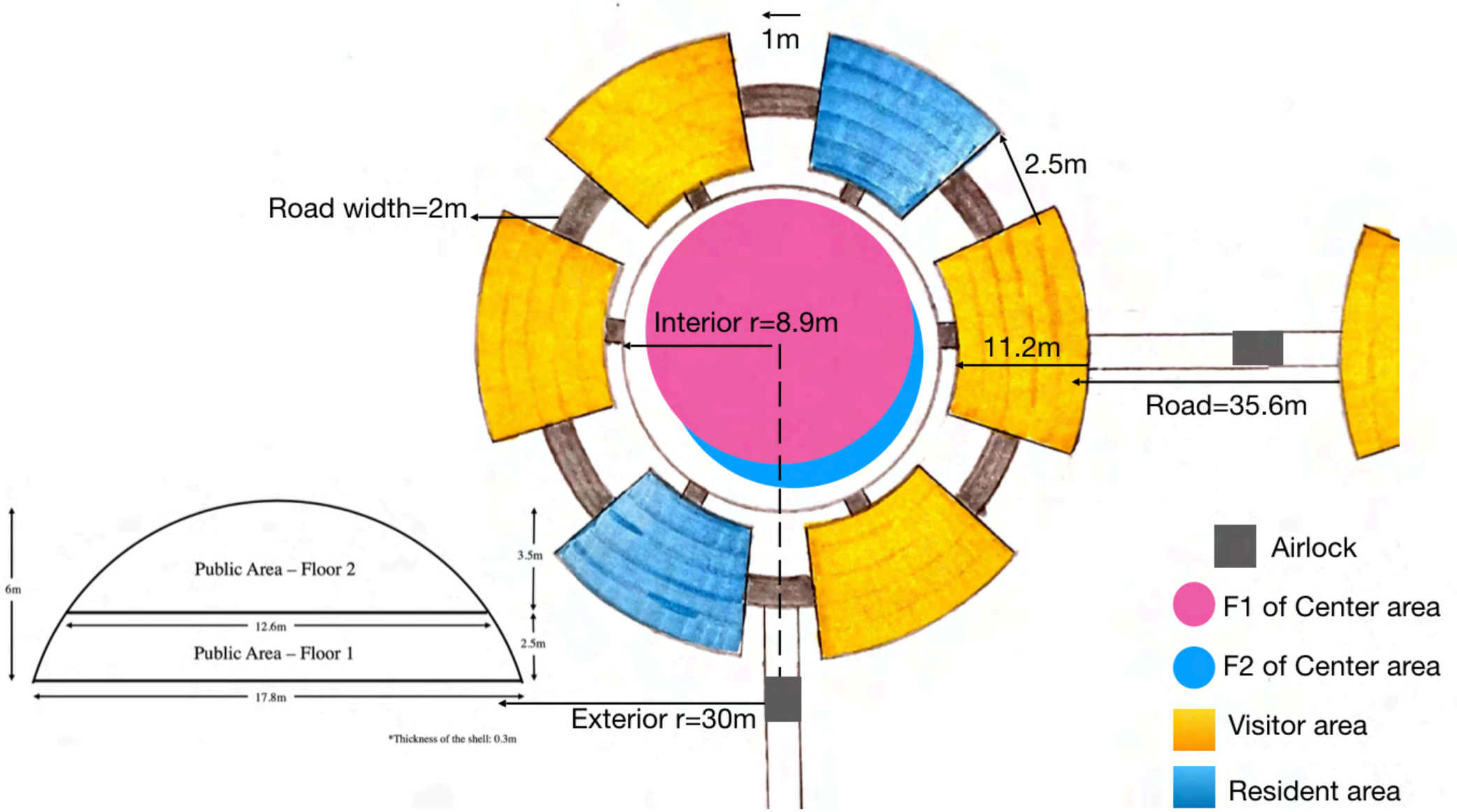
Artemis




RFP 4.1

# Detailed Look-top View

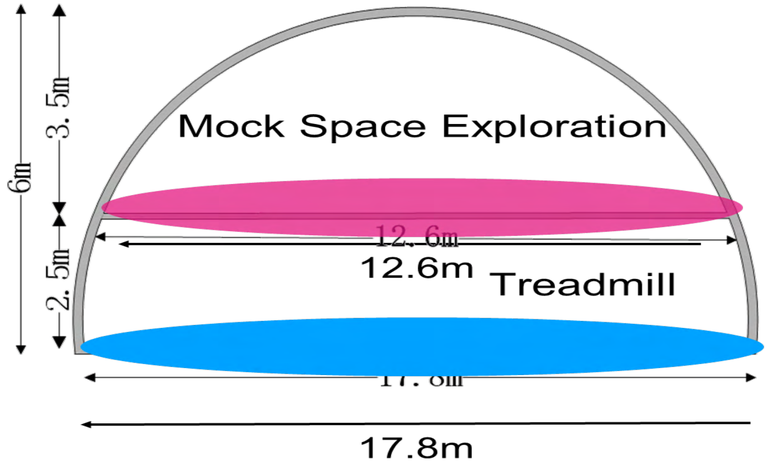
Artemis

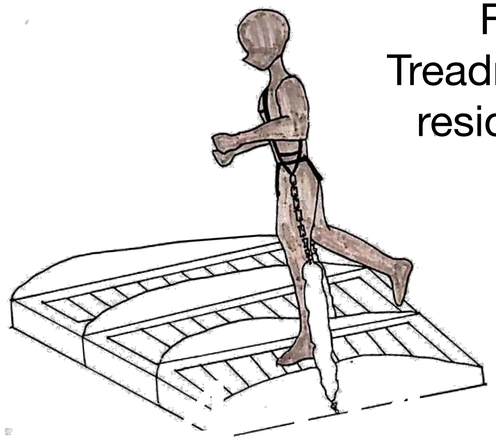



RFP 4.1

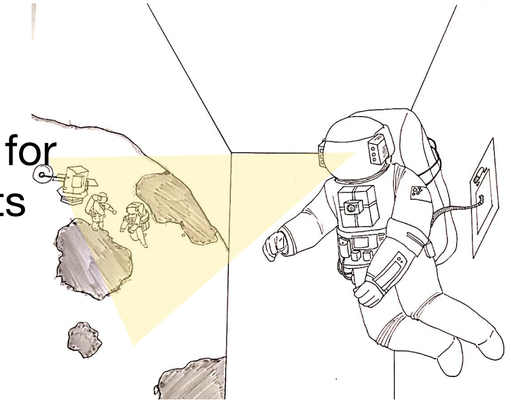
# Exercising & Visiting Space

Artemis

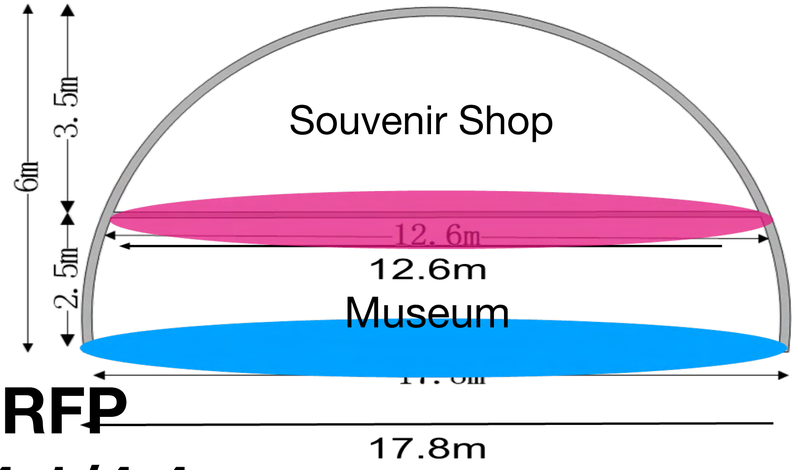


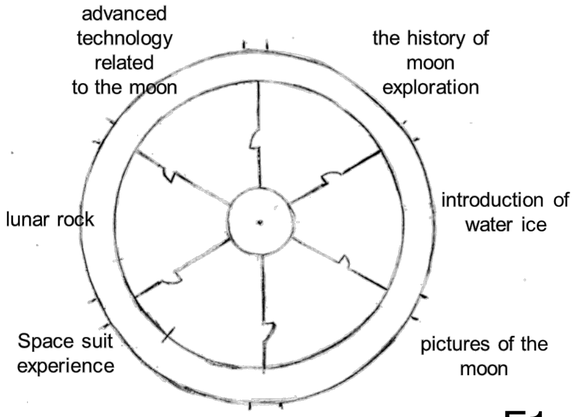
F1
Treadmill for residents



F2
VR Mock Universe Exploration (for residents & visitors – enhance communications and integration to community

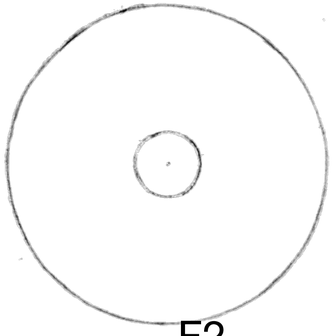



**RFP 4.1/4.4**




museum

F1
(e.g. Updating with new researches)



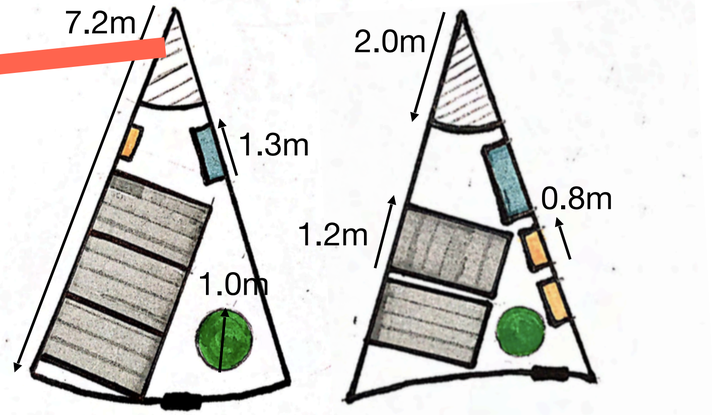
F2
Souvenir store (e.g. sell ores on moon and their products)

