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OFFICE OF EXPLORATION OVERVIEW

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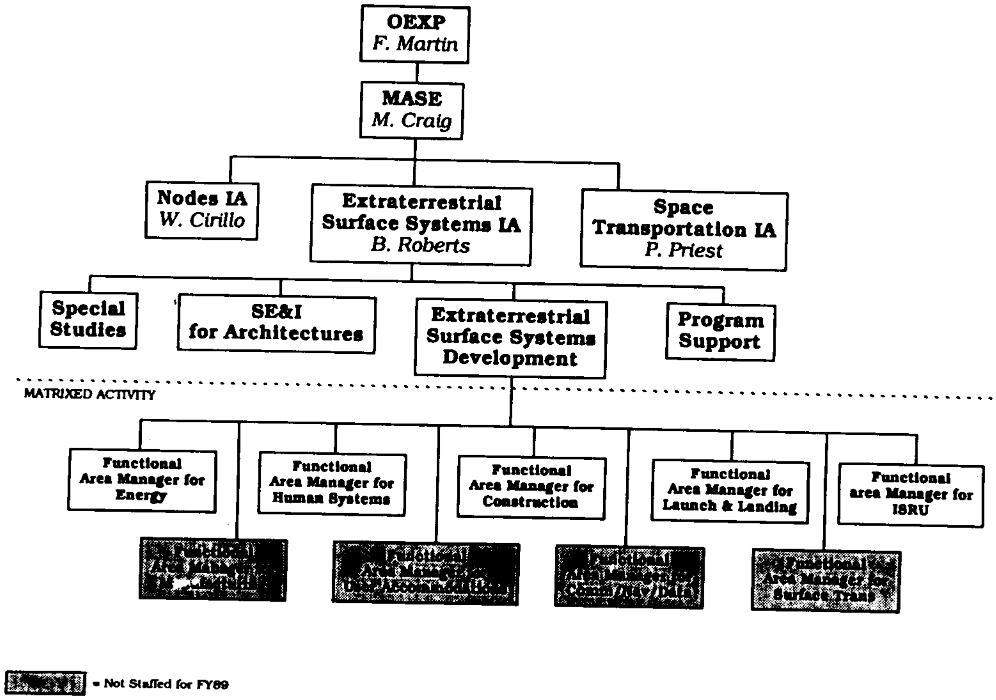
Abstract

The NASA Office of Exploration case studies for FY 89 are reviewed with regard to study groundrules and constraints. Three study scenarios are presented: lunar evolution, Mars evolution, and Mars expedition with emphasis on the key mission objectives.



Specific Exploration Studies Goals and Objectives for FY 1989

Primary Goal

- Develop knowledge base for FY 91 "decision Year" Budget

Objectives

- Update and refine exploration cases
- Obtain a detailed understanding of prerequisite requirements
- Continue building exploration team capability
- Develop effective external interactions
- Conduct first relative cost estimate

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Objective: Update and Refine Exploration Cases

Strategy for Case Study Additions and Modifications

- Do an in-depth penetration of technologies, systems, and operations capabilities required to conduct a "bare bones" trip to Mars
- Investigate the potential for Mars evolution capability using scaled down vehicles and systems (relative to FY 88 studies) and constant annual investment (i.e., mass-to-LEO)
- Using the same constant annual investment strategy as in the Mars evolution case study, investigate the potential for a lunar evolution capability characterized by robust objectives for scientific achievement, technical research and development, operations support, and human aclimation

Objective: Update and Refine Exploration Cases

Strategy for Case Studies Analysis

- Conduct systematic evaluations to ensure determination of cause and effect. Emphasize parametric analyses of capabilities and configurations, and conduct broad trade studies
- Identify enabling technology areas and special exploration opportunities along with their associated systems alternatives
- Conduct trade studies in technology and operations areas having potential for high yield relative to reduced mass-to-LEO, reduced dependency to a LEO node, improved systems performance and operation, and reduced cost
- Evaluate the impact of using an artificial-g transfer vehicle and a conjunction trajectory on a mission to Mars/Phobos
- Augment understanding of the effect of constant annual investment (using mass-to-LEO as the investment constraint) on lunar and Mars evolution strategy

Objective: Update and Refine Exploration Cases

Strategy for Program Planning

- Formulate an advanced development plan and identify candidate case study technologies
- Conduct technical studies of international participation implications

Objective: Obtain a Detailed Understanding of Prerequisite Requirements

Areas

- Earth-to orbit transportation
- Life sciences
- Scientific precursors
- Space Station Freedom
- Technology

