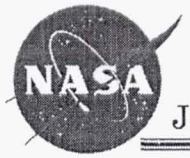

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An Inflatable Habitation Module for Multiple Space Applications

An Overview

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TOPICS

- OVERVIEW
- FEATURES / TESTING
- MATERIAL SELECTION
- CONCLUSION

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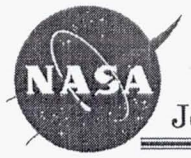

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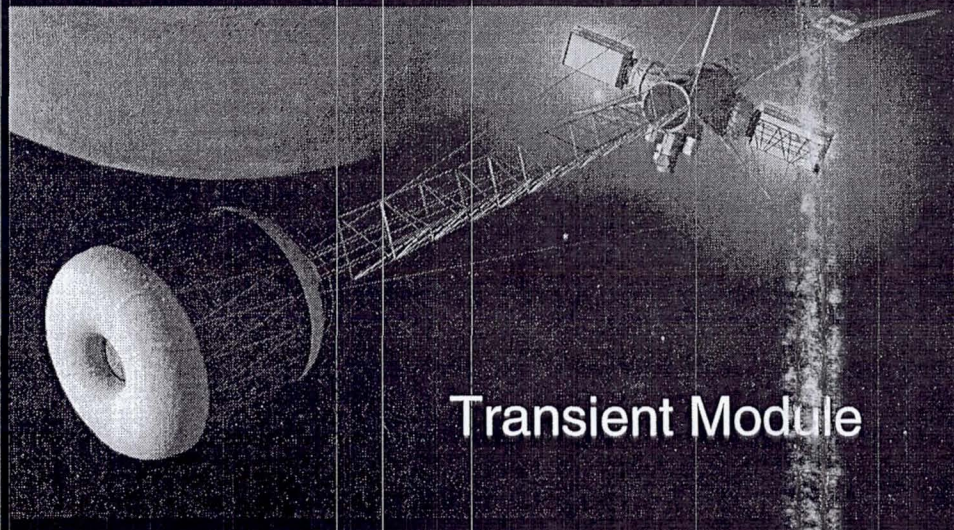
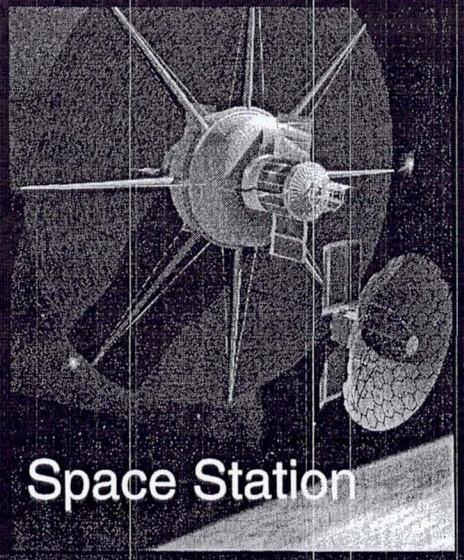
OVERVIEW