External:
Cooperate with **SuiteLock Systems Corp.**

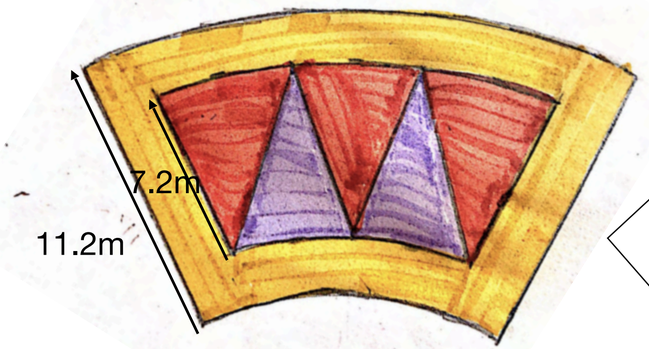
Elaborate in industry department

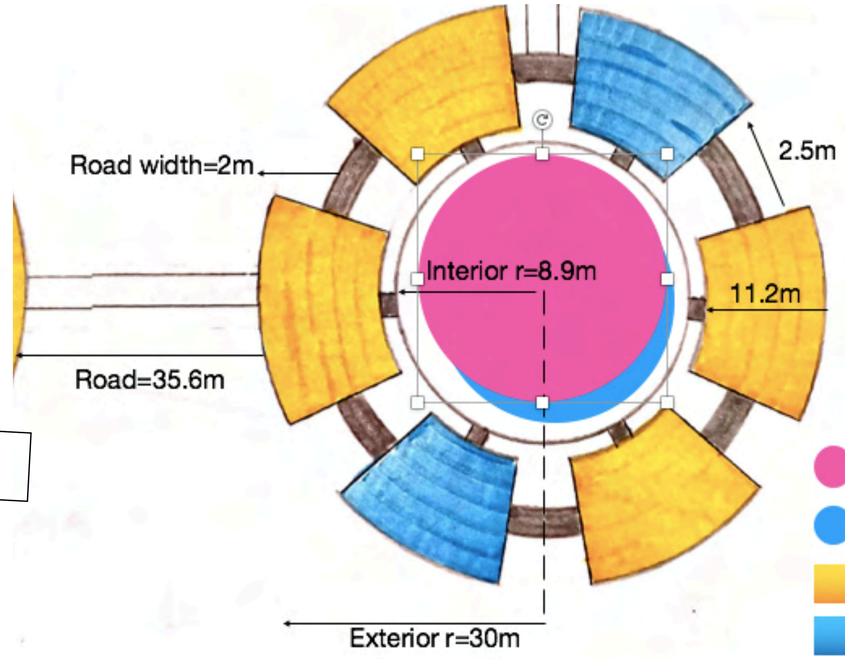
# Visitors' Area

Artemis




bathroom
bed
shelf
desk
table
shower



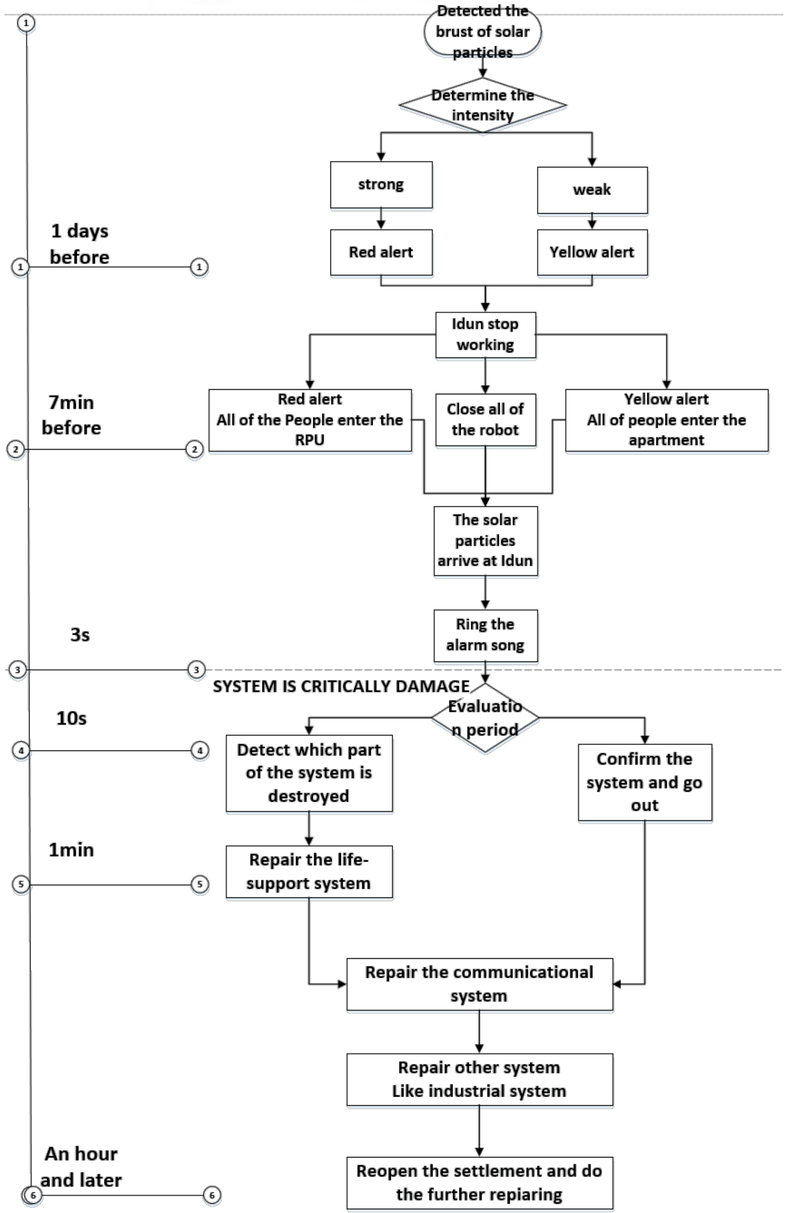

House for 3 visitors
House for 2 visitors
Visitor area

Airlock
F1 of Center area
F2 of Center area
Visitor area
Resident area

**RFP 4.4**

# Contingency Plan

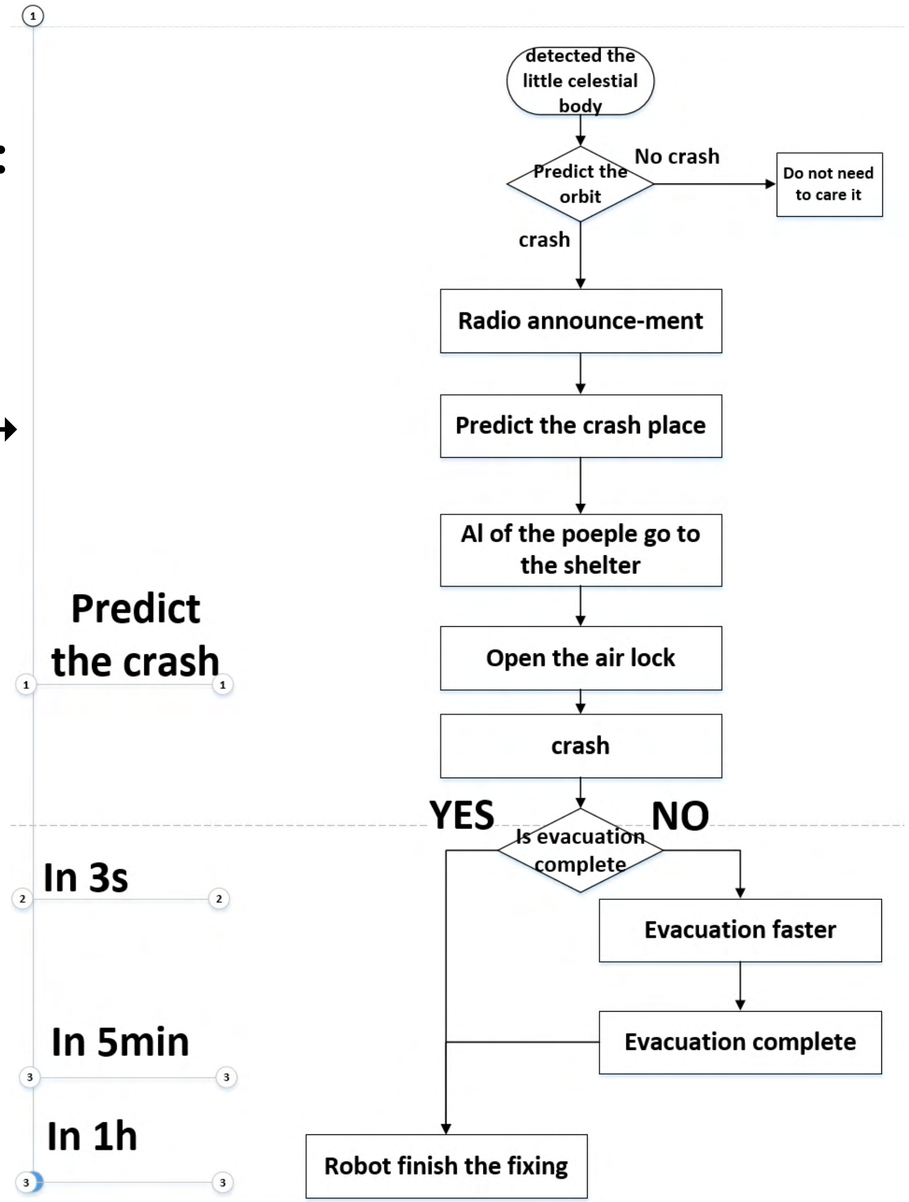
Artemis