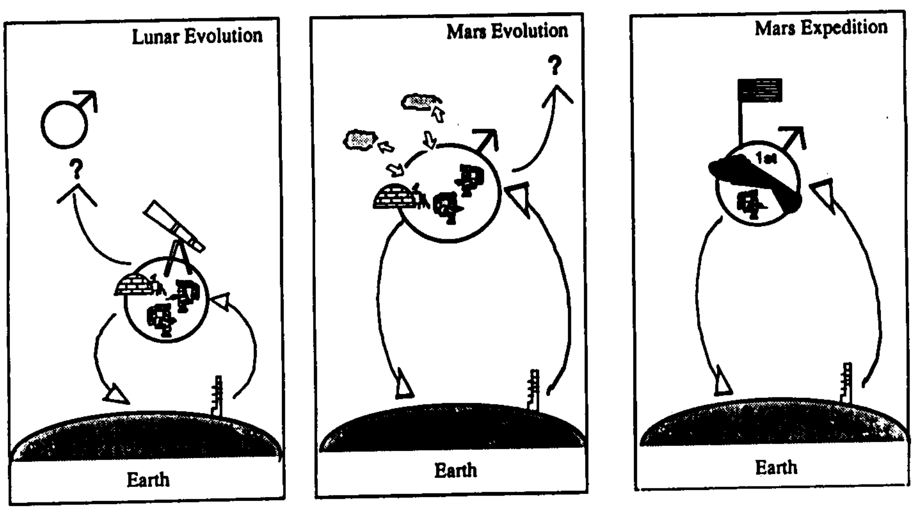
Strategy

- Seek to understand truly enabling vs. enhancing prerequisites
- Iterate plans with appropriate program offices
- Initiate (with Code E) science studies and user requirement and opportunity development
- Develop artificial gravity research facility feasibility and concepts
- Emphasize exploiting the systems and infrastructures that will be in place in the late 1990s for initiating exploration

Generic Groundrules and Constraints for Studies

- All case studies shall be evaluated to answer the question "why send humans?"
- All case studies shall be evaluated for the potenteial of maximizing science return
- All case studies shall be unconstrained by budget
- Relative, not absolute, cost estimates will be made for the FY 1989 case studies
- Evolutionary case studies shall be evaluated for the potential suitability of extraterrestrial resources
- All case studies shall be evaluated for the potential of international cooperation

FY89 Focused Case Studies



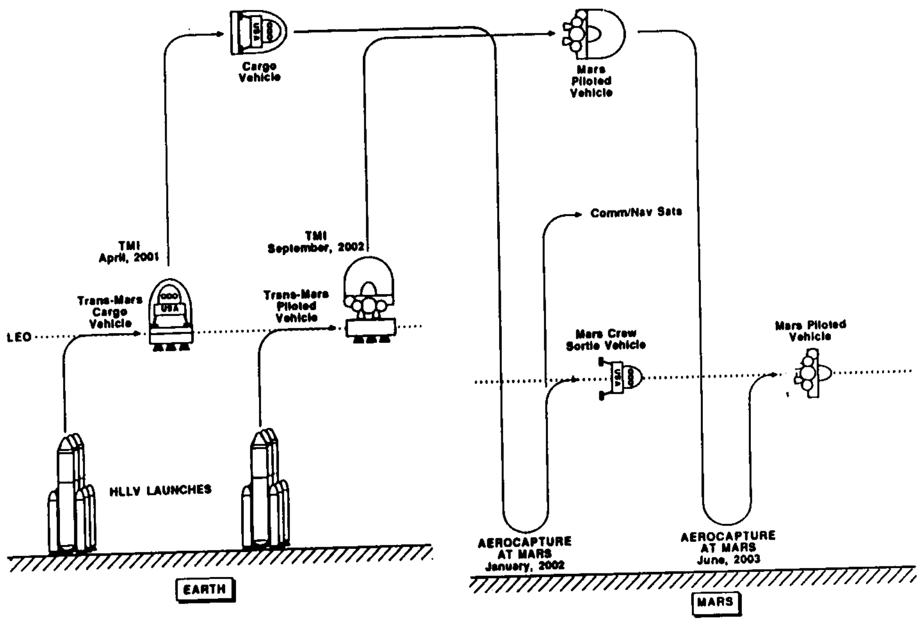
Study Parameters Spread

	Lunar Evolution Case Study	Mars Evolution Case Study	Mars Expedition Case Study
Destination	Moon	Mars	Mars
Exploration Approach	Permanent Base	Permanent Base	Expeditionary
Vehicle Gravity Environment	Zero-G	Artificial-G	Zero-G
Trajectory Type	Minimum Energy	Minimum Energy	Sprint
On-orbit Assembly	In LEO	In LEO	None
Reusability vs. Expendability **	All Reusable	Reusable/Expendable	All Expendable
Aerobrake L/D	None Specified	None Specified	0.9-1.2

