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First Lunar Outpost

Lunar Habitat Concepts and Issues

Third Space Exploration Initiative
Technical Interchange

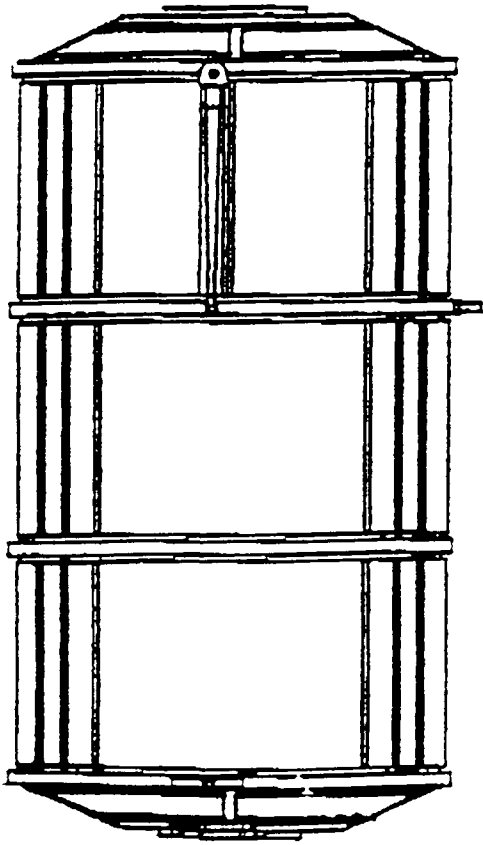
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May 5, 1992

First Lunar Outpost Requirements and Guidelines

- Flight Elements Shall Provide for a First Launch as Early as 1999
- Initial Design for a Mission Capability is a Crew of Four and a Lunar Surface Stay of 45 Days (lunar day-night-day)
- Initial Mass Requirement is 25 mt. (Current Assessment is 31 mt.)
- Existing Hardware is Utilized where Practical (As determined by cost, schedule, risk, and performance impacts and savings)
- Specific Design Goals are:
 - Reuse every six months
 - Provide solar flare protection
 - Enables manned EVA activities
 - Capable of operation anywhere on the lunar surface
 - System test occurs before crew launch
 - Crew surface operations begin within 24 hours of crew arrival
 - Access to all hardware to provide for infinite life
 - Design for growth capabilities

SSF Habitat Module as Lunar Campsite?



SSF Habitat Module Contains:

- * Pressure Shell & Structural Support
- * Galley
- * Housekeeping Equipment
- * Storage
- * ECLSS/ Thermal
- * Power Distribution
- * Wardroom
- * DMS/Communications
- * Hygiene Equipment

Internal Equipment Removed/Reduced:

- * Galley/ Wardroom
- * Hygiene Equipment
- * ECLSS

Additional Equipment Required:

