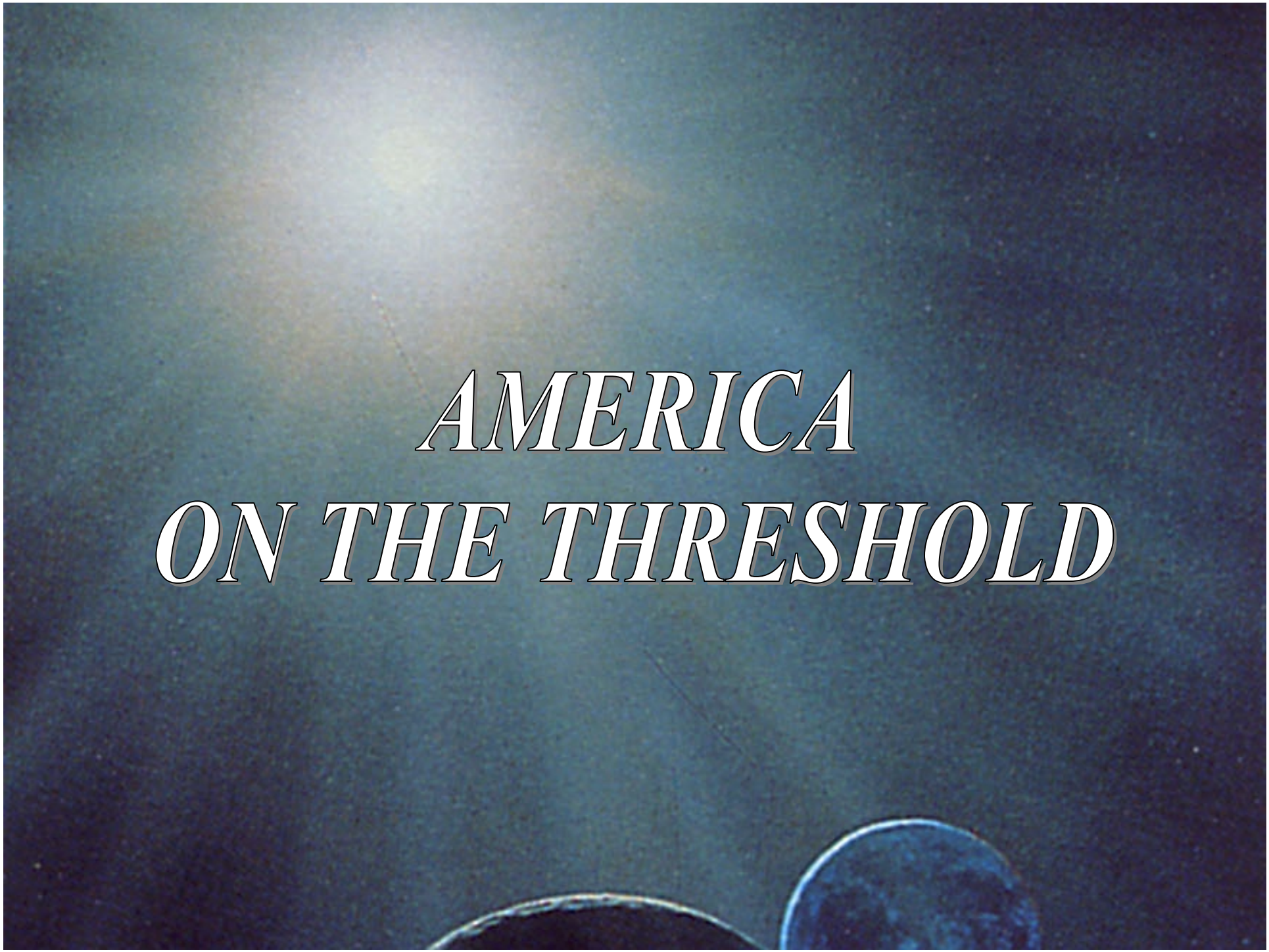
AMERICA
ON THE THRESHOLD

ARCHITECTURES

I. Mars Exploration

II. Science Emphasis for the Moon and Mars

III. The Moon to Stay and Mars Exploration

IV. Space Resource Utilization

Space Exploration Initiative

Architectures

Emphasis Areas

RECOMMENDATIONS

1. Long range strategic plan
2. National Program Office
3. NASA Associate Administrator as Program Director
4. Aggressive acquisition strategy for SEI
5. SEI requirements incorporated into Heavy Lift Program
6. Nuclear thermal rocket technology development
7. Space nuclear power technology based on SEI requirements
8. Focused life sciences experiments
9. Education as principal theme of SEI
10. Continue and expand outreach program