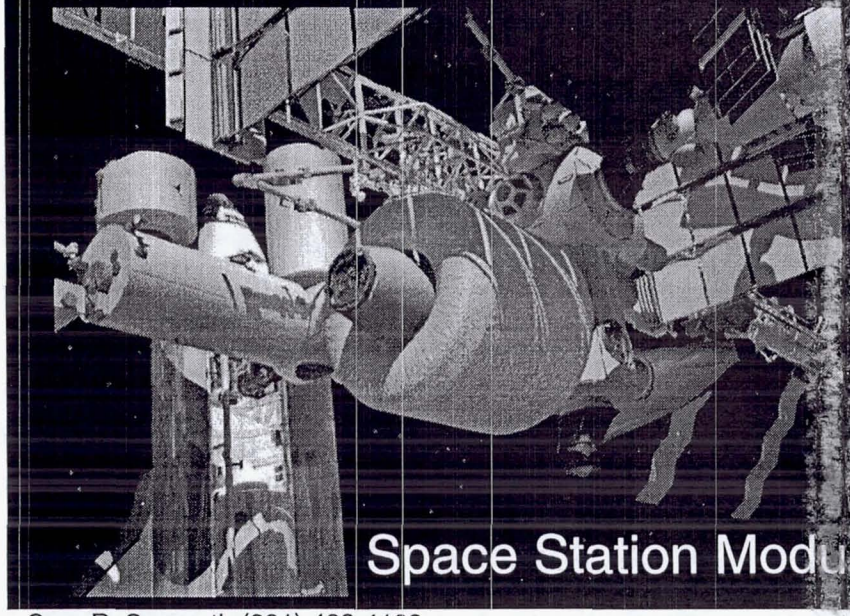
Multiple Space Applications Capability



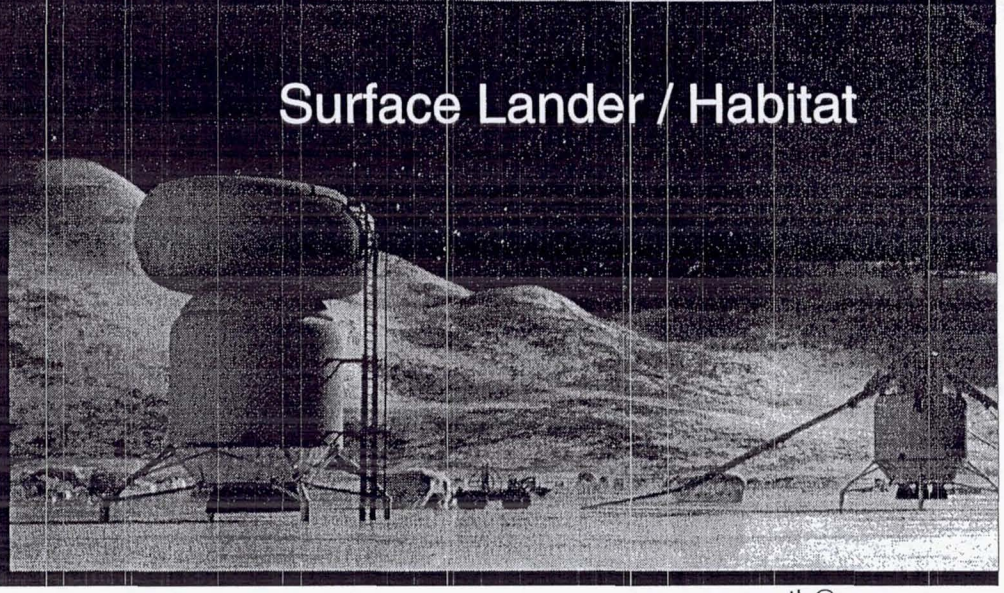
Transient Module



Space Station



Space Station Module



Surface Lander / Habitat

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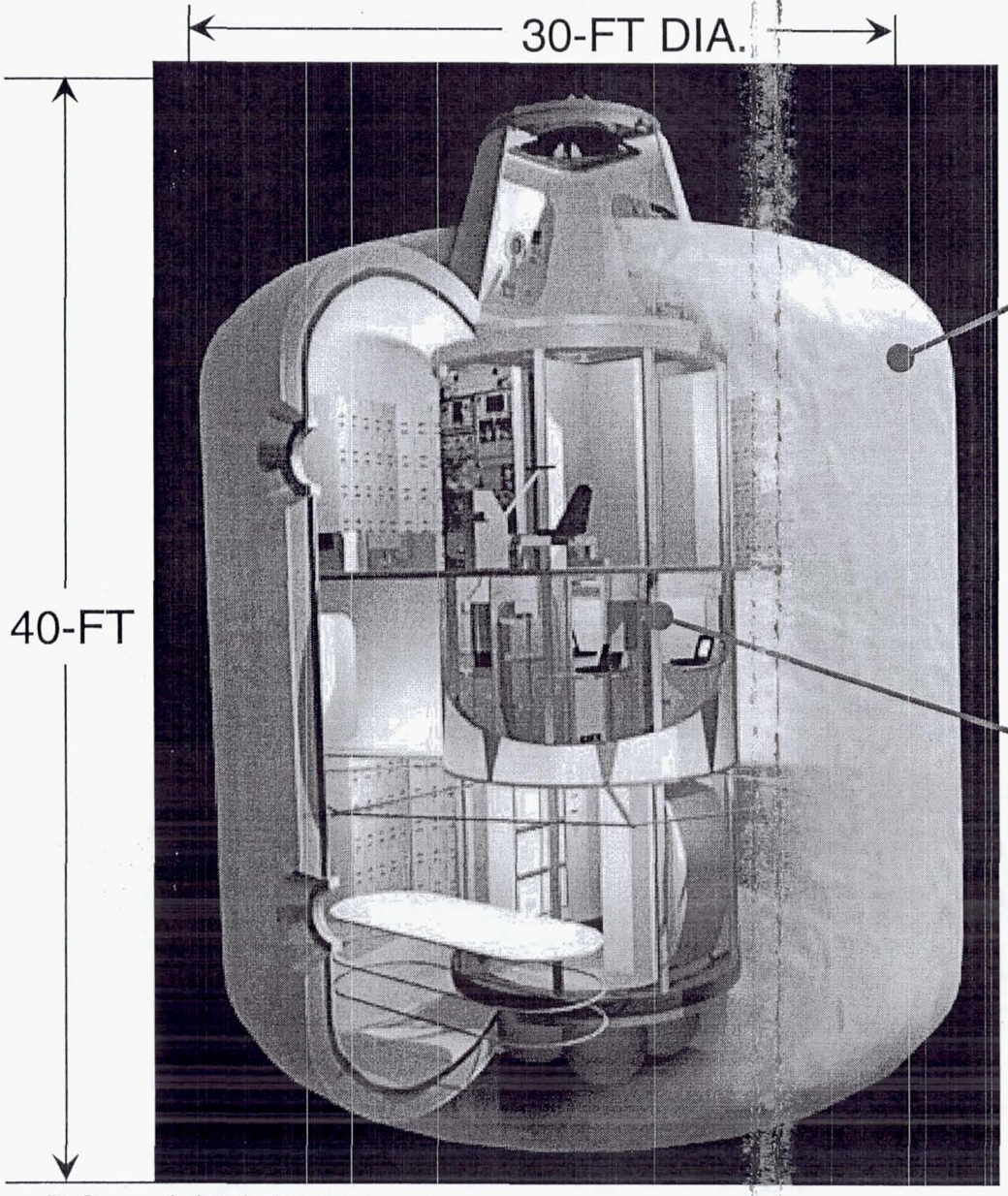
OVERVIEW



(Dimensions may be tailored for specific applications)

Multi-Layer Inflatable Shell
(Folds around core for launch)

Central Structural Core
(Longerons, bulkheads, shear panels)