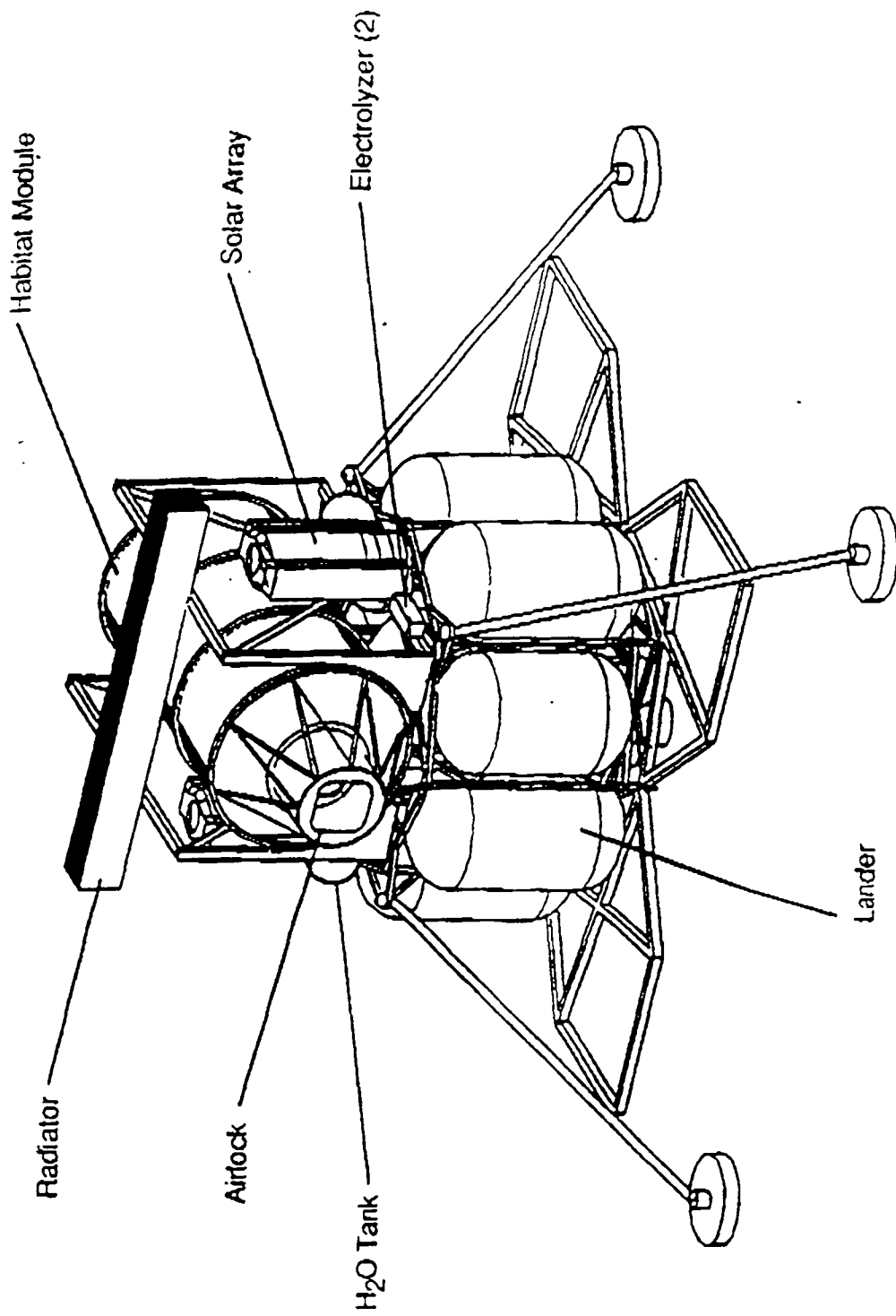
External

- * Energy Source, Converters, & Conditioning
- * External Structures
- * External Fluid Storage
- * Radiators
- * Communications