**Emergency Plan of：**

**←Solar Particle**

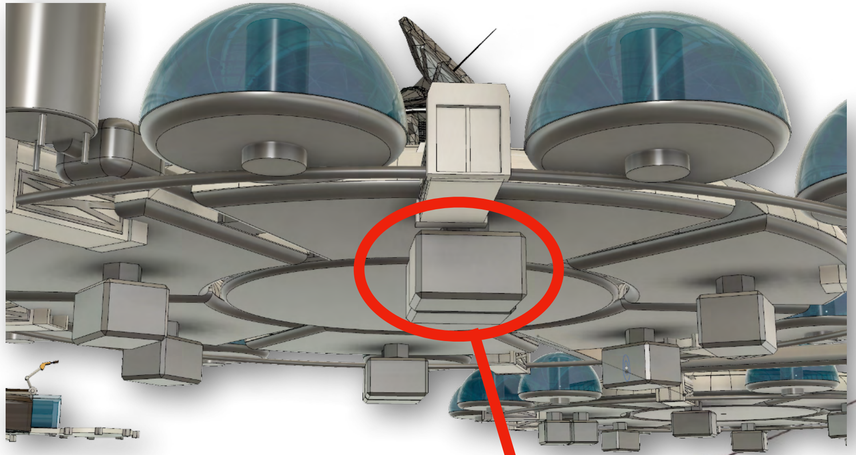
**Meteoroid Attack→**

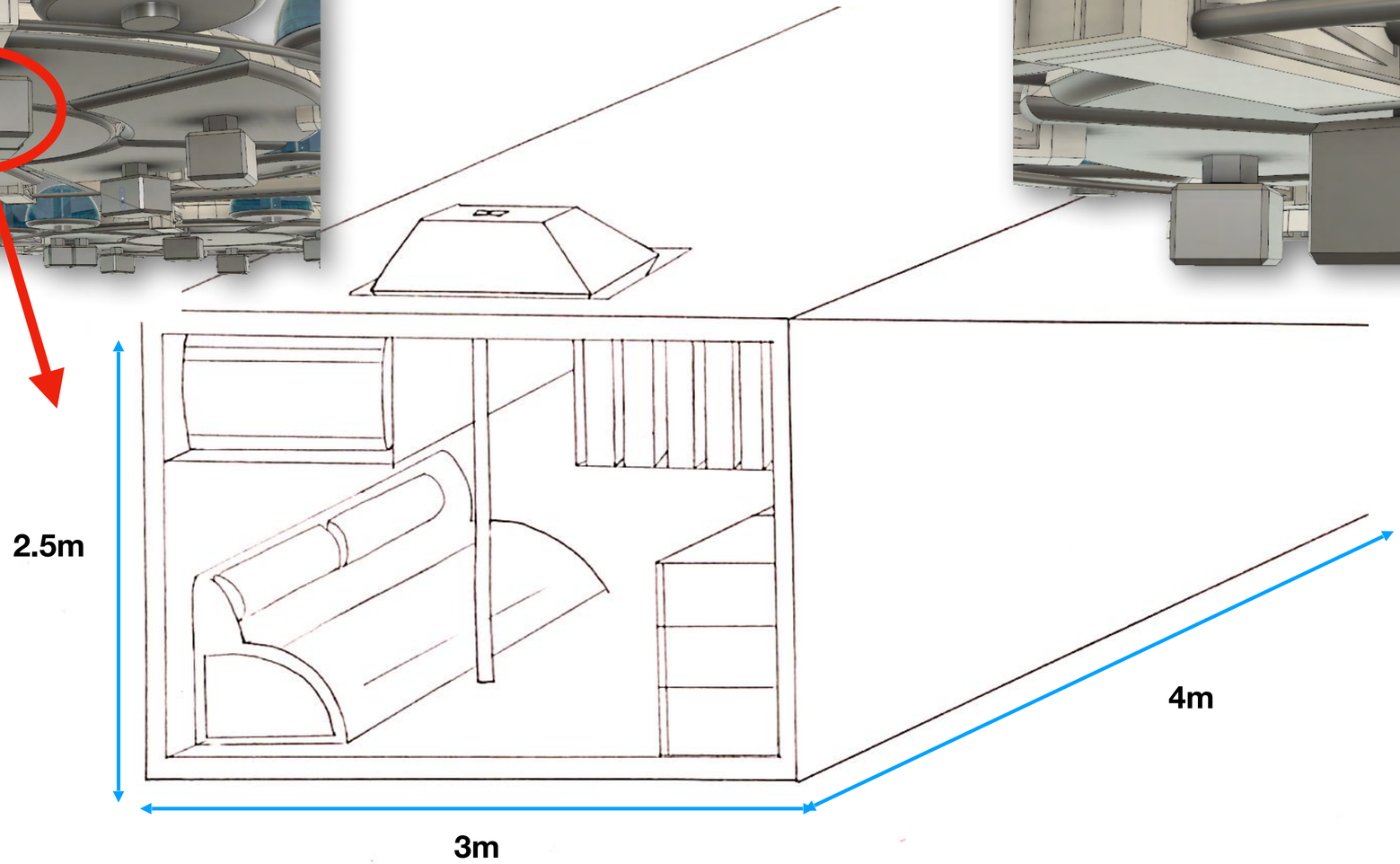



RFP 4.3

# Emergency Basement

Artemis



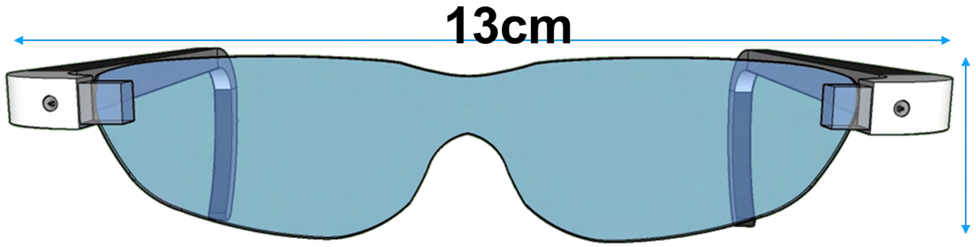



RFP
4.3

# Automation Devices

Artemis

**Reduce routine tasks & increase efficiency**

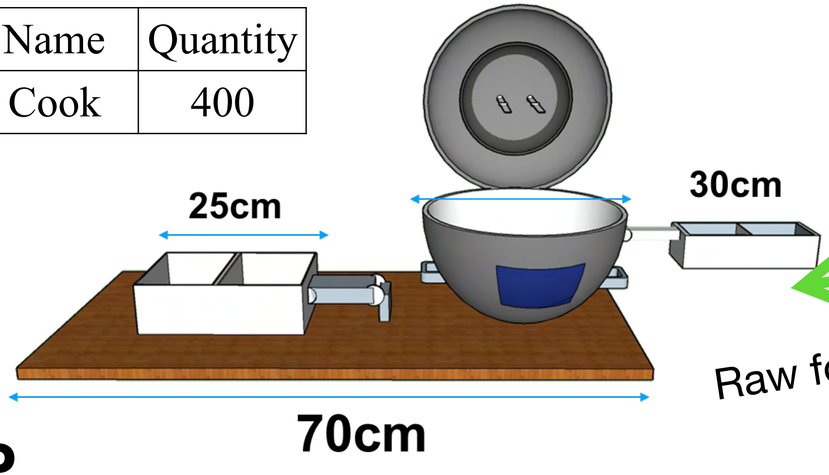



Multifunction sunglasses
- GPS
- Communication
- AI server

**3cm**

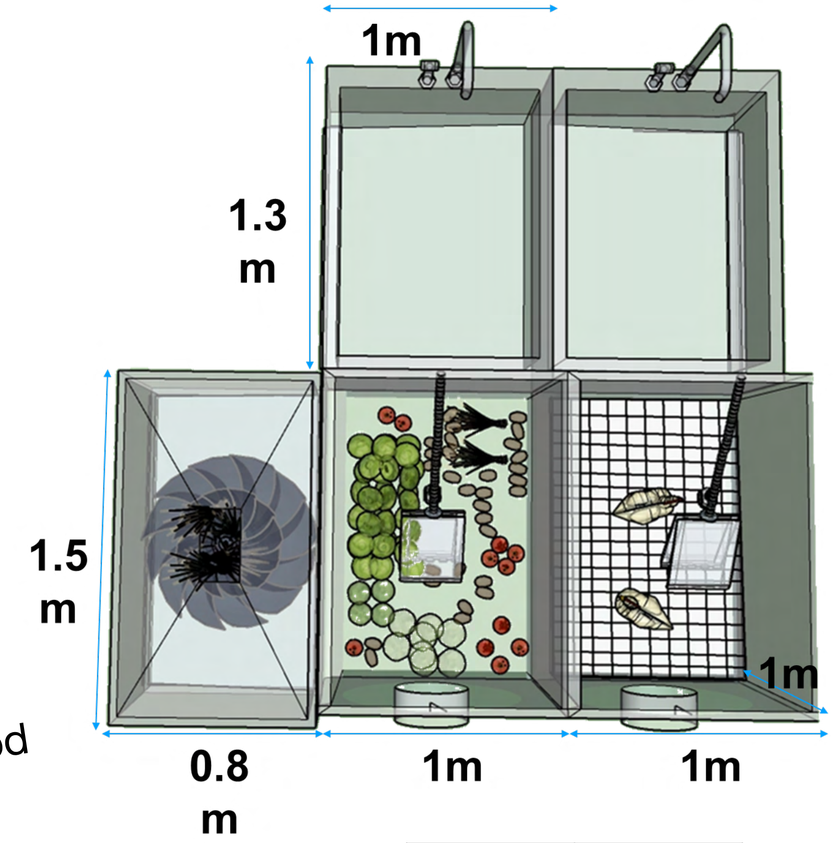
| Name | Quantity |
|---|---|
| Super G | 400 |