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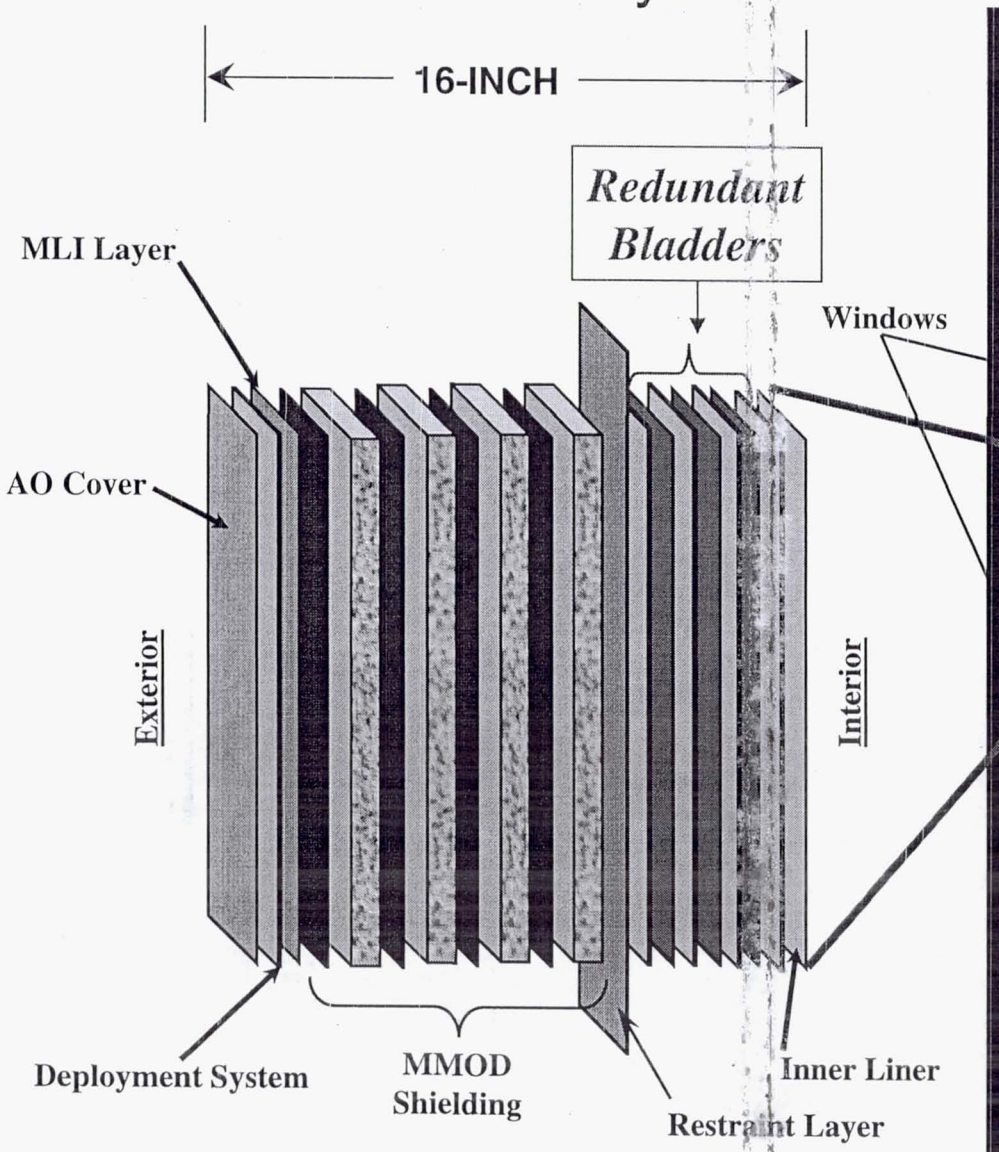
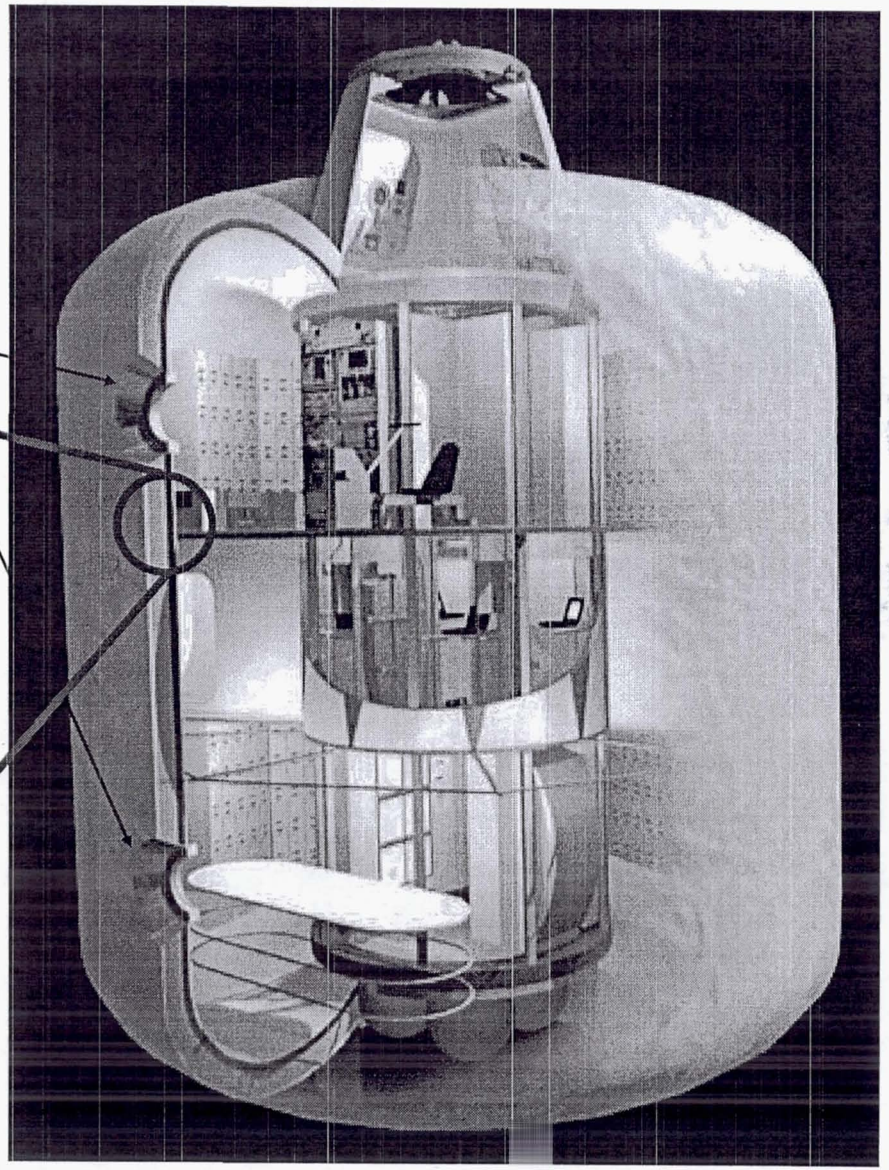
OVERVIEW (cont.)