Recommendation 1

Establish within NASA
a long-range strategic plan
for the nation's civil space program
with the Space Exploration Initiative
as its centerpiece.

Recommendation 2

Establish a National Program Office by Executive Order.

Recommendation 3

Appoint NASA's
Associate Administrator for Exploration
as the Program Officer for the
National Program Office.

Recommendation 4

Establish a new, aggressive Acquisition Strategy for the Space Exploration Initiative.

Recommendation 5

Incorporate Space Exploration Initiative requirements into the joint NASA-DOD Heavy Lift Program.

Recommendation 6

Initiate a nuclear, thermal
rocket technology development program.

Recommendation 7

Initiate a space nuclear power technology development program based on Space Exploration Initiative requirements.

Recommendation 8

Conduct focused, life sciences experiments.

Recommendation 9

Establish education as a principal theme of the Space Exploration Initiative.

Recommendation 10

Continue and expand the Outreach Program.

SUPPORTING TECHNOLOGIES

1. Heavy lift launch with a minimum capability of
   150 metric tons with designed growth to 250 metric tons

2. Nuclear thermal propulsion

3. Nuclear electric surface power to megawatt levels

4. Extravehicular activity suit

5. Cryogenic transfer and long term storage

6. Automated rendezvous and docking of large masses.

7. Zero gravity countermeasures.

SUPPORTING TECHNOLOGIES

8. Radiation effects and shielding

9. Telerobotics

10. Closed loop life support systems

11. Human factors for long-duration space missions

12. Lightweight structural materials and fabrication

13. Nuclear electric propulsion for follow-on-cargo missions

14. In situ resource evaluation and processing

SPACE EXPERIENCE LEGACIES

Guidelines and Pitfalls

Guidelines

Establish crew safety as the number one priority

Have clean lines of management authority and responsibility for all elements of the program. Ensure that one organization or prime contractor is clearly in charge.

Guidelines

Establish realistic program milestones that provide clear entry and exit criteria for the decision process And create useful capabilities at each step.

Ensure that the Administration and the Congress clearly understand the technical and programmatic risks and realistic costs of the Space Exploration Initiative.

Guidelines

Mandate simple interfaces between subsystems and modules.

Make maximum use of modularity over the life of the program to maintain flexibility. Successive missions should build on the capabilities established by prior ones. Provide the capability to incorporate new technology as required.

Guidelines

Press the state-of-the-art in technology when required –

and/or when technological opportunities are promising

-- with acceptable risk.

Ensure optimum use of man-in-the-loop. Don’t burden man

if a machine can do it as well or better, and vice versa.

Guidelines

Limit development times to no more than ten years.

If it takes longer, the cost goes up

and commitment goes down.

Focus technology development toward programmatic needs.

Guidelines

Minimize or eliminate on-orbit assembly requiring extravehicular activity.

Minimize mass to low Earth orbit to reduce cost.

Guidelines

Have redundant primary and separate backup systems.

Design in redundancy versus heavy reliance
on onboard/on-site maintenance.

Hire good people, then trust them.

Pitfalls

Establishing requirements that you will be sorry for;
i.e., wish lists being treated as requirements and
allowing requirements to creep.

Trying to achieve a constituency by promising too much
to too many …

and “low balling” the technical and financial risks.

Pitfalls

Committing to interminable studies and technology demonstrations without a firm commitment to execute a real program.

Not establishing configuration controls/baselines as soon as possible; e.g., weight and electrical power requirements.

Pitfalls

Allowing software to run unchecked and become a program constraint rather than a supporting element.

Setting up agreements for development of program elements that are not under direct program management control.

Pitfalls

Not saying “We were wrong” when we were wrong.