

LUNAR HOUSING SIMULATOR

~~Justifications for---~~

Introduction.

The Lunar Housing Simulator is envisioned as a structural complex in which to develop the design criteria and operational protocol for an actual lunar base. Its operation will be a combined program of engineering and biological research and development necessary to the establishment of a lunar base.

2 It is required that all lunar conditions which can be simulated be imposed in order that transition from LHS operation to true lunar base operation involve as few unknowns as possible. Manned lunar base function implies the necessity for routine operation outside the house in space suits. These operations will include exploration, astronomy, construction, material collection and analysis, and ultimately vacuum research and manufacturing.

Internal operation on the basis of a closed ecological system requires the minimum loss of matter - much less than could be tolerated by leak rates associated with a full atmosphere of pressure differential in a reasonably structured enclosure.

Justifications for---

Outer shell

4. Research Potential

Engineering research-

A. To simulate the actual operational situation by providing a vacuum surround.

B. By virtue of the vacuum surround provide the capability for -

- Combine
1. Structures research and development (actual construction methods in a vacuum)
 2. Testing of structural designs

- Combine
3. R & D on sealing techniques
 4. Testing of sealing techniques under operational conditions

3. R & D and testing of leak detection methods, and temporary and permanent repairs.

6. Heat transfer research under operational conditions. Low energy radiation research.

Replace with

omit

7. Operational testing to point up design deficiencies and to further refine design criteria.

C. Provide large evacuated area for vacuum research in connection with integrated program of manned lunar base operation.

Biological Research

A. Space suit R & D - testing of suits under operational conditions (pressure, temperature, humidity, oxygen, Carbon dioxide regulation, mobility, etc.)

1. Effects of radiation (U.V., intense visible light, etc.) on space suit materials.

2. Correlation of work activities (construction techniques, etc.) with the tolerance of the individual for such activities in a long term program of work-rest cycle.

B. Simulate the operational environment of the lunar base from the psychological standpoint. ~~Present space cabin simulators (including S.A.M.'s new 2-man simulator) cannot provide this stress. Pressure change resulting from simulated puncture of these cabins would be unrealistic and in favor of the subject; in the LHS the result would be realistic.~~

C. ~~No present~~ Facility can provide an operational environment which could continue for days, weeks or months. *Present facilities cannot do this.*

D. Operation of a ~~nearly~~ completely sealed, ~~nearly~~ completely self-sufficient system on a long term basis ~~on a long term basis~~ with an absolute minimum requirement for ^{re}supply.

X. Methods of air lock operation and leak control to provide least possible loss of atmosphere.

Reduced Pressure Environment

A. O₂ leak rate. No outside source for atmosphere as in pressurized aircraft.

Must be replenished from stored source. Therefore, can't afford a leak.

1) 1 atmosphere increases leak potential with more severe physiological

B.5 under
Engineering
Research

effects; increasing requirement for O₂ replenishment.

2) Reduces structural requirements (except for radiation shielding)

B) Present knowledge indicated there is no contraindication for use of 1/2 - 1/3 of an atmosphere, but there are also indications for further research in this area such as:

- 1) Body susceptibility to bacterial invasion under reduced pressures (connective tissue permeability)
- 2) Immune response - change of antibody titer under reduced pressures.
- 3) Effect of reduced pressures on germination of seeds, plant growth and product.
(Nothing has been done in this area)
- 4) Atmosphere composition research
- 5) Atmosphere composition controls problems made easier by reduced pressure

III

It is important to integrate all research on closed ecologies in one facility, test concept of operation, and component systems before actually designing a lunar base.

The lunar housing simulator is envisioned ^{to develop} as a structural complex in which the design criteria and operational protocol for an actual lunar base.

Its operation will be a combined program of engineering and biological research and development necessary to the establishment of a lunar base.

It is required that all ^{lunar} conditions that can be simulated be imposed in order that transition from LHS operation to true lunar base operation involve as few unknowns as possible.

Manned lunar base function implies the necessity for routine operation outside the house in space suits. These operations will include exploration, ~~scientific experimentation~~ construction, astronomy, material collection and analysis and ultimately vacuum research and manufacturing ~~and~~

Internal operation on the basis of a closed ecological system requires the minimum loss of matter - much less than could be tolerated by leak rates associated with full atmosphere pressure differential in a reasonably structured enclosure.

Lunar Housing Simulator - Justifications for -

I Outer Shell

Engineering Research

1. To simulate actual operational situation by providing vacuum surround.
2. By virtue of vacuum surround provide capability for.
 - A. Structures research & development (actual construction methods in vacuum)
 - B. Testing of structural designs
 - C. Sealing techniques R & D
 - D. Testing of sealing techniques under operational conditions.
 - E. R & D, & testing, on leak detection methods, temporary & permanent repairs
 - F. Heat transfer research under operational conditions
Low energy radiation research.
 - G. Operational testing to point up design deficiencies, and to further refine design criteria.
3. Provide large evacuated area for vacuum research in connection with integrated program of manned lunar base operation.

Final Statement of Intent

Biological Research

1. Space Suit R & D - testing of suits under operational conditions (temperature, humidity, O_2 & CO_2 regulation; mobility, etc).
 - A. Effects of radiation (U.V., intense visible light etc) on space suit materials.
 - B. Correlation of work activities (construction techniques etc) with tolerance of the individual for such activities, in long term program of work & rest cycle.

2. Simulate operational environment of lunar base from psychological standpoint. Present space cabin simulators (including SAM's new 2-man cabin) cannot provide this stress. Pressure change resulting from puncture would be ^{unrealistic and} in favor of subject; in our simulator the result would be realistic.

3. No present facility can provide an operational environment which could continue for days, weeks or months.

5. Methods of air lock operation ^{and leak control} to provide least possible loss of atmosphere.

4. Operation of a ^{nearly} completely sealed, ^{nearly} completely self-sufficient system on a long term basis with an absolute minimum requirement for resupply.

~~B. Recovery of atmospheric oxygen from igneous~~
~~basalts~~

B

II. Reduced pressure environment

A. O-leak rate. No outside source for atmosphere as in pressurized aircraft. Must be provided from within or replenished from stored source. \therefore Can't afford a leak.

1. 1 atmosphere increases leak potential with more severe physiological effects, increasing requirement for O_2 replenishment.
2. Reduces structural requirements (except for radiation shielding).

B. Present knowledge indicates there is no contraindication for use of $\frac{1}{2}$ - $\frac{1}{3}$ of an atmosphere, but there are also indications for further research in this area, such as:

1. Body susceptibility to bacterial invasion under reduced pressures (connective tissue permeability).
2. Immune response - change of antibody titer under reduced pressures.
3. Effect of reduced P on germination of seeds, plant growth + product. (Nothing has been done in this area)
4. Atmosphere composition research.
5. " " controls problems made easier by reduced pressure

III. It is important to integrate all research on closed ecologies in one facility, test concept of operation, and component systems before actually designing a lunar base.