Multi-Layer Inflatable Shell Details





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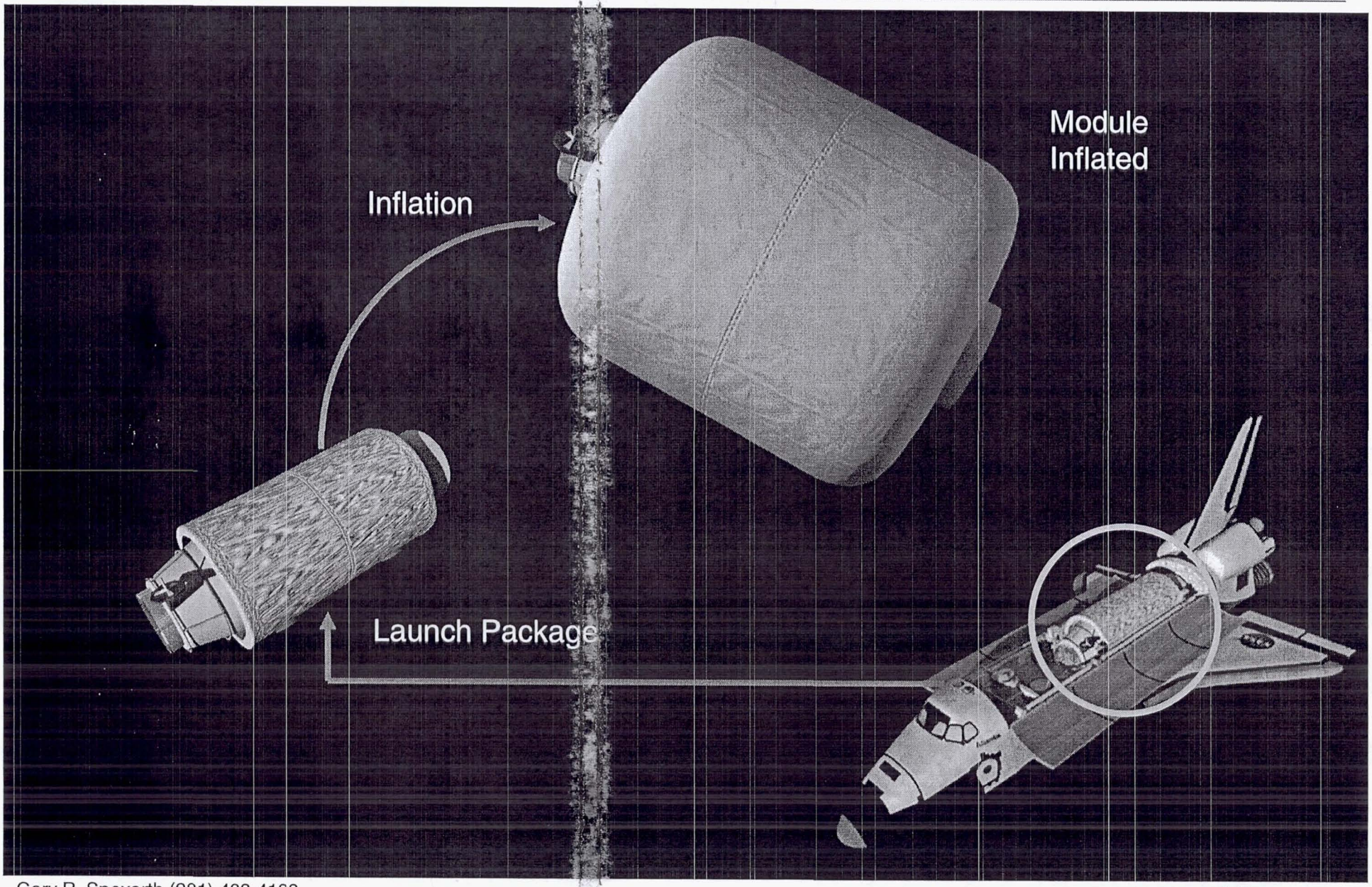
OVERVIEW (cont.)



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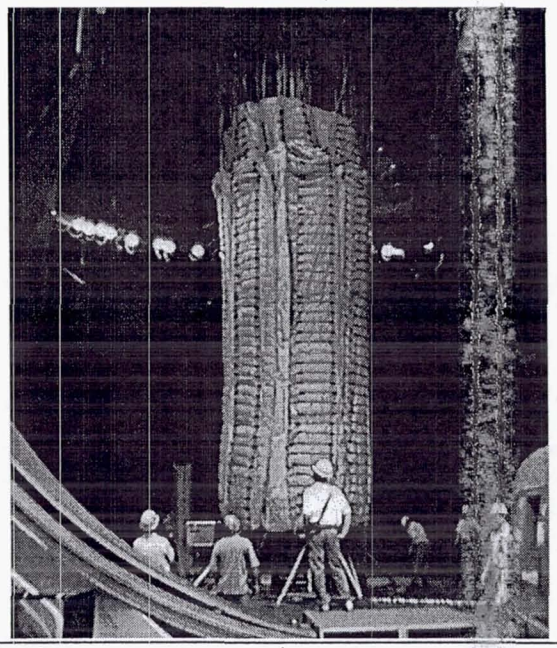
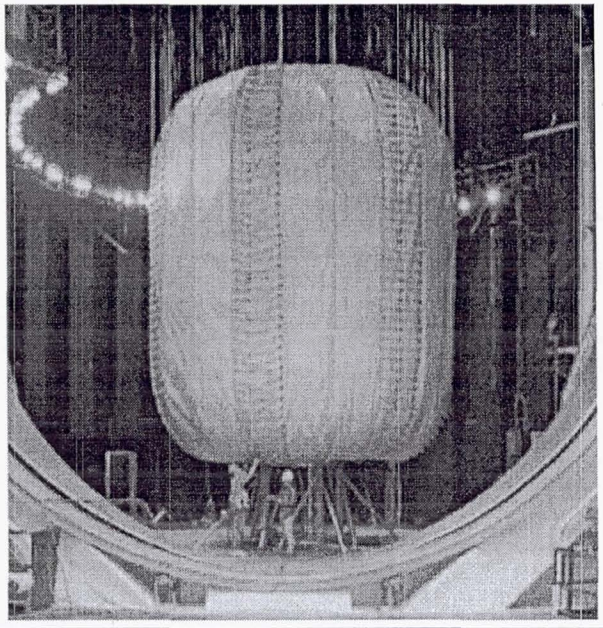
FEATURES / TESTING

- Large volume in small package
  - Inflatable shell folds around core for launch.
- Lightweight
  - ~ 3 times more volume than US Lab for about the same weight.