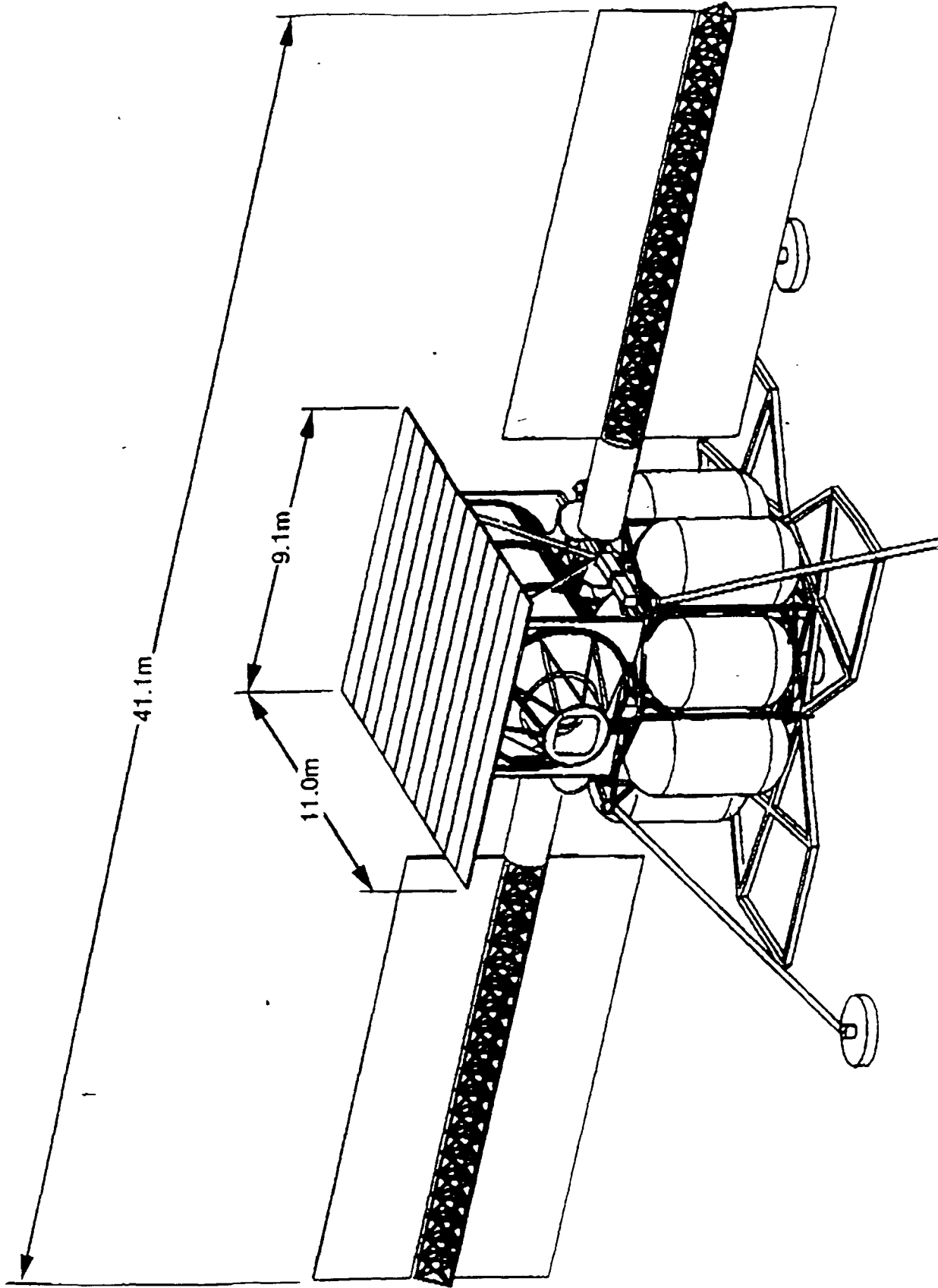
Internal

- * Airlock/EVA Support
- * Maintenance/ Science Support
- * Communications/ DMS Equipment
- * Radiation Protection
- * Medical Capabilities