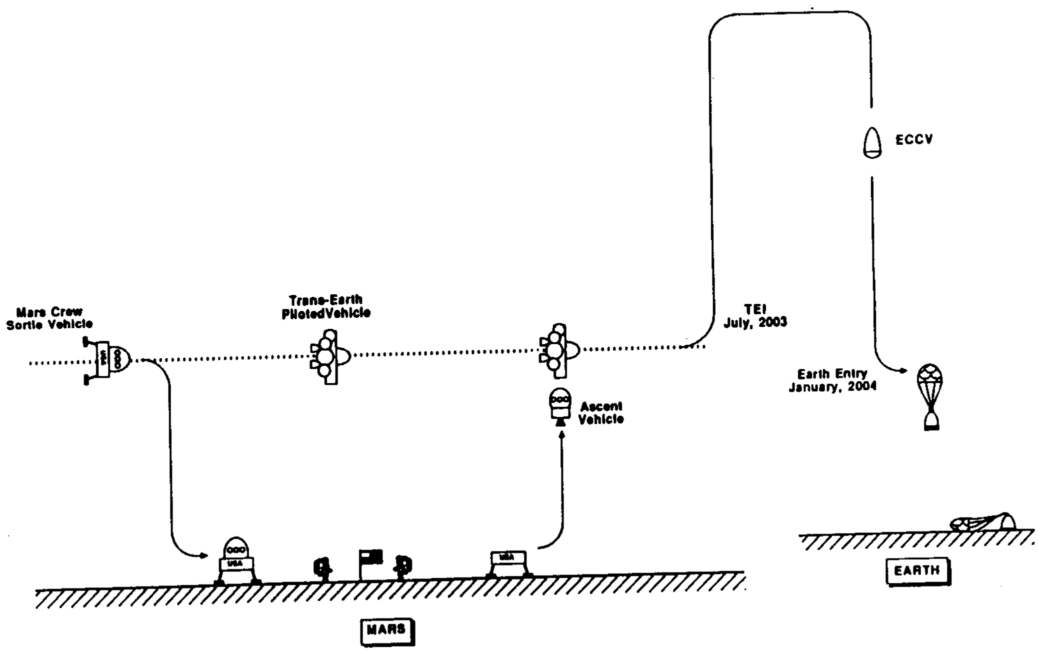
** To Be Studied

Mars Expedition

- **Split Mission Concept**
  - **Outbound cargo consists of crew sortie vehicle for descent and ascent at Mars and supporting infrastructure**
  - **Outbound piloted vehicle carries trans-Earth injection stage**



MARS EXPEDITION CASE STUDY -- flight profile.



MARS EXPEDITION CASE STUDY -- flight profile.

Mars Evolution Case Study

Exploration Objectives

- the emplacement of a permanent, self-sufficient base on Mars, and the establishment of early leadership in manned exploration of the Mars system