Vacuum Deployment Test: December 21, 1998





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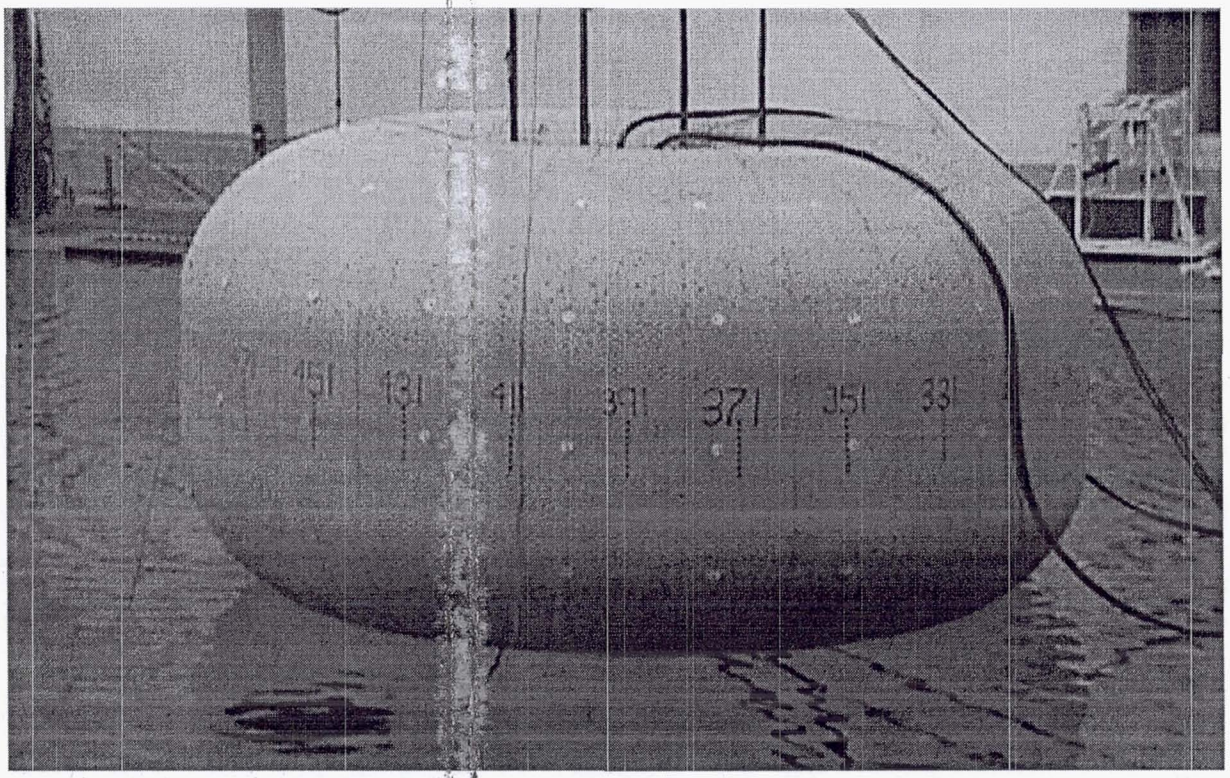
FEATURES / TESTING(cont.)

- Excellent Structural Integrity
  - Successfully pressure tested full-scale shell to Factor of Safety of 4.0
    - Aluminum Modules typically designed to 1.5 or 2.0.



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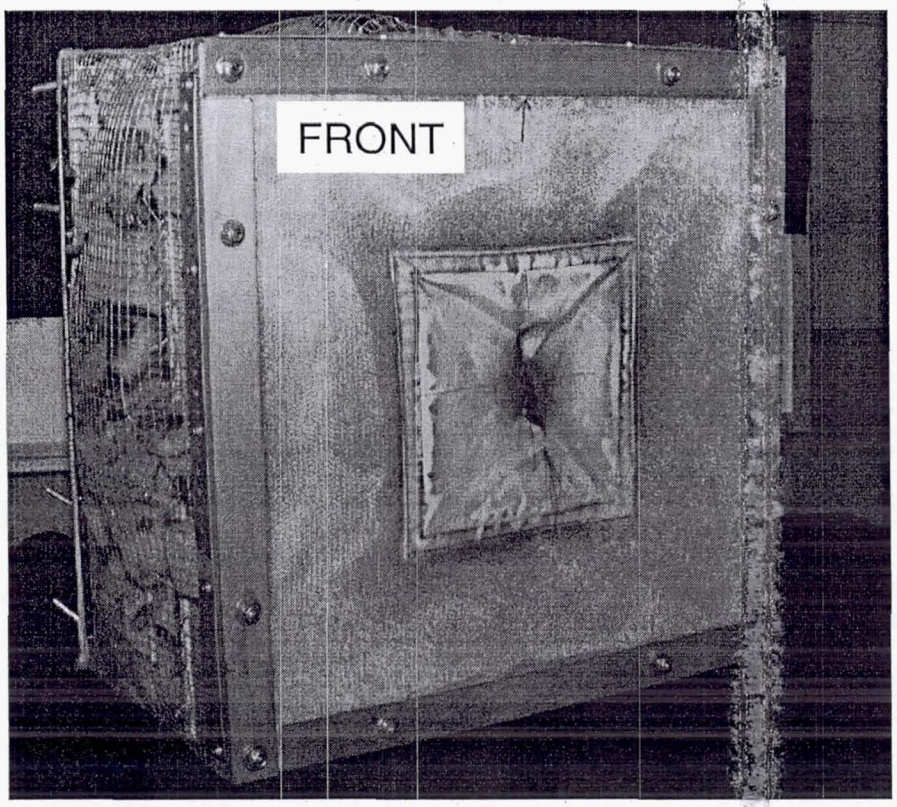
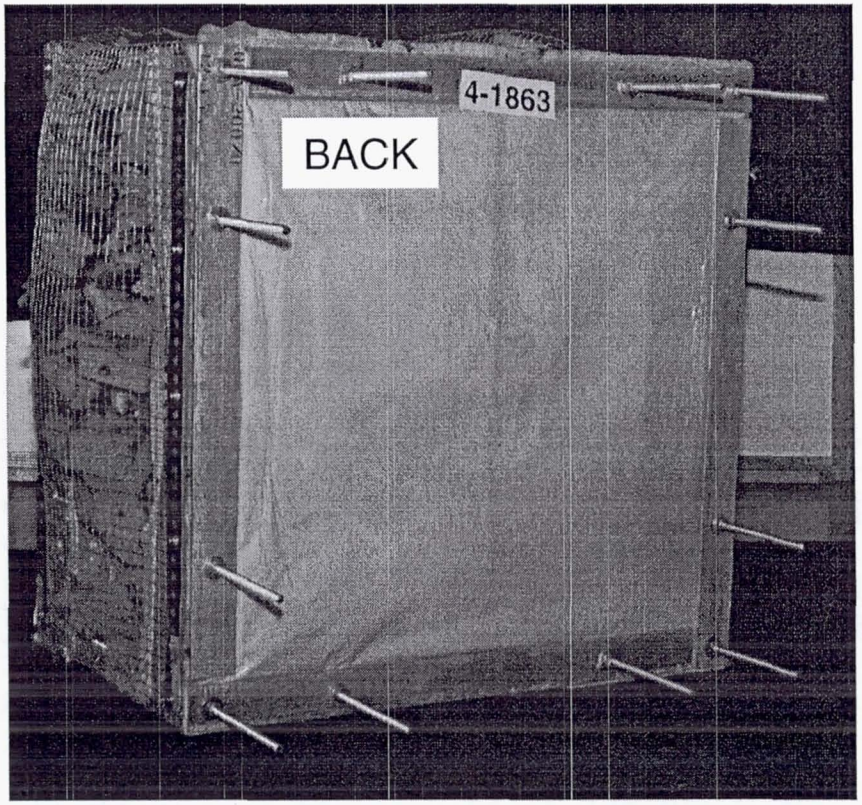
FEATURES / TESTING(cont.)