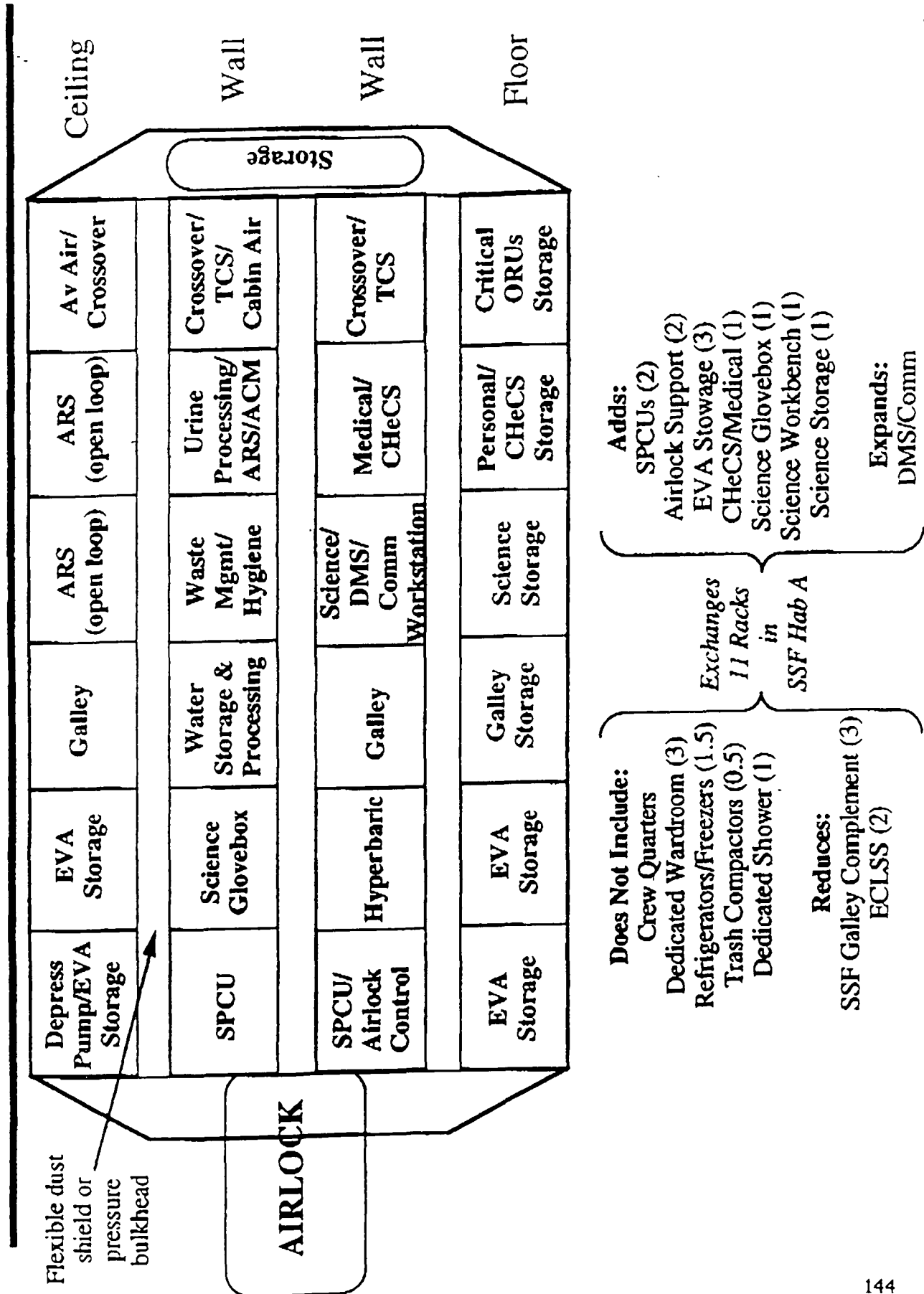
Lunar Habitat Stowed Configuration



Lunar Habitat Space Station Derived



Habitation Module Layout



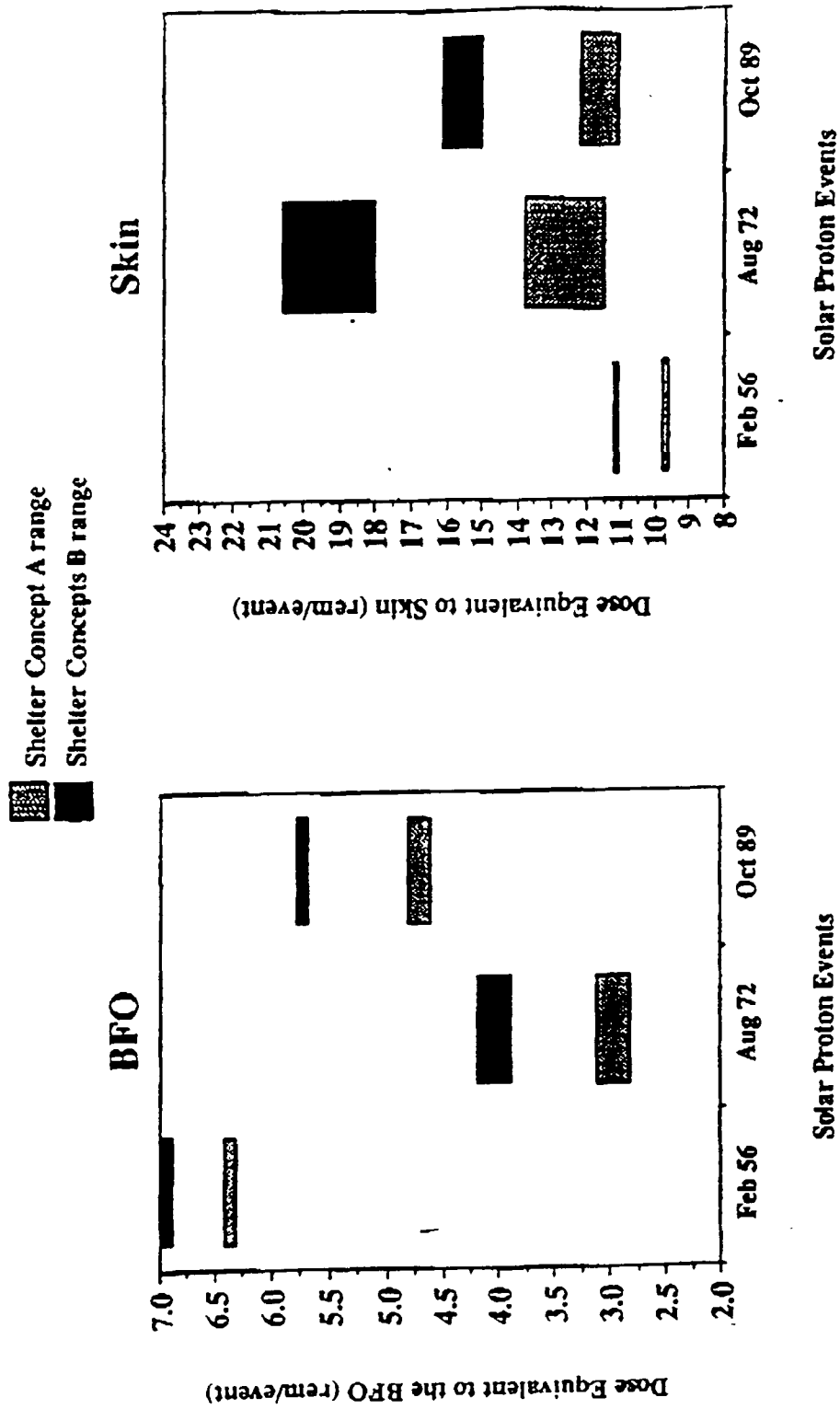


First Lunar Outpost Surface Habitat Mass



	(kg)
Structure and Subsystems	
Module	7302
External Structure	1614
ECLSS	2656
Medical Support/Life Science	445
Crew Systems	1294
Storm Shelter	1000
CDMS	863
Power System	3461
Thermal Control System	1990
Airlock System	4236
Subtotal (Habitat)	24,861
Contingency	2,486
Total (Habitat)	27,347 kg
Consumables	1506
Fuel Cell Reactants	1811
EVA Suits	635
Science Equipment	62
Total (Mass to the Surface)	31,361 kg

Blood Forming Organ and Skin Dose Equivalent Comparison for Shelter Concepts A and B



Dose equivalent rates determined using the Computerized Anatomical Man Model (CAM)

First Lunar Outpost

Initial Study Conclusions

- **A Feasible Habitat Has Been Defined That Can Be Emplaced In One Launch**
- **Habitat and Crew Module Utilize A Common Lander**
- **Habitat Is Derived From SSF Hardware (70% By Weight)**
 - **Module**
 - **Crew Systems**
 - **ECLSS**
 - **Data Management System**
 - **Internal Thermal Control System**
 - **Airlock**
- **Major Development Item Is the Power System (PV/RFC)**
 - **Lifetime**
 - **Reliability**
 - **High Pressure Tankage**

First Lunar Outpost Further Study Efforts and Trades

- **Configuration Options**
 - Space Station Freedom Module
 - Clean Sheet
 - Inflatables

- **Design Definition and Assessments**
 - Detailed Structural Assessment
 - Systems Definition
 - Radiation Shielding Definition
 - Internal Configuration Layouts

- **Consumables Stowage/Transfer Logistics**

- **Growth Scenarios**
 - Joining of Multiple Habitats
 - Offloading and Burying of Habitats