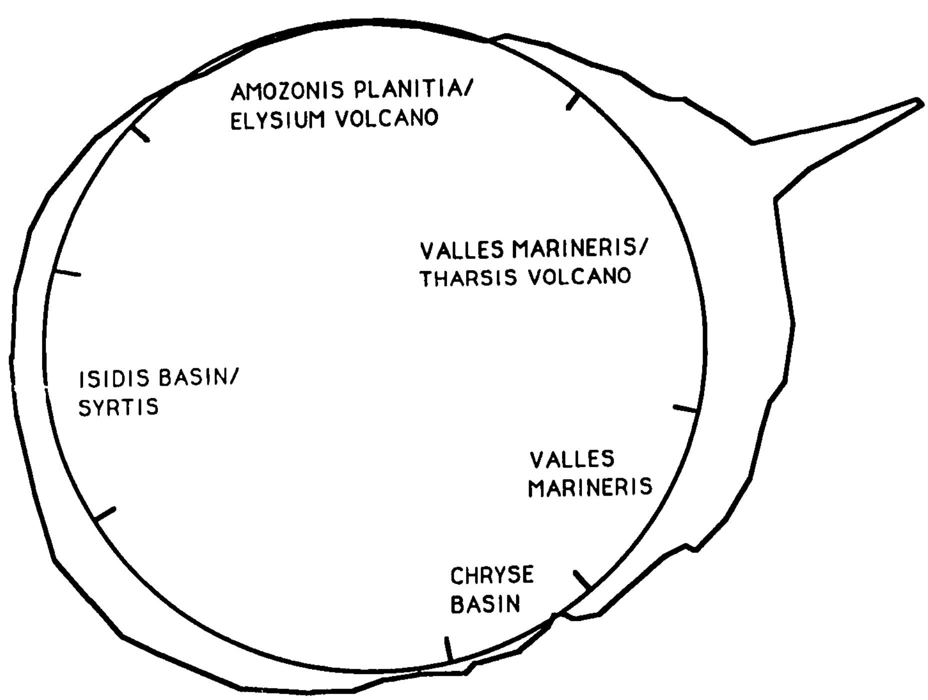
Mars Evolution Case Study

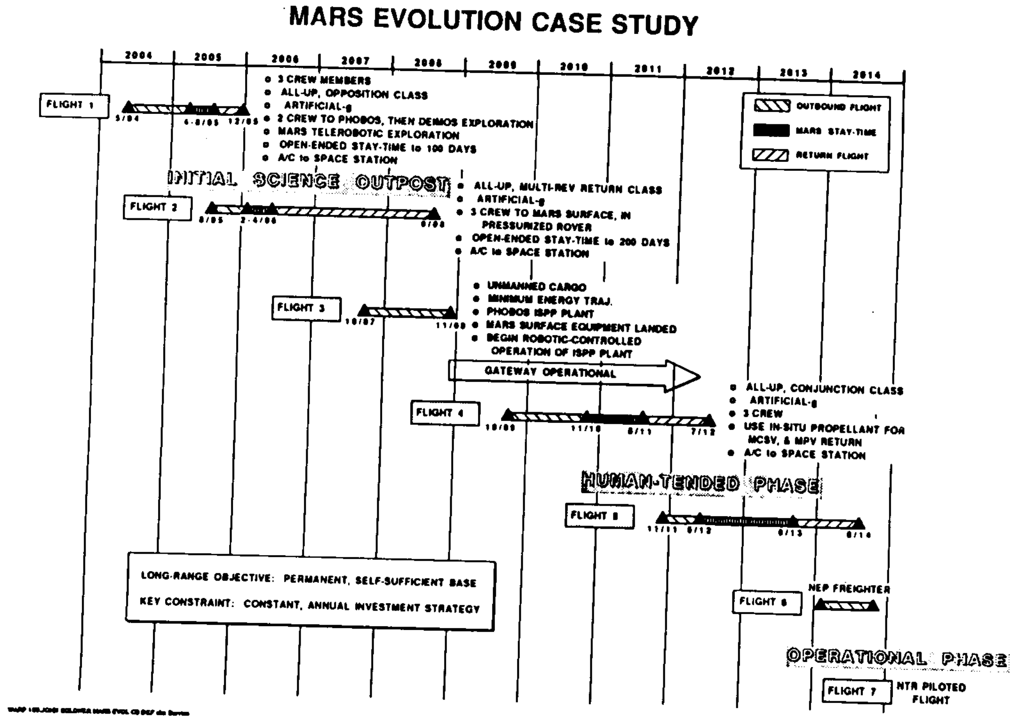
Key Features

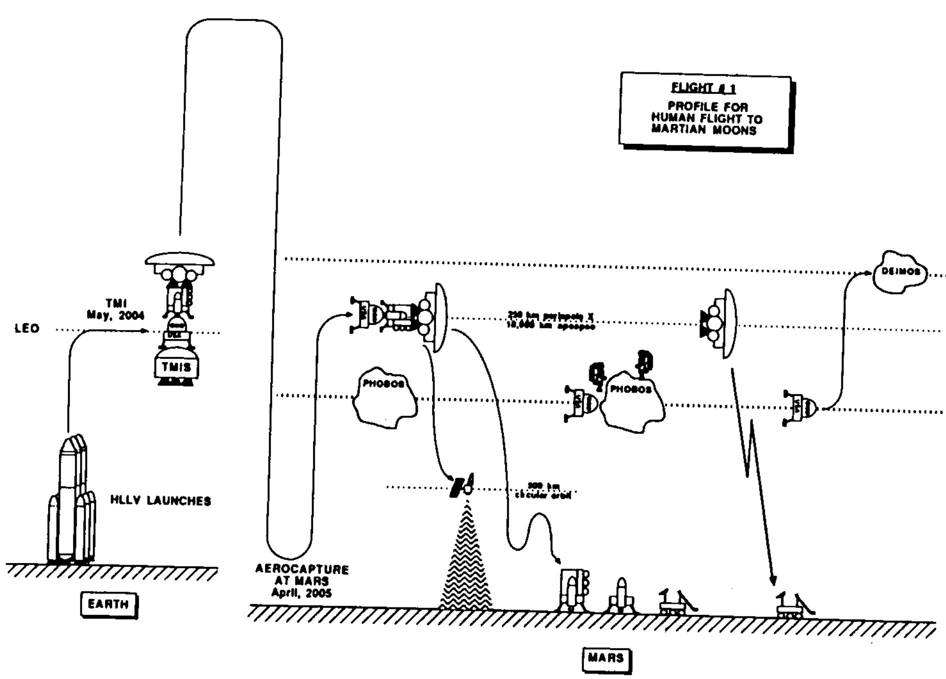
- Annual limit on mass to low Earth orbit
- Advanced technology
- Establishment of an initial manned habitat on Mars
- Early emphasis on a martian moon gateway to produce water and cryogenic propellants
- Utilization of in situ resources
- Varied classes of missions using varied trajectories
- Block I reference
  - initial flight uses opposition-class trajectory