- Excellent micro-meteorite Protection
  - Successfully tested:
    - ~ 2.0 cm particle at 7 km/sec.
    - 1 gram particle at 11.5 km/sec





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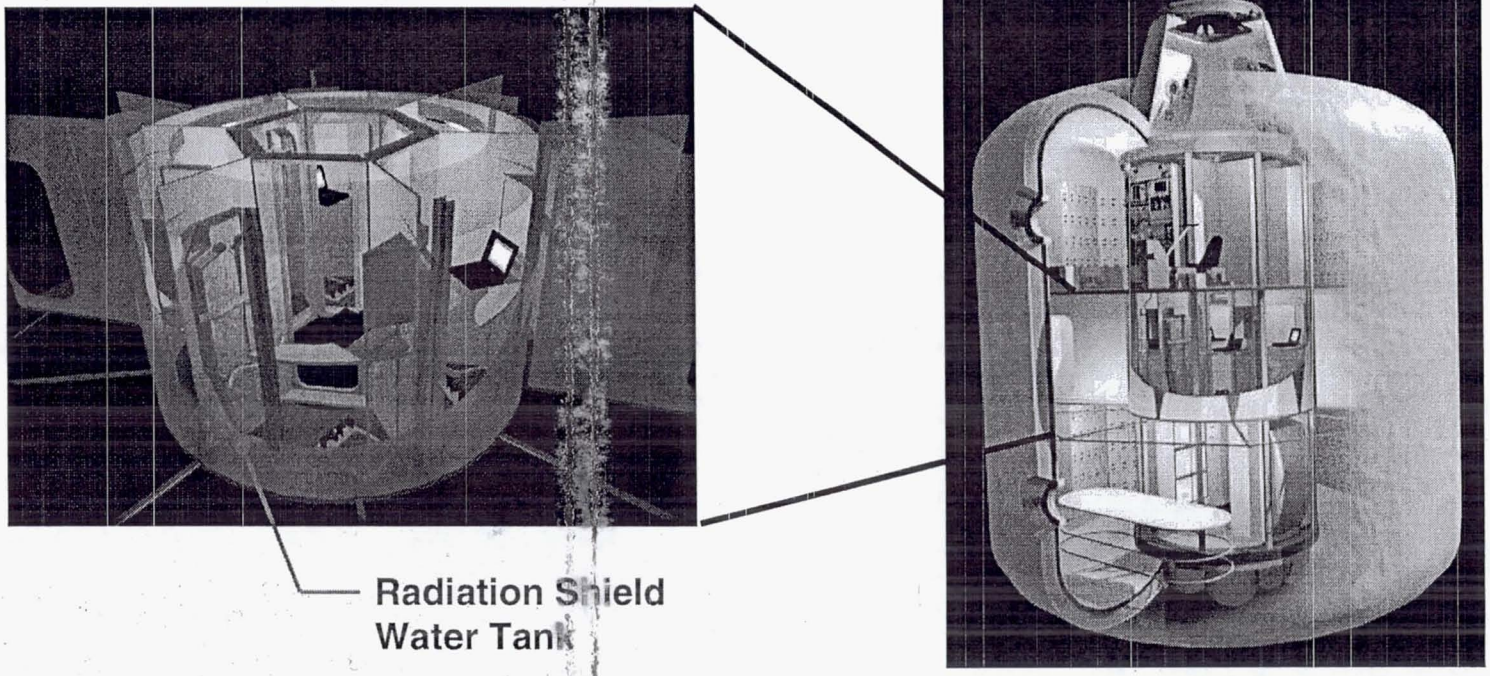
FEATURES / TESTING(cont.)

- Excellent Radiation Protection
  - Non-metallic shell does not produce secondary, heavy ion particles, as does metallic modules.
  - Radiation Storm Shelter surrounding crew quarters (Life Support water in polyethylene tank).