- **Operational Issues (maintenance/dust mitigation)**

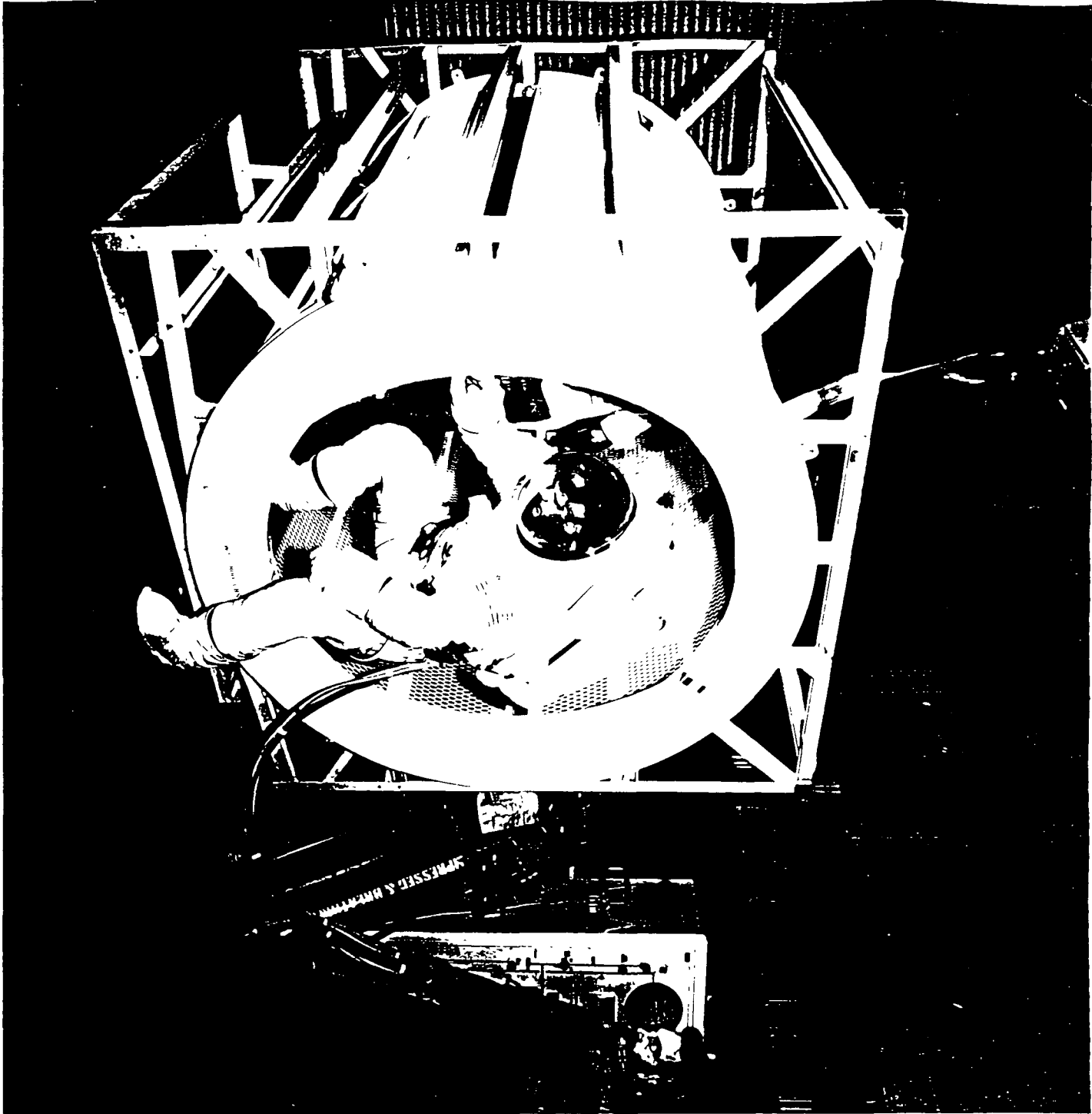
- **Airlock Options/Definition**

- **Integration of Lander and Habitat**

First Lunar Outpost Definition Process



- FLO activity is an on-going requirements development process that will progress through numerous iterations before final selection of technical approach
- Current FLO concepts provide a framework for developing and testing requirements, the concepts are a "first cut" that will be refined considerably as analysis proceeds
- In summary:
 - These approaches are not final and others have not been ruled out
 - Additional concepts, approaches, and issues will be identified and assessed
 - Input from the SEI community has been and continues to be valuable
 - Interim status reviews will continue as FLO products mature



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