  - all other flights use conjuction-class or opposition-class
  - advanced chemical propulsion
  - aerobraking at Mars and Earth
  - reusable vehicles
  - propellant production fron indigenous resources
- Block II update

Mars Evolution

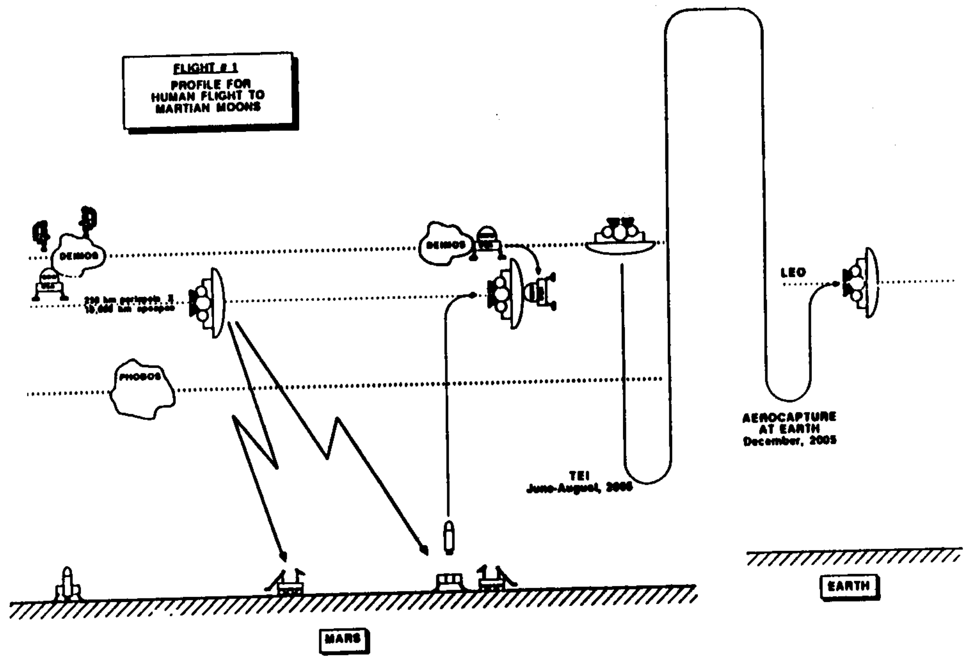
- **BASE SITE LOCATION**
  - **Simund Valley (Chryse Basin) in Hydraotes Complex**
  - **0 deg latitude, 33.5 deg west longitude**







MARS EVOLUTION CASE STUDY -- flight 1 profile.



MARS EVOLUTION CASE STUDY -- flight 1 profile.