| Name | Quantity |
|---|---|
| Cook | 400 |




Raw food from pipes→processed food

Cooking Machines 1



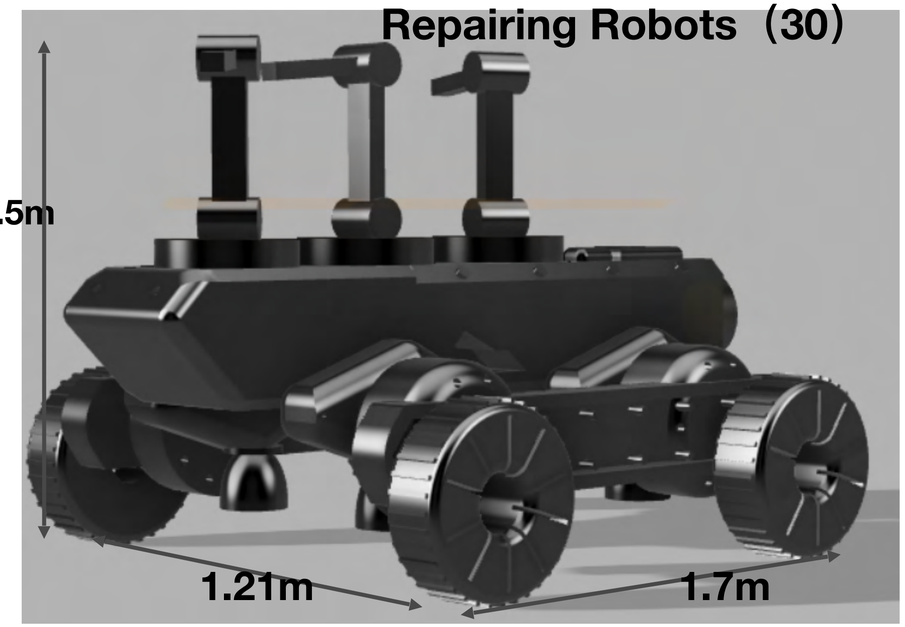

| Name | Quantity |
|---|---|
| R3D | 5 |

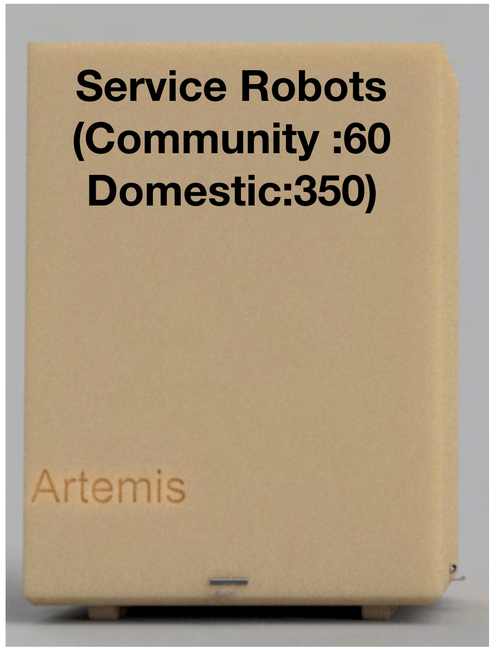
**RFP 4.2**

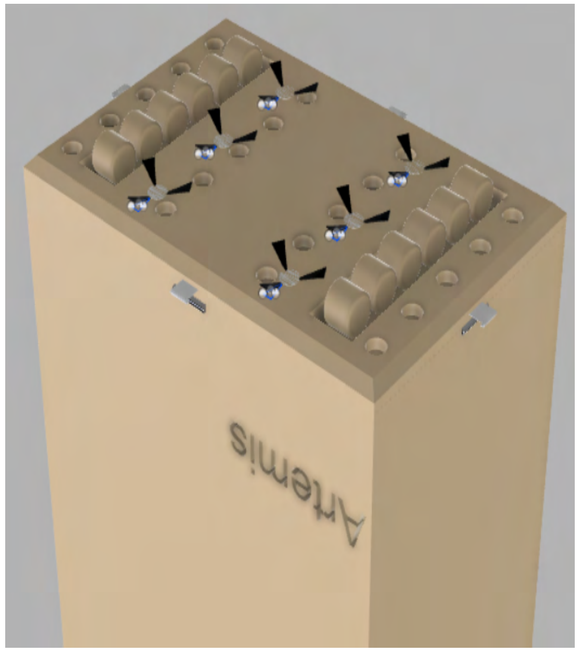
Cooking Machines 2

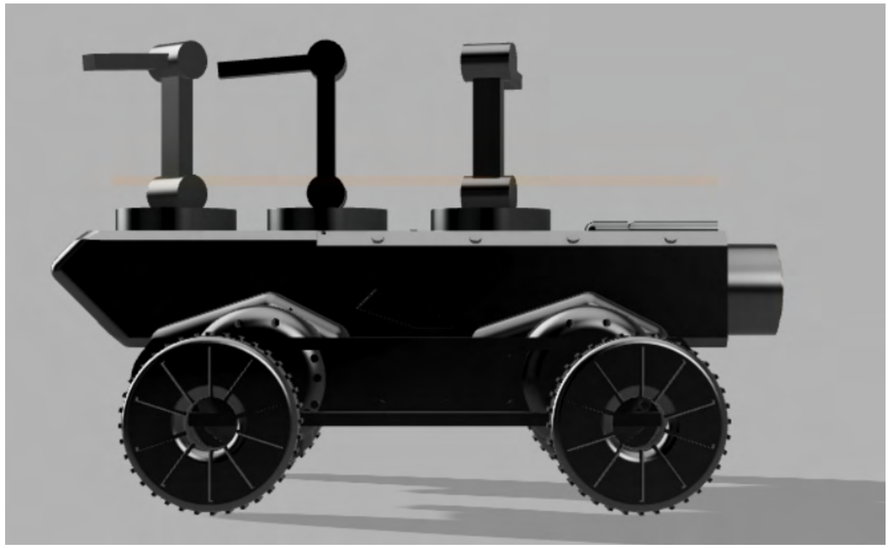
# Residential Automation Facilities

Artemis

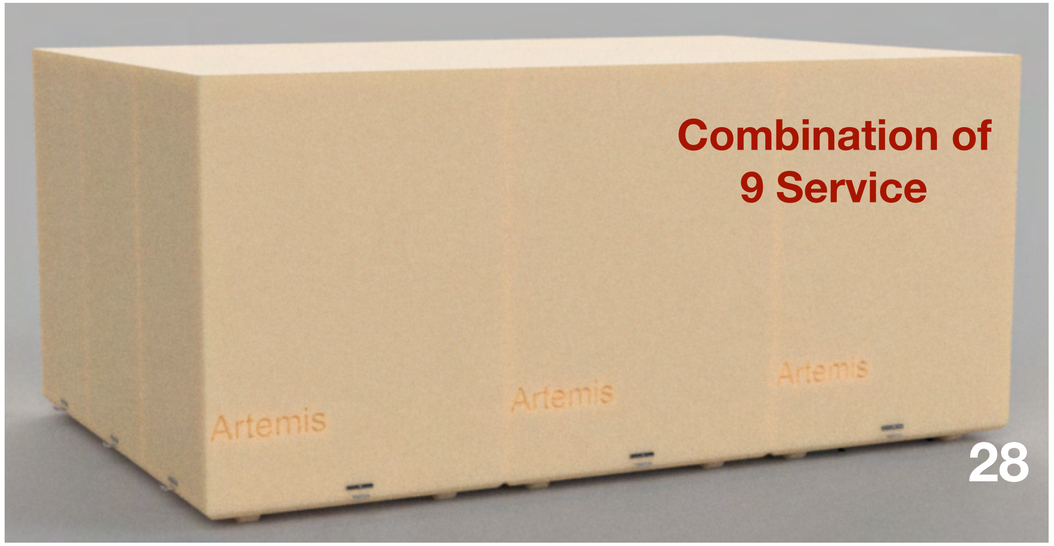


RFP
4.2



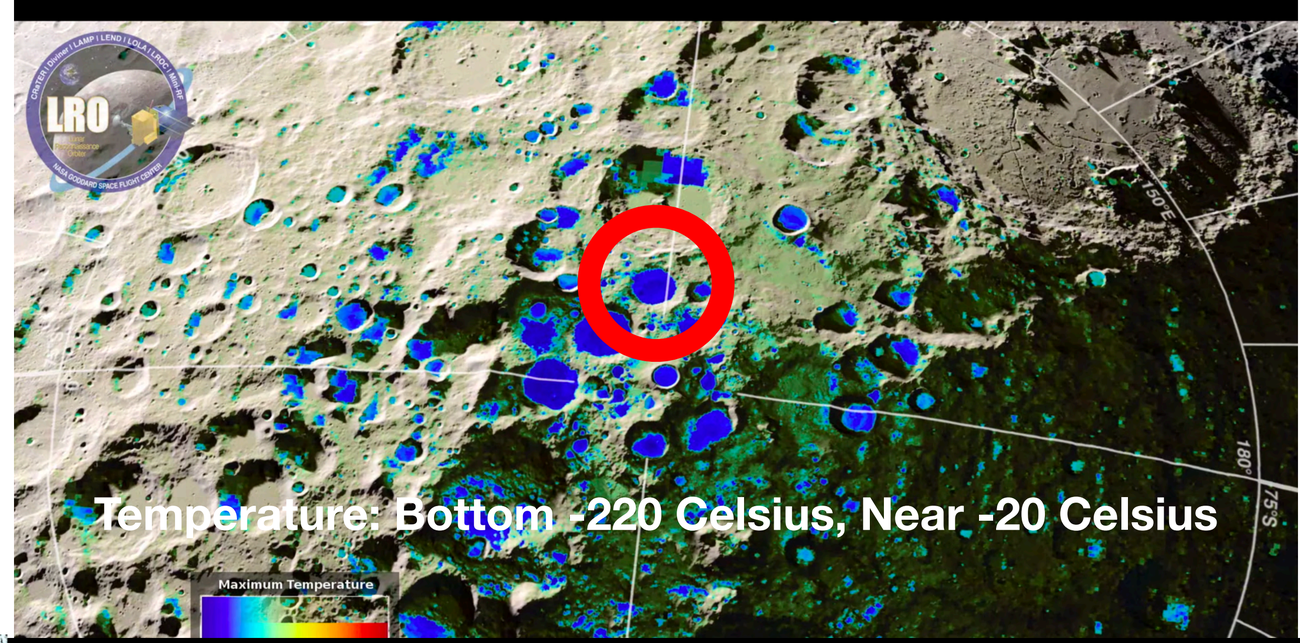
# Lunar Ice Mine Site Choice

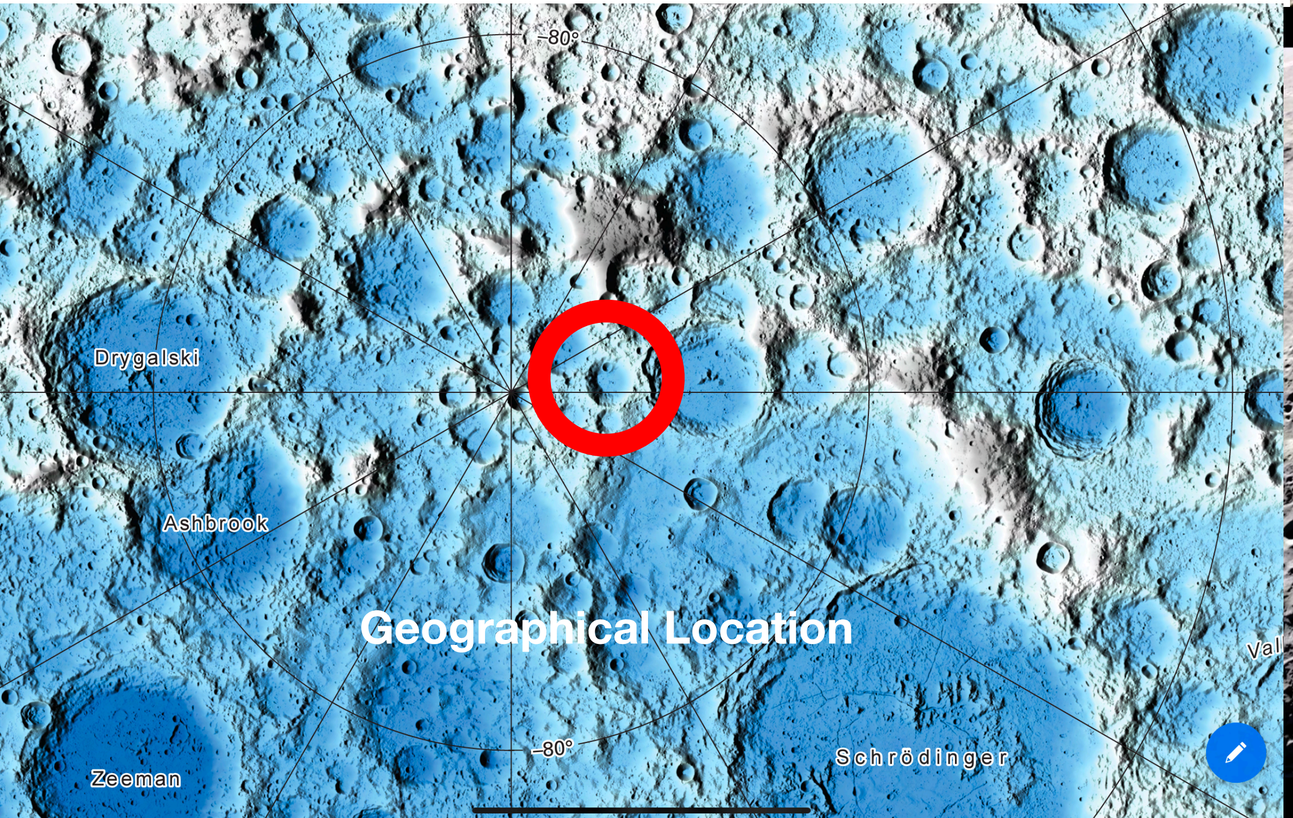
**Abundant Water Ice Resources near south pole**