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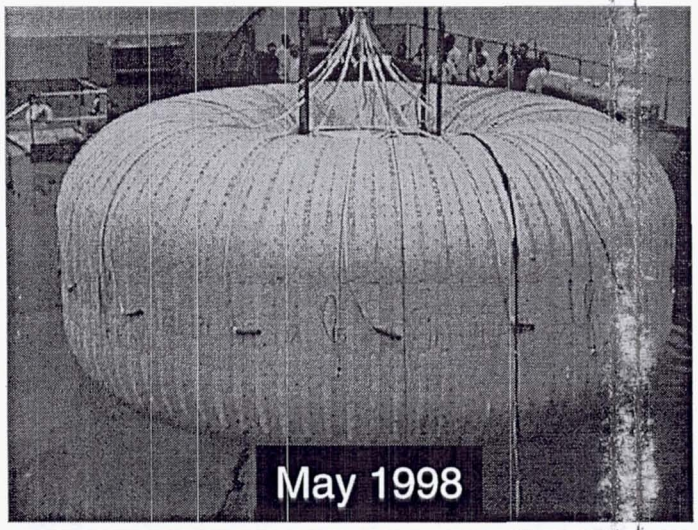
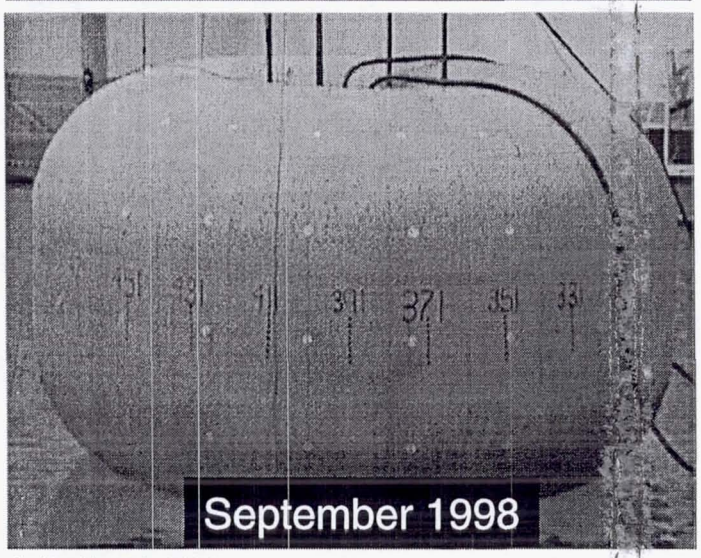
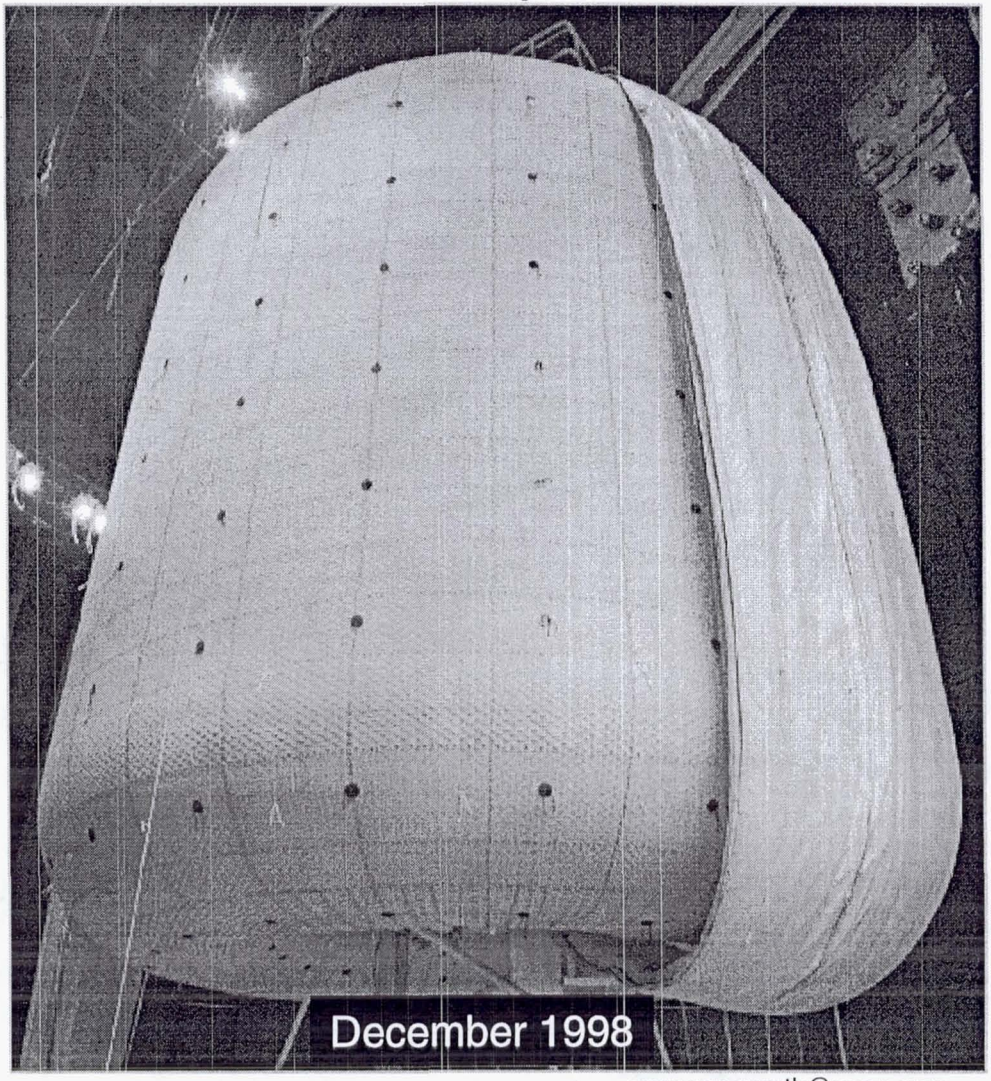
FEATURES / TESTING(cont.)

- Ease of Manufacturing
  - Built 3 full-scale test articles in a 9-month period.







