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Mars Exploration Program



Mars Exploration Program

Nuclear Propulsion Technical Interchange Meeting

Sandusky, OH
October 20, 1992

Dwayne Weary
Exploration Programs Office (EXPO)
NASA Johnson Space Flight Center

Space Exploration Missions to the Moon, Mars, and Beyond ...



America wants a NASA of explorers, pioneers, and innovators to boldly expand the frontiers of air and space for the benefit of all.



Mars Exploration Program
- Program Goals -



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Technical Goal

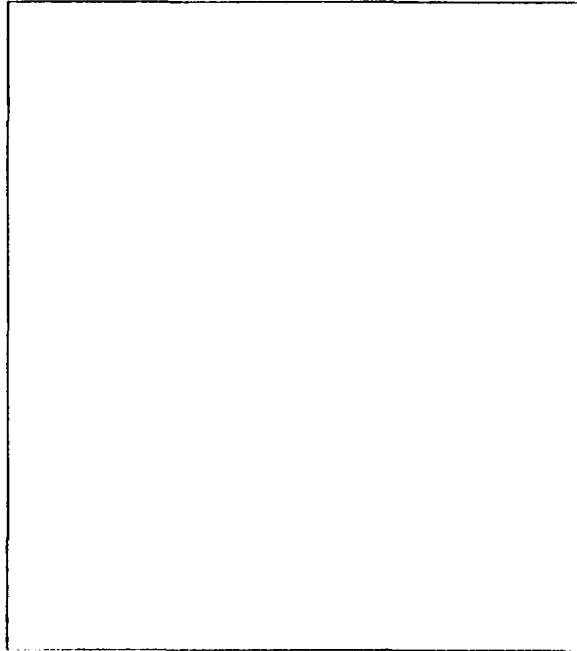
Verify the ability of people to inhabit the planet Mars

Management Goal

Demonstrate effective global cooperation in a high-technology initiative

Societal Goal

Demonstrate improvements in economic vitality and the quality of life for all participating nations



Mars Exploration Program
- Surface Mission Objectives -

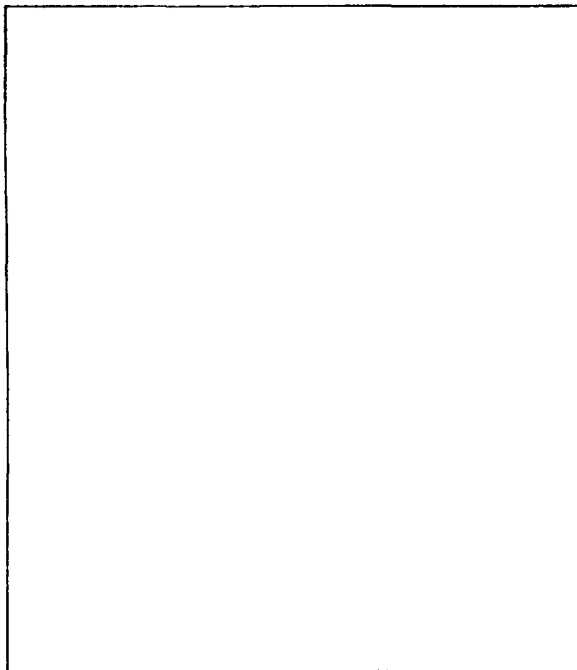


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- Demonstrate substantial self-sufficiency in life-support consumables and in fuel on a local scale
- Determine the potential for expansion of the initial outpost
- Explore Mars - Understand Similarity to, and Differences from, Earth
 - Life - Past and Present
 - History of Atmosphere/Climate
 - Geologic Evolution and Present State