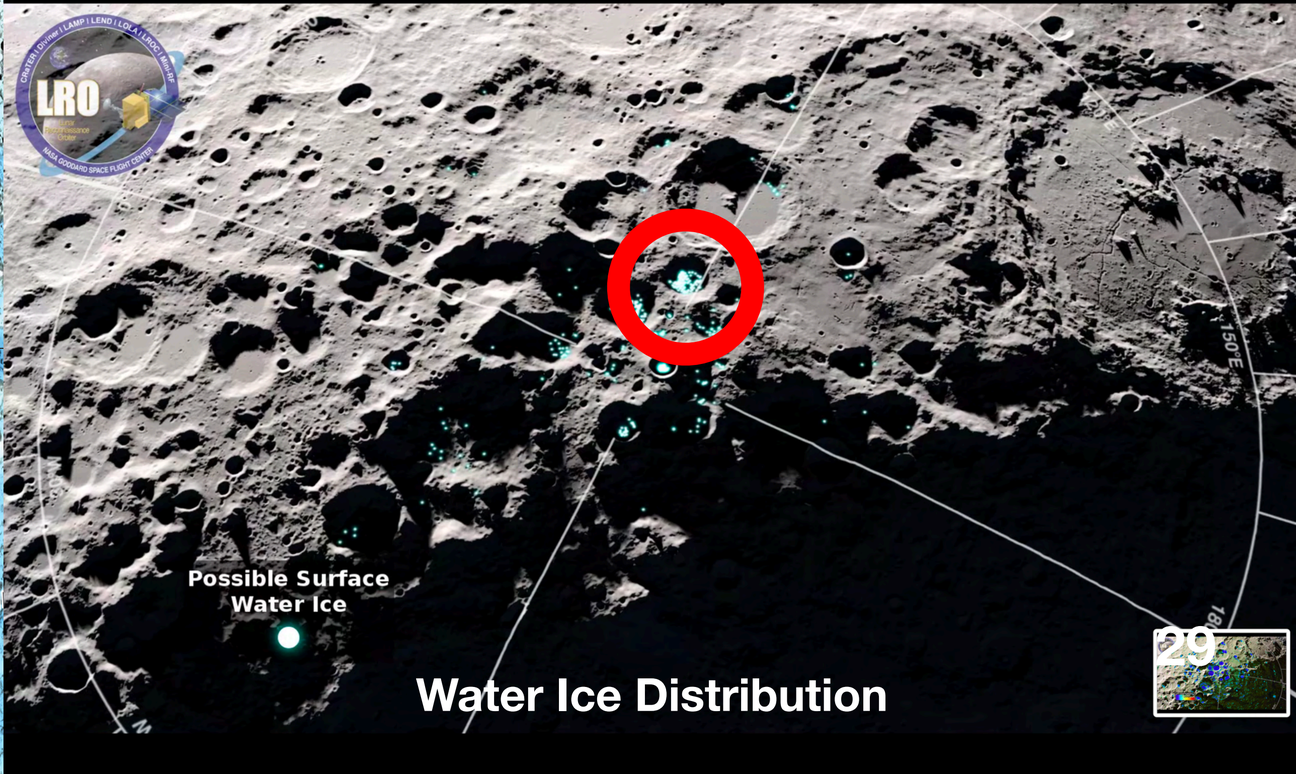
**On the Earth facing side so better for communication**