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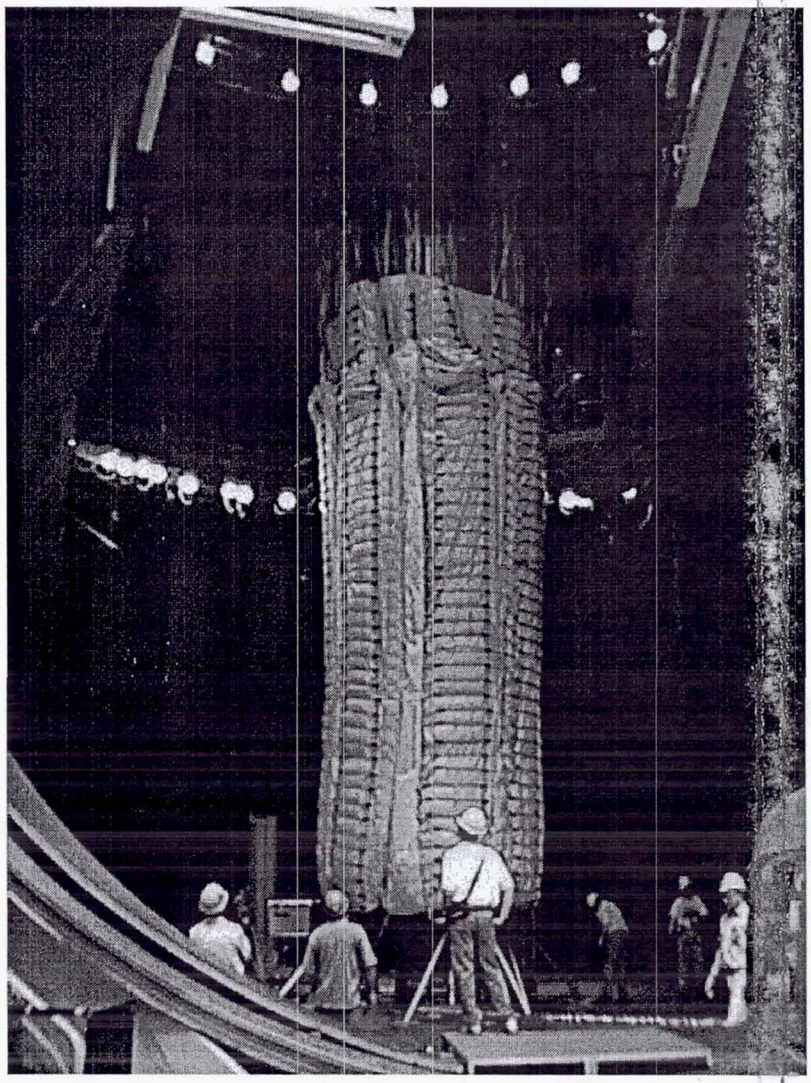
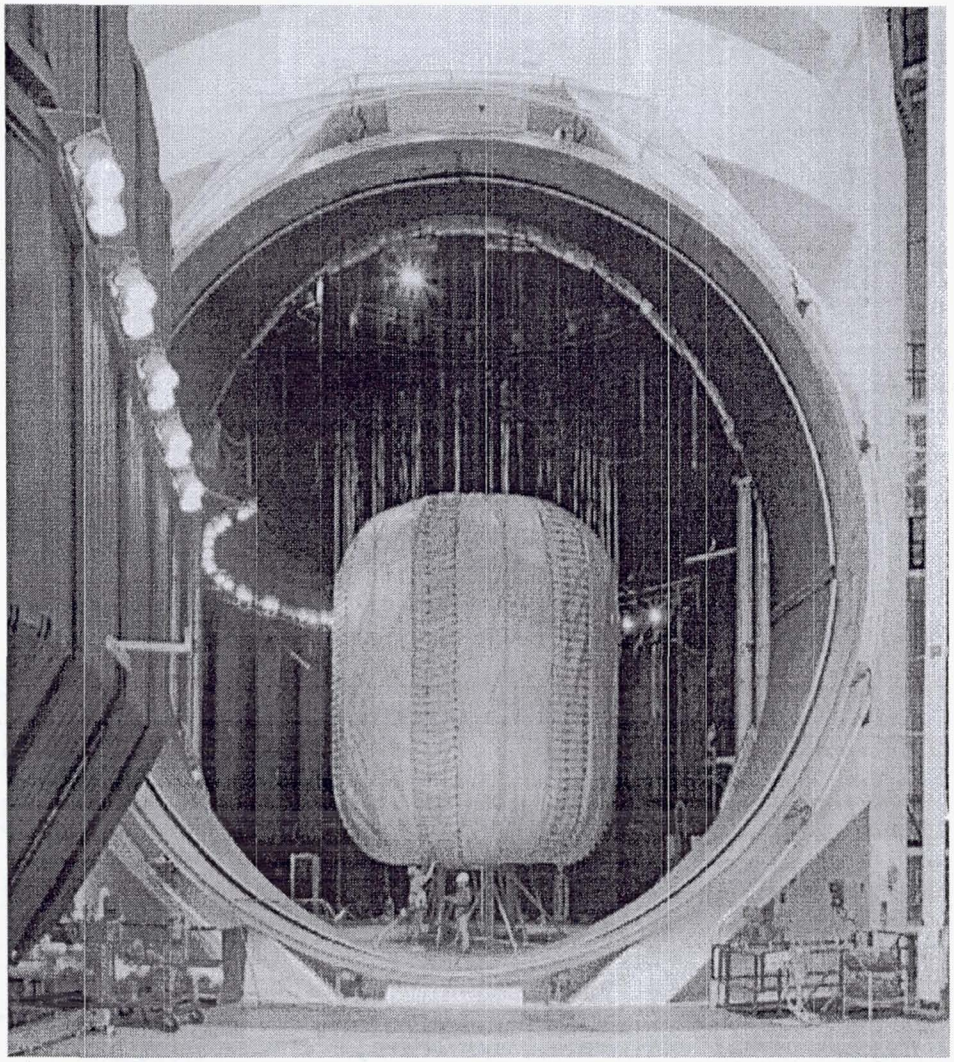
FEATURES / TESTING(cont.)

Vacuum Deployment Test: December 21, 1998





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MATERIAL SELECTION

- Material Selection was crucial for a successful design. Some examples:
  - Bladder Requirements:
    - Low permeability rate
      - ~ 0.32 O2 cc/100in^2/day/atm
      - 0.05 lbm/day air total bladder
    - Excellent flex cracking resistance at low temperatures.
  - Restraint Layer Requirements:
    - High strength
    - Ease of folding, flexibility
    - Ease of manufacturing
  - Micro-meteorite shield Requirements:
    - Ease of folding, flexibility
    - Ease of manufacturing
    - Ability to absorb energy of impacts
  - Radiation Protection
    - Polyethylene used where possible
- Extensive testing program enabled the correct materials to be identified and used in the design.

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- Material Challenges
  - Bladder material that has low permeability and good flex crack resistance at low temperatures (<-20 F)
    - Bladder Material has been identified and successfully tested to meet these requirements.
      - Polyurethane laminated to air barrier film.
    - Additional materials may be available and/or developed.
  - Radiation protection for exploration missions
    - Good radiation protection for low Earth orbit.
    - Needs to be augmented for exploration missions.

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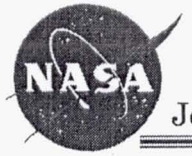

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CONCLUSION

- The following has been demonstrated and shown to be very feasible with no show stoppers.
  - Structural Integrity
  - Micro-meteorite Protection
  - Manufacturing
  - Assembly
  - Folding
  - Deployment / Inflation
  - Flammability
  - Off-gassing/Toxicity, Out-gassing
  - Thermal Performance (Component)
  - Radiation
  - Shell Ascent Venting (Component)
  - Electrostatic Discharging
  - Window Design

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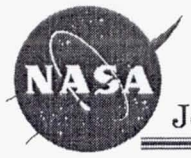

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CONCLUSION, cont.

- Forward Work
  - Leak Rate Performance
  - Shell Ascent Venting (Full Scale)
  - Thermal Performance (Full Scale)
  - Window Integration
  - Horizontal Folding and Packaging
  - Radiation Protection for Exploration Missions.

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