Crew is assumed fit on Mars arrival

Back contamination assumed resolved by precursor missions



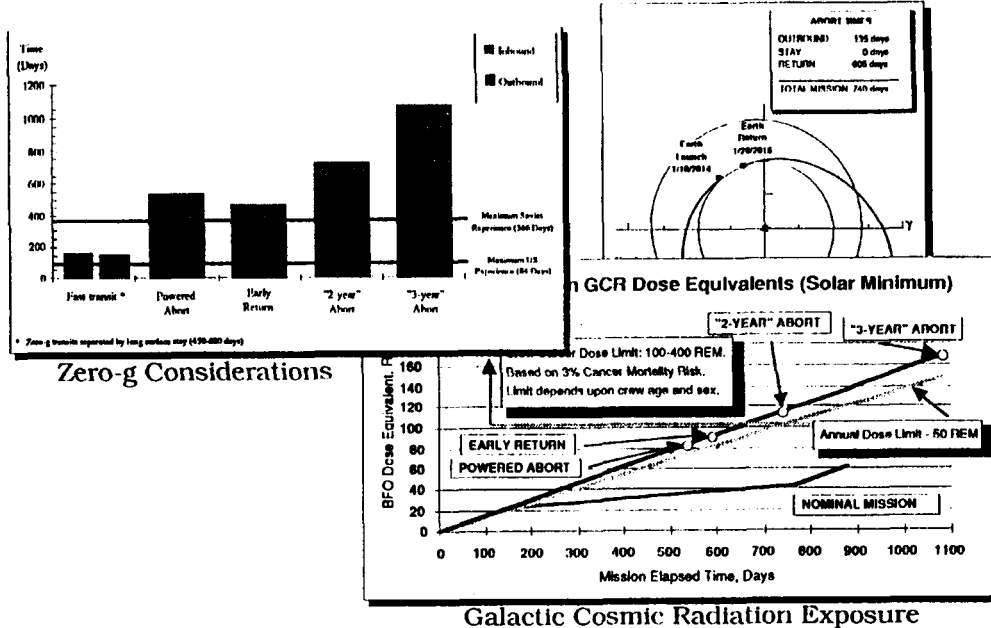


Mars Exploration Program - Mission Class Considerations -



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Abort Strategies

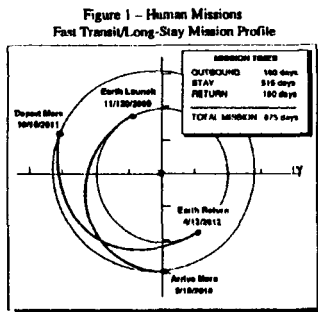


Mars Exploration Program - Reference Mission Groundrules -



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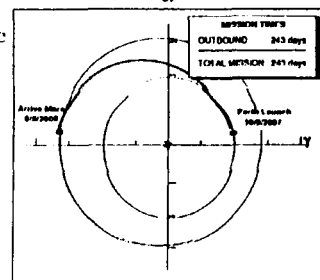
Split Mission Strategy:



- Basic approach - humans on fast, moderately energetic transfers; cargo and all other assets delivered to Mars via minimum-energy trajectories
- Eliminate LEO Assembly
- Human missions employ long duration stay (~550 days at Mars) mission profiles with fast (<180 days) Earth-Mars and Mars-Earth transit legs
- Abort strategy:
 - Abort for human missions post-TMI are to the surface of Mars
 - Program assets directed toward the focus of the mission

- First human mission in 2010
 - Most challenging opportunity in the 15-year Earth-Mars cycle
 - Performance margin exists for other opportunities
 - Achievable development schedules
- First cargo mission in 2008
 - Cargo requirement of ~150 t to the surface of Mars
- Crew of 6
 - Based on past studies of skills mix and threshold psychological group dynamics
 - Reasonable starting point

Figure 2 - Cargo Missions Minimum Energy Mission Profile





Mars Exploration Program - Split Mission Strategy -



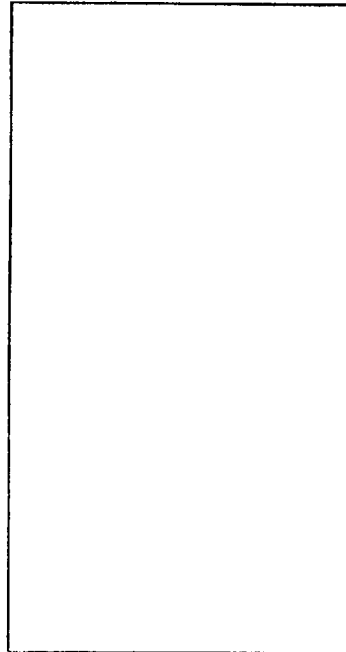
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Objectives:

- Eliminate LEO Assembly for both cargo and piloted missions
- Use the FLO HLLV, or a FLO-evolved HLLV (shroud)
- Reduce number of HLLV launches
 - Send all surface and orbital assets to Mars on minimum energy trajectories
 - Crew-only use medium-energy, fast transit trajectories
- Provide mission flexibility to recover from contingencies
- Reduce engine testing requirements, if NTR is employed
- Provide launch window flexibility
 - 3/4 launches within the Earth-Mars window

Results:

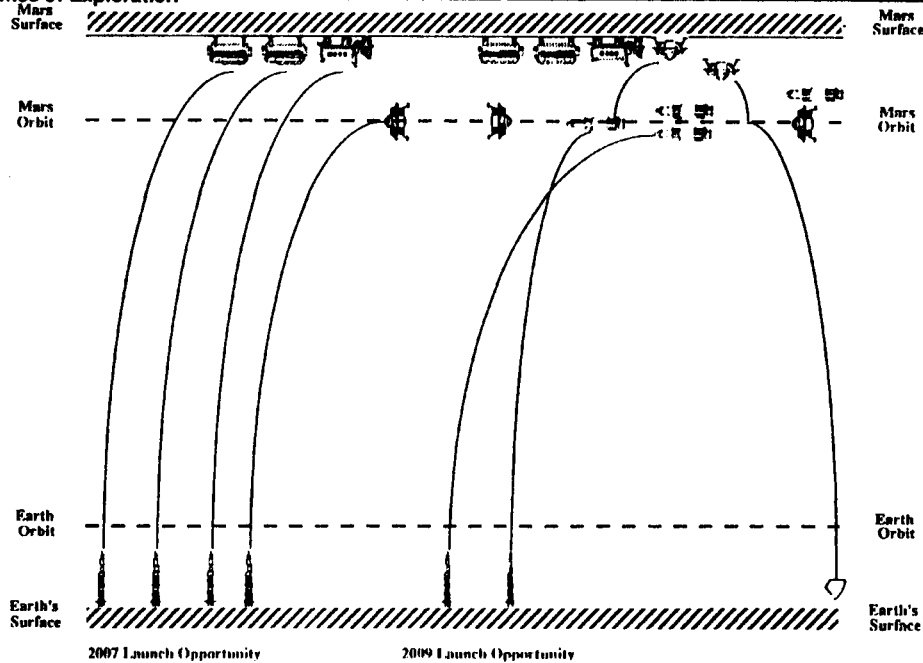
- First human mission to Mars reasonably achievable in 6 total launches of a FLO HLLV. Potentially achievable in 4.
- Significant mission content. 150 t of usable payload delivered to the surface of Mars
- No LEO assembly, rendezvous, or lotter needed
- Significant mission flexibility with this type of strategy



Mars Exploration Program - Mission Overview -



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