**Diameter 31km**

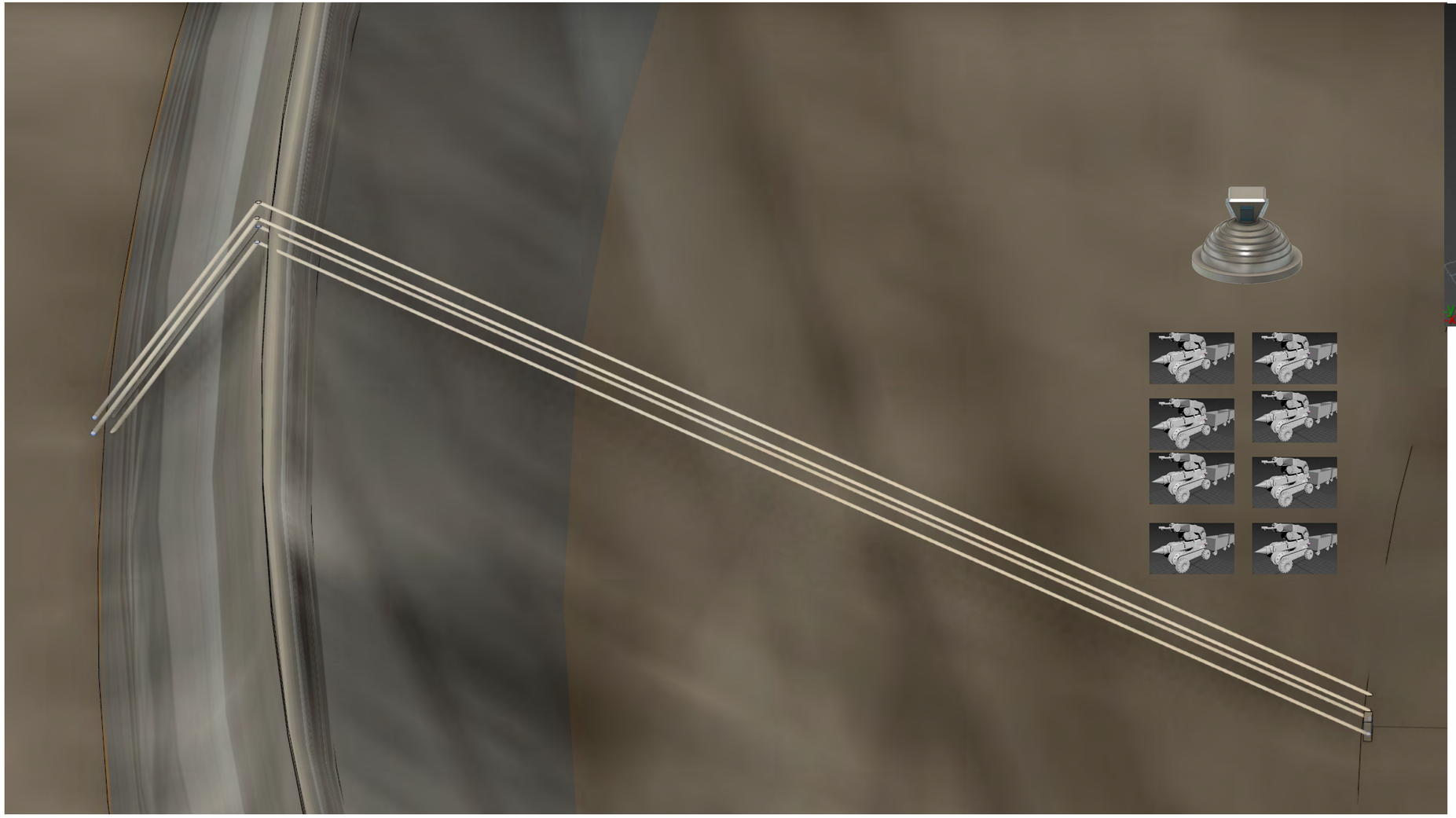
**Lunar crater height 1km**

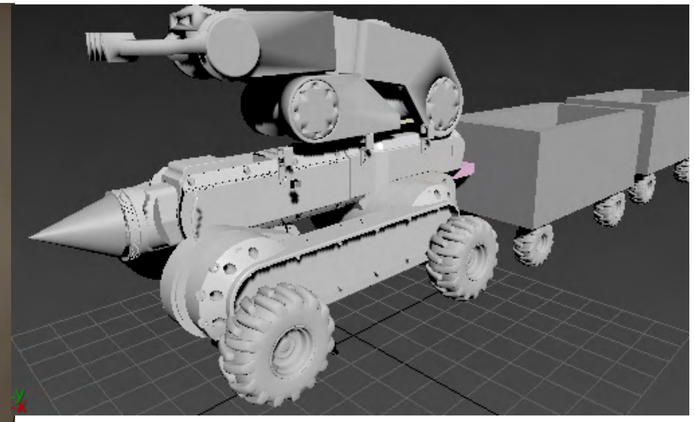


# Exploitation: mining robots



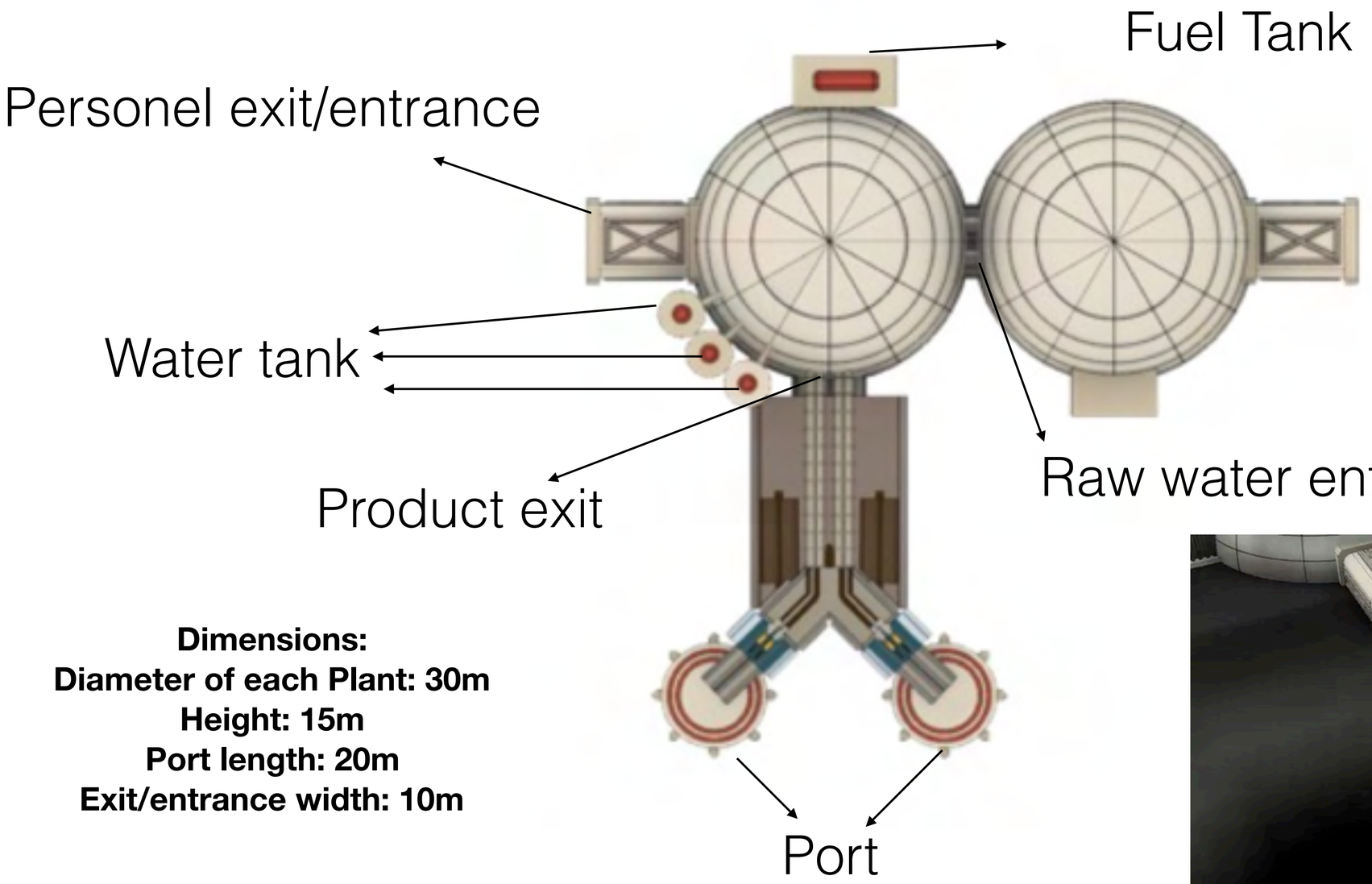


**Mining robot is composed of  a main Cart and two draggers for storage.**

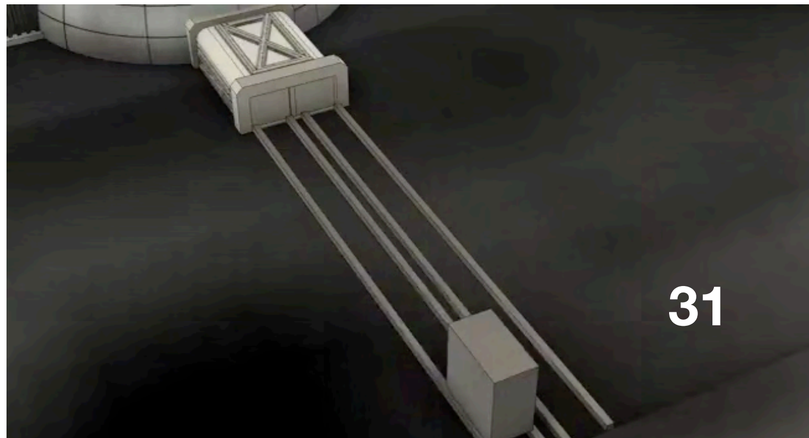
**It is based on same module design As the construction robots**