Lunar Evolution Case Study

Exploration Objectives

- Long range objective
  - establishment of a permanent facility on the lunar surface with a significant capability for self support
- Evolutionary objectives
  - provision of test bed and learning center for long duration planetary missions
  - cut the tie to Earth by development of the lunar resource potential including propellant production and exploitation of resources
  - development of a significant science research capability for astronomy, planetary science, life sciences, and other fields
  - development of a gateway both inward for lunar base expansion and outward to support expansion of human presence into the solar system

Lunar Evolution Case Study

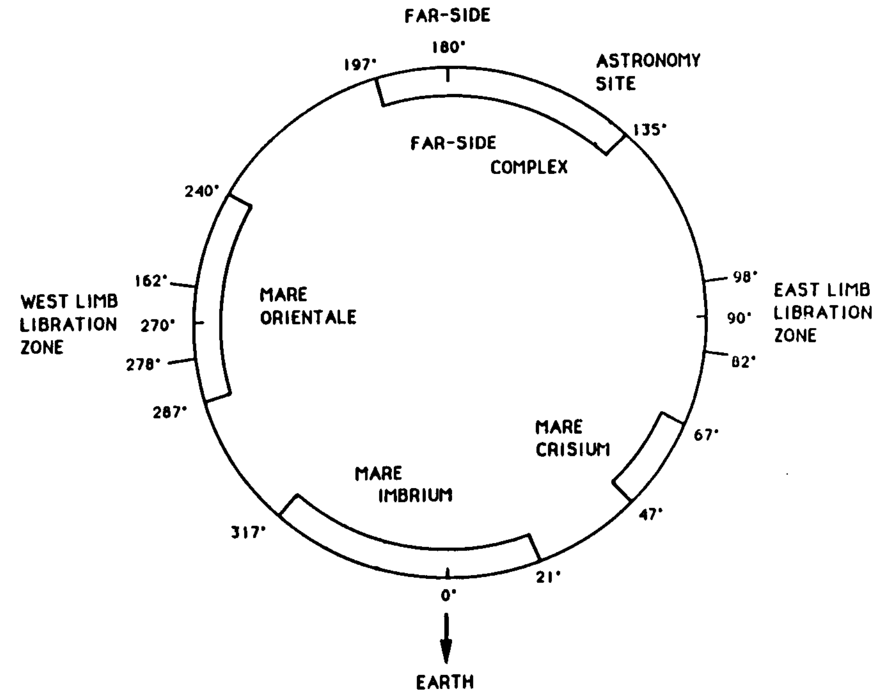
Key Features

- Lunar base evolves through three phases: human-tended, experimental, and operational
- Annual limit on mass to low Earth orbit
- Use of advanced technology
- Emphasis on early development of a human-tended outpost
- Utilization of in situ resources
- Lunar facility has a variety of scientific, technological, and operational objectives
- Block I reference
  - advanced chemical propulsion
  - aerobraking
  - reusable vehicles
  - propellant production fron indigenous resources
- Block II update
  - additional mass-to-LEO allocation, and/or
  - new technology