# Lunar ice processing plant

Artemis



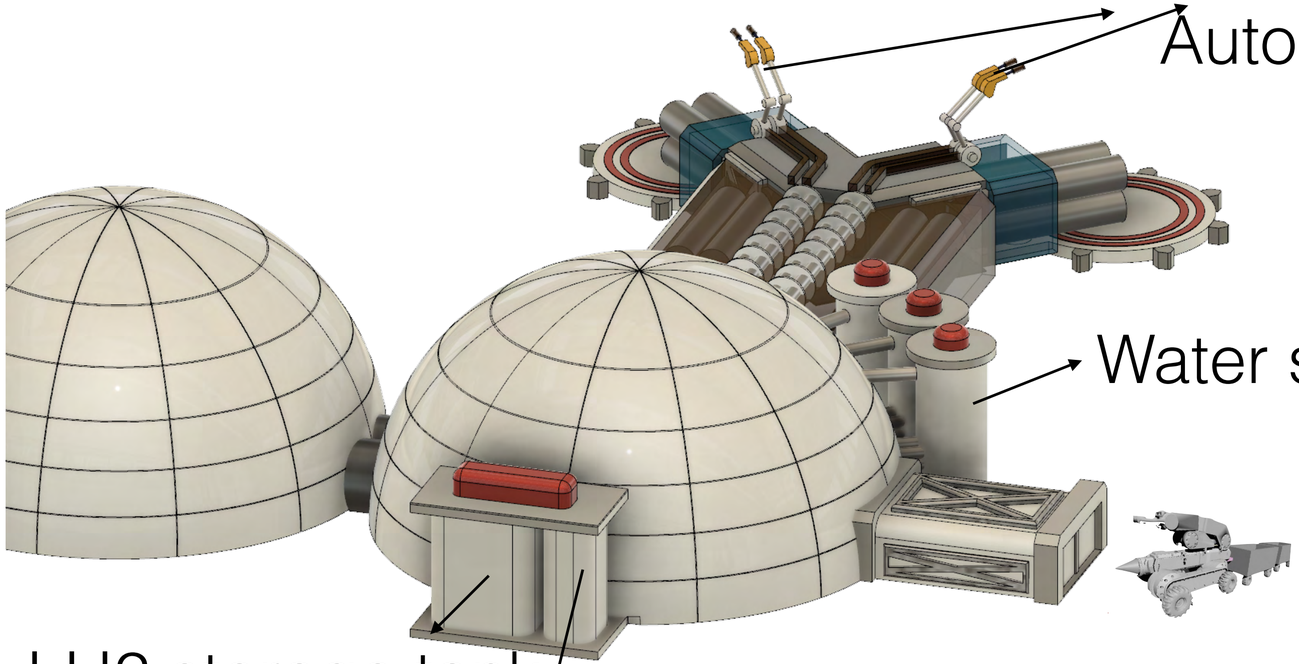

**Dimensions:**
**Diameter of each Plant: 30m**
**Height: 15m**
**Port length: 20m**
**Exit/entrance width: 10m**

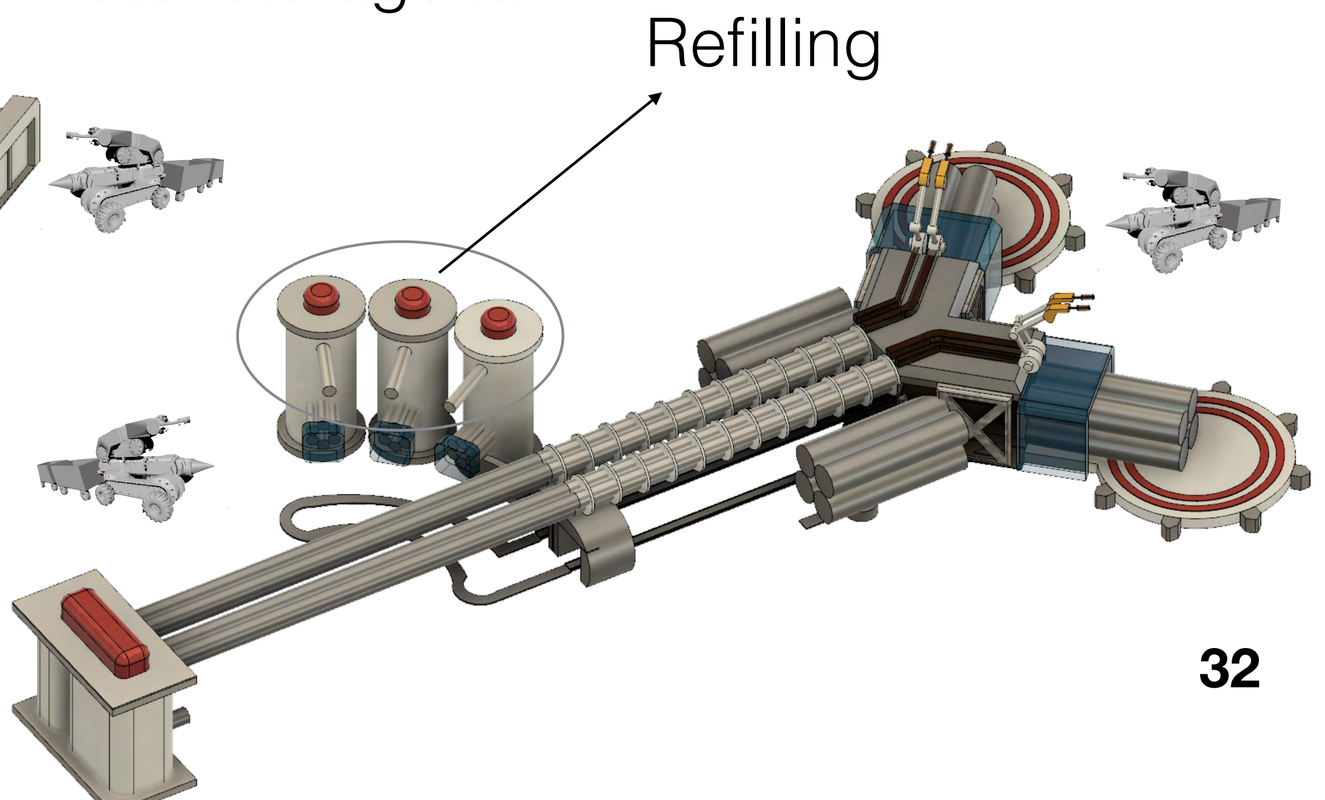


**RFP 5.1**

# Processing: Industrial Area

Artemis



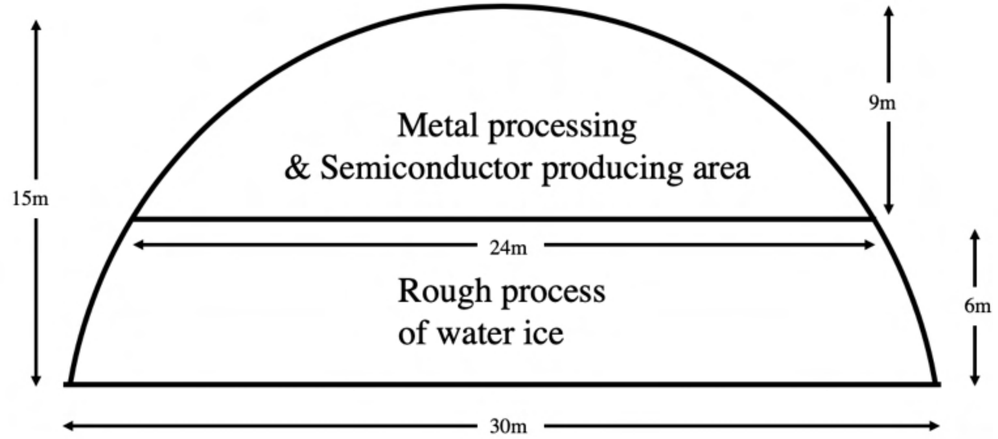




**RFP 5.1**

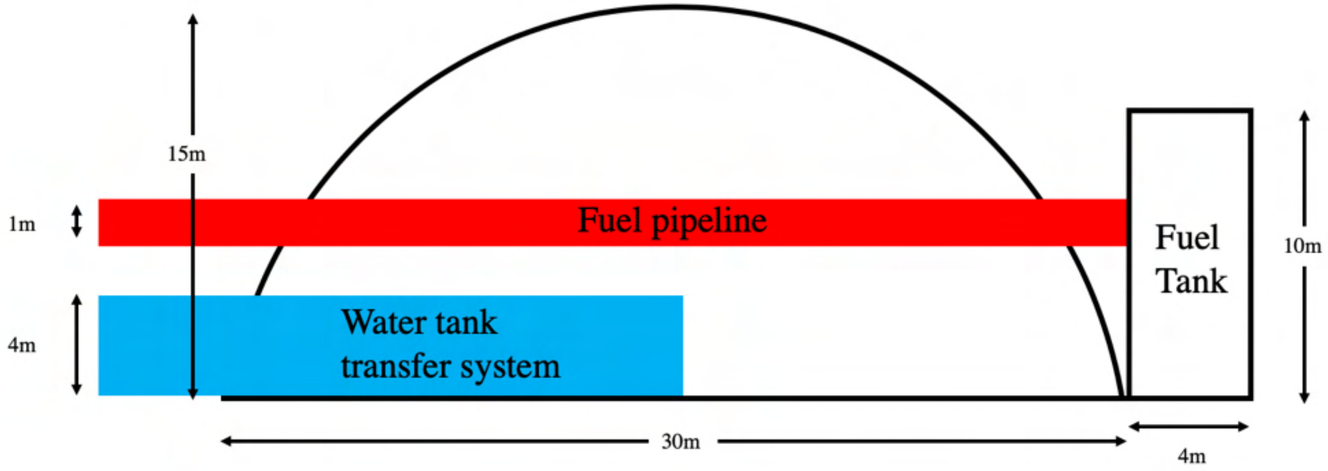
# Industrial area

| | Product area | Area for the rough processing of water | Area for the fine finishing of water |
|---|---|---|---|
| ***Area/m²*** | ***277.45*** | ***706.5*** | ***706.5*** |
| ***Volume/m³*** | ***3052*** | ***4012.9*** | ***7065*** |