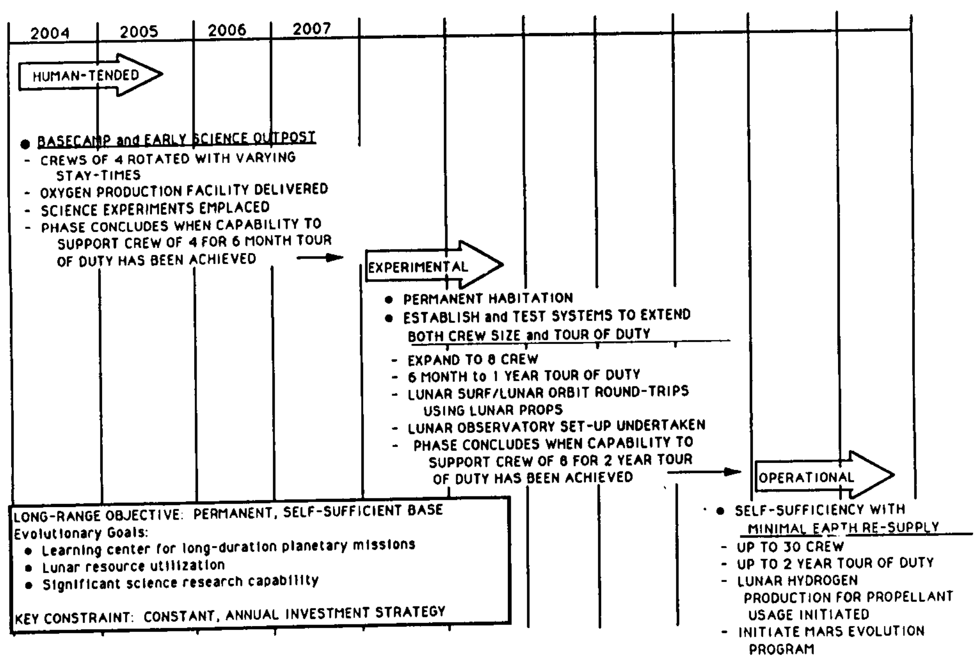
Lunar Evolution

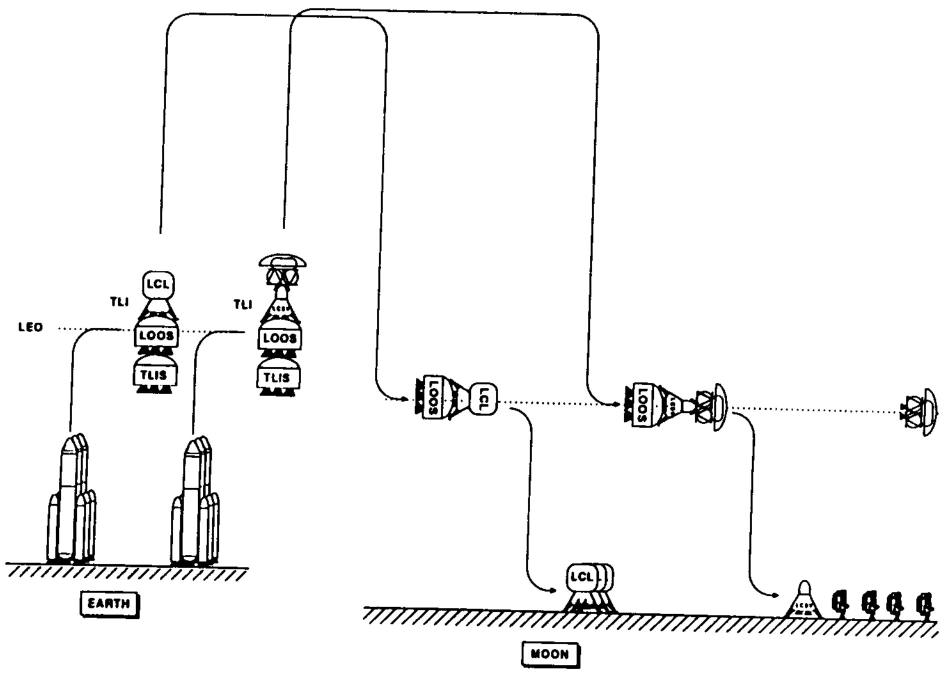
- **BASE SITE LOCATION**
  - **North of crater Moltke in southerm region of Mare Tranquillitatis**
  - **0 deg latitude, 24 deg east longitude**
- **FAR-SIDE ASTRONOMY SITE**
  - **0 deg latitude, 141 deg longitude**

LUNAR SITE DIAGRAM

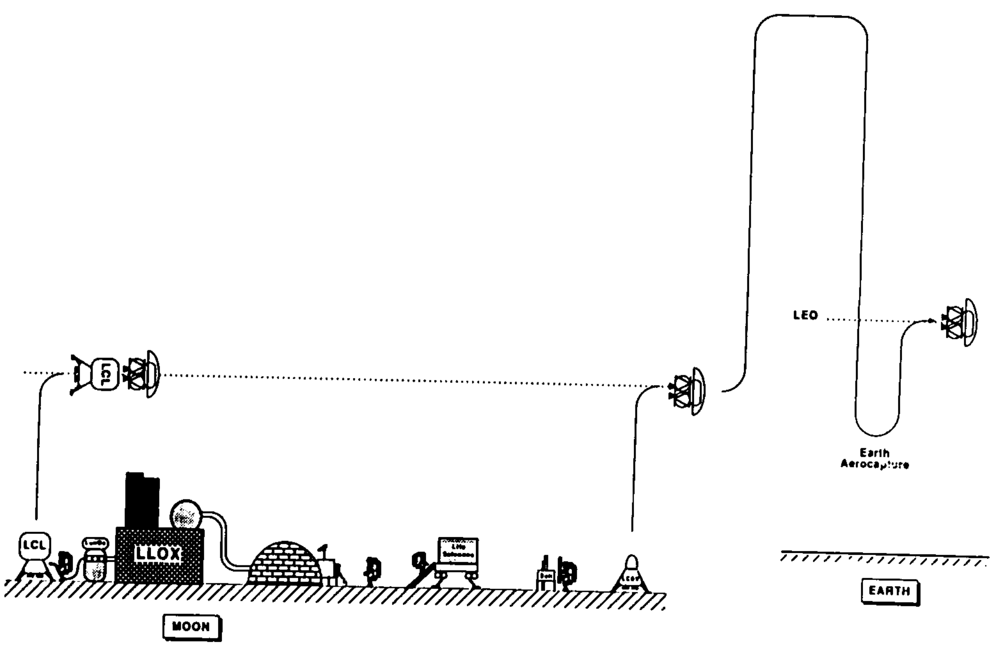


LUNAR EVOLUTION CASE STUDY

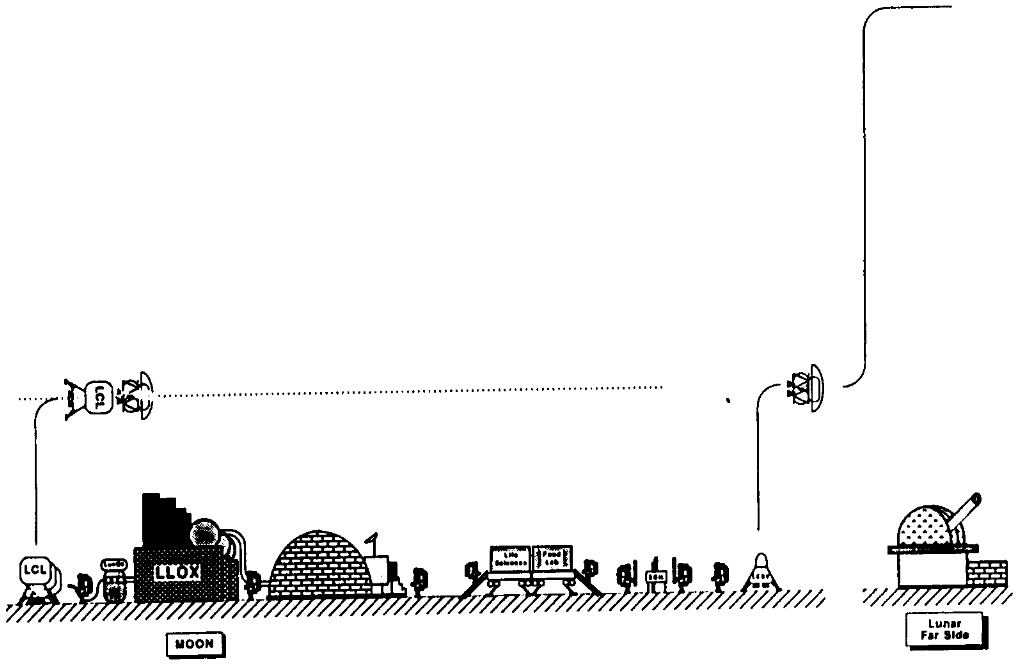




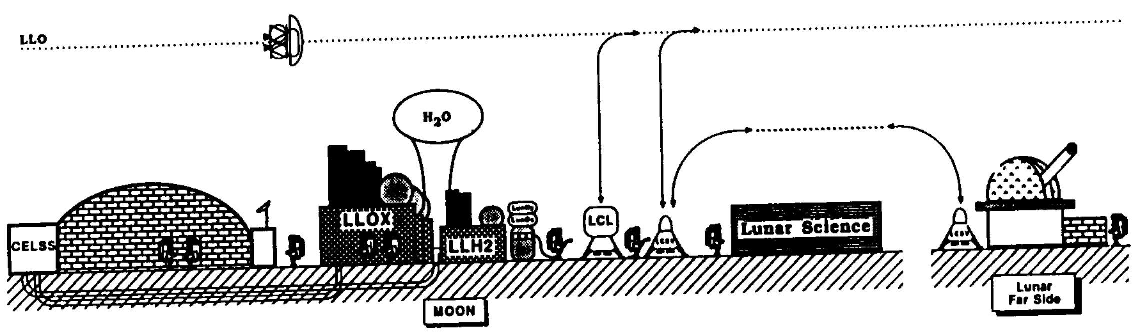
LUNAR EVOLUTION CASE STUDY -- science outpost/human-tended phases.



LUNAR EVOLUTION CASE STUDY -- science outpost/human-tended phases.



LUNAR EVOLUTION CASE STUDY -- experimental phase.



LUNAR EVOLUTION CASE STUDY -- operational phase.

FY 89 Emerging Case Studies