Industrial Area




Industry Plant

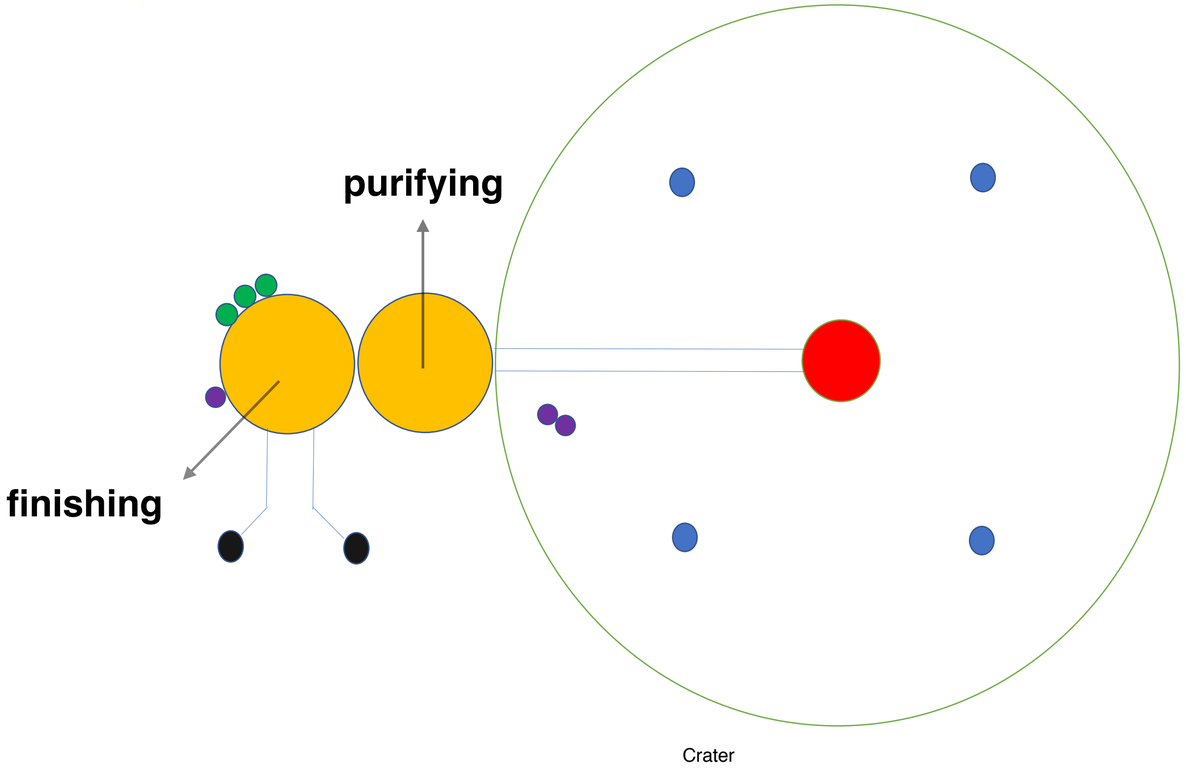



RFP
5.1

*Thickness of the shell: 0.45m

# Processing of Lunar Water Ice

Artemis



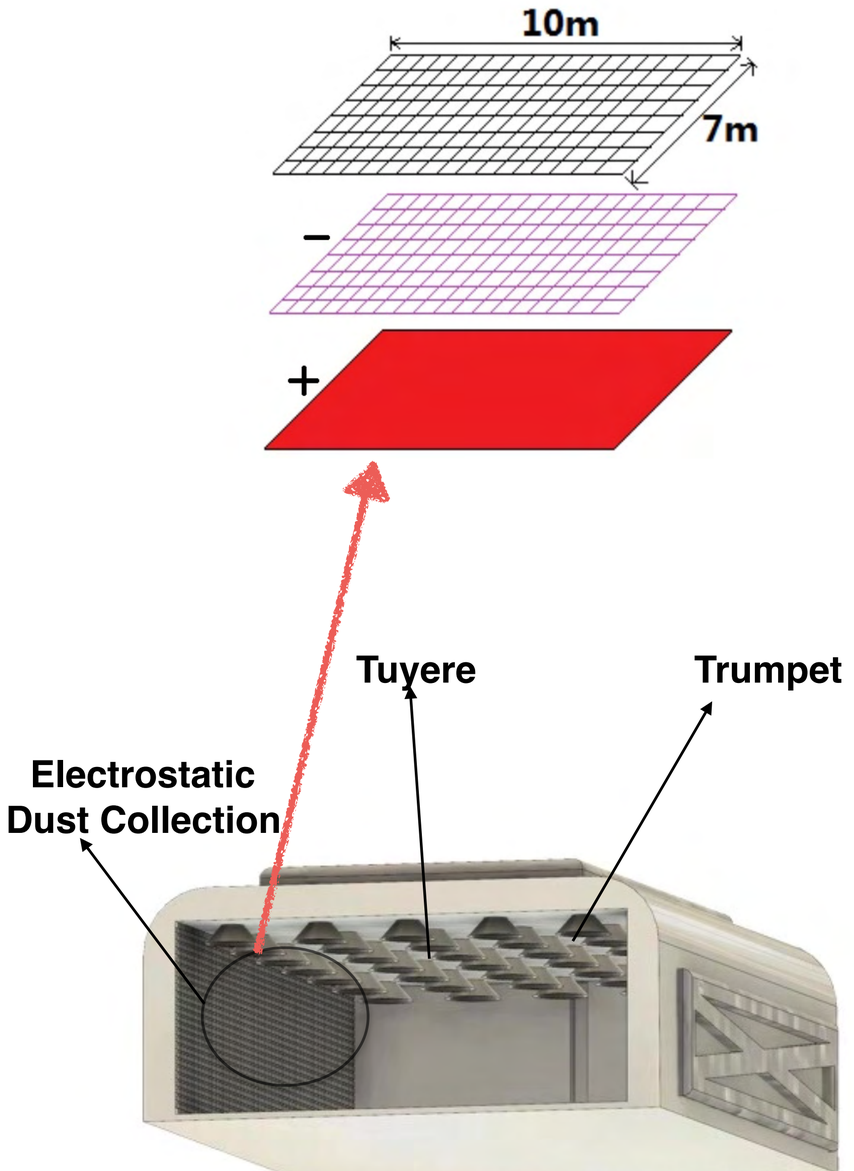

Collection

Port

Monitor

LH2 storage

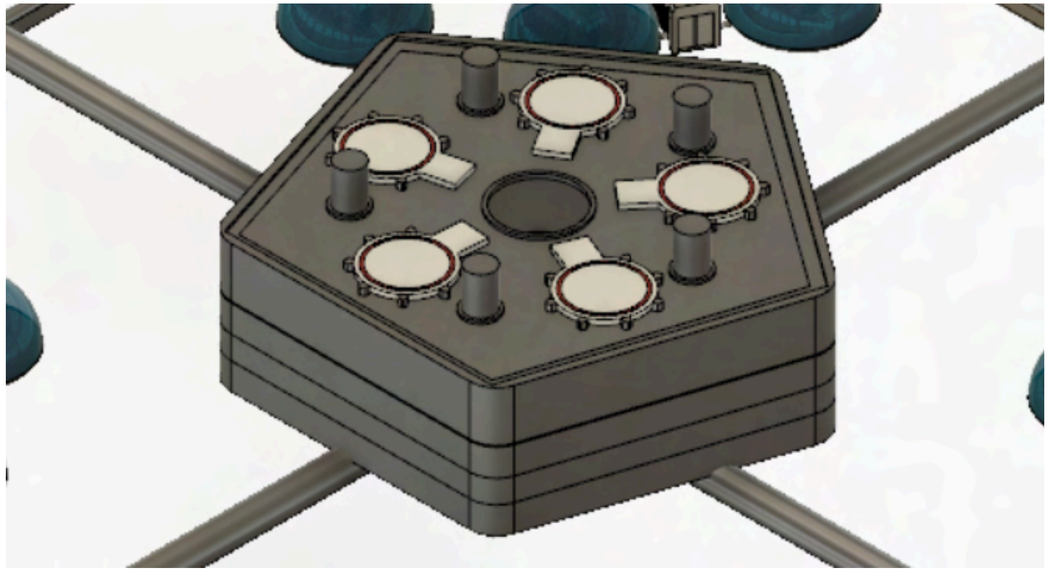
LOX storage

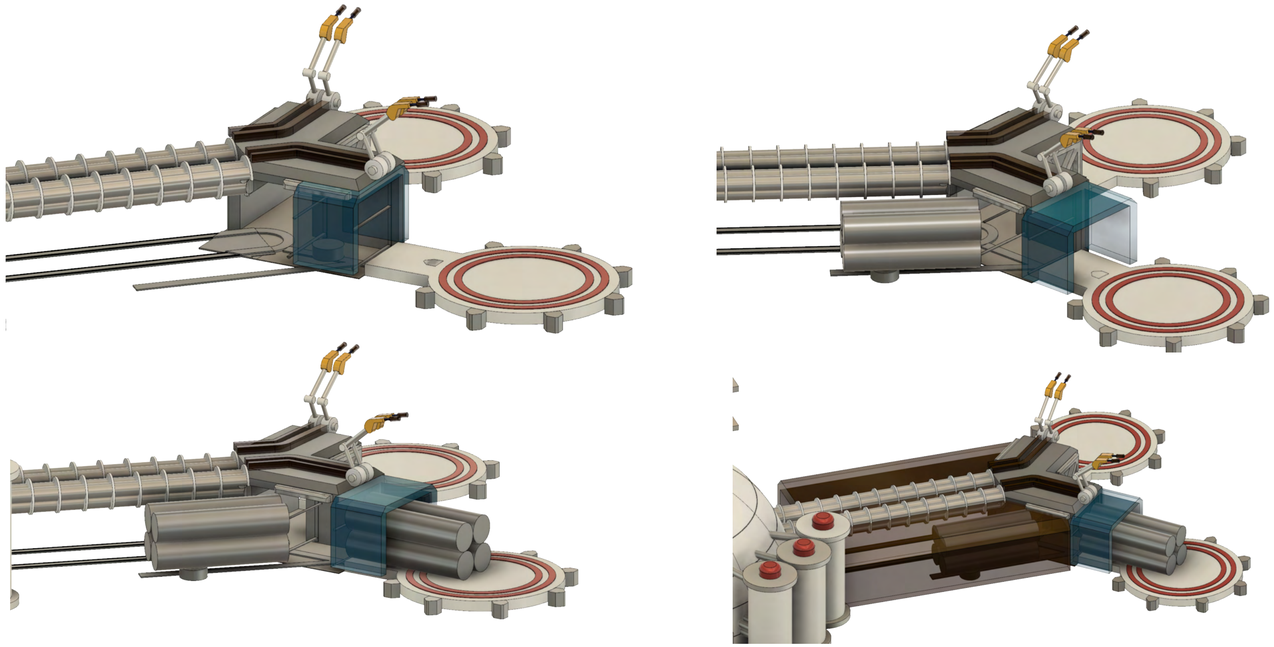



RFP 5.1

# Development: Spacecraft Fuel Supply

Artemis





**Port for cargo ships to recover fuel**

**Port for supply ships to transfer fuel to LX-1**

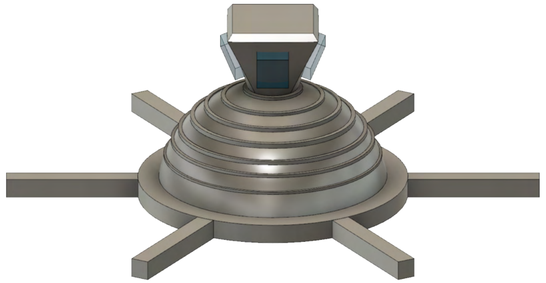
**Dimensions:**
**Length of port side: 20m**
**Height: 8m**
**Port length: 10m**
**Center hole diamter: 6m**

**RFP 5.2**

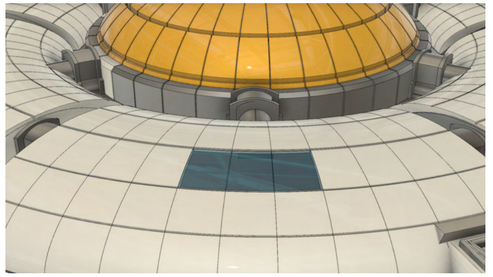
# Space Tourism



- External tourism
  - Travel on lunar vehicles to appreciate overall design of the base
  - Visit the production line of mineral processing
- Internal tourism
  - Science lecture
  - Star-gazing on the moon
  - Visiting museum which records the development of ‘IDUN’
  - Shopping
  - Using lunar materials to apply the 3D printing technology



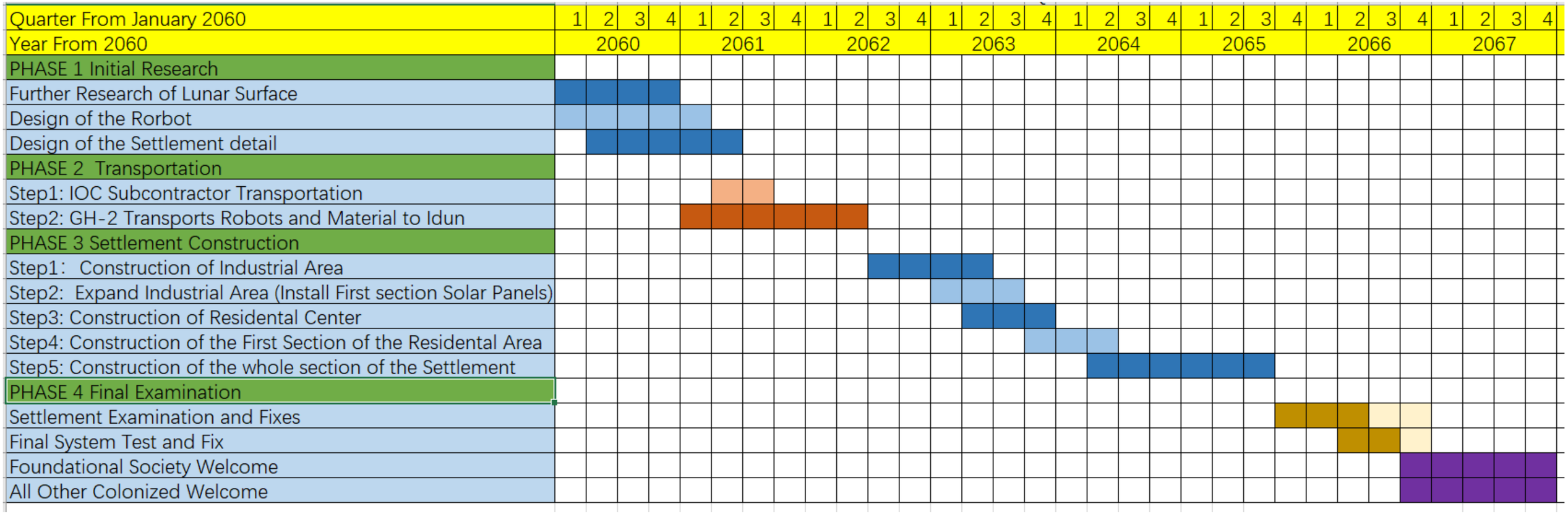
**Dimensions of observing hub**
**Diameter: 6m**
**Height: 4m**
**Length of a leg: 3m**



**RFP 5.3**

# Construction Schedule

Artemis




RFP
6.1

# Robot Manage Table



| | Amount(Phase1) | Amount(Phase2) | Amount(Phase3) |
|---|---|---|---|
| External Construction Robots | 5 | 40 | 10 |
| Internal Construction  Robots | 0 | 20 | 5 |
| Transportation Cargo | 10 | 10 | 10 |
| Cooking Robots | 0 | 0 | 30 |
| Repairing Robots | 0 | 0 | 20 |

RFP 6.1

# Total Cost



## TOTAL COST: 109.9B RMB

| | salary (constructing process) | salary (after automation) | | the cost of the technology | launch cost |
|---|---|---|---|---|---|
| Artemis | 50*50000*12 | | | 100000000 | |
| Lunar express | 50*50000*12 | | | 1000000000 | 10000000 |
| Interplanetary energy | 50*50000*12 | 200*90000*12=216000000 | | 100000000 | 100000000 |
| Ecoline Corp. | 50*50000*12 | | | 30000000000 | 20000000000 |
| Space Roaming Corp. | 50*50000*12 | | | 100000000 | 1000000000 |
| | | Total human capital cost: | 3660000001RMB/year | Total: | 52.41 billion RMB |
| | | | Launch cost of industrial area | 0.125*13000*1000*20000 | 32.5 billion RMB |

**The cost of human factors**

| Materials | Origin | Unit/kg | Unit price | Transport (RMB/kg) | Cost (billion yuan) |
|---|---|---|---|---|---|
| **Aigis** | Earth | 8556381 | 869.6 | 2000 | 24.6 |
| **Al** | Moon | 5756355 | | 0 | 0 |
| **Ti** | Moon | 86345326 | | 0 | 0 |
| **Si** | Moon | 8556381 | | 0 | 0 |
| **Fe** | Moon | 600000 | | 0 | 0 |

**Operational cost**

| | | | | | |
|---|---|---|---|---|---|
| **Glass** | Moon | 1660000 | 0 | 0 | 0 |
| **Cu** | Moon | 78400 | 0 | 0 | 0 |
| **Ti-Fe Alloy** | Moon | 1381967.35 | 0 | 0 | 0 |
| **Solar panel** | Moon | 451200 | 0 | 0 | 0 |

**Structural cost**

| | | | | | |
|---|---|---|---|---|---|
| **Aigis material** | LX-1 | 1213000 | 0 | 50 | 0.1 |
| **Nano-porous silicon ma** | Earth | 10000 | 1.5 | 20000 | 0.2 |
| **Ti-Fe Alloy** | Moon | 11000000 | 0 | 0 | 0 |
| | | | | | |
| | The total cost will be around 109.81 billion RMB | | | | |

RFP 6.1

# Estimate recovery of facilities



- Recover the module shell of the residential areas and industrial area
- Recover the rails by disassembling
- Recover the machines in the industry plants
- Recover the radars and solar panels
- Recover the robots by modulizing

**RFP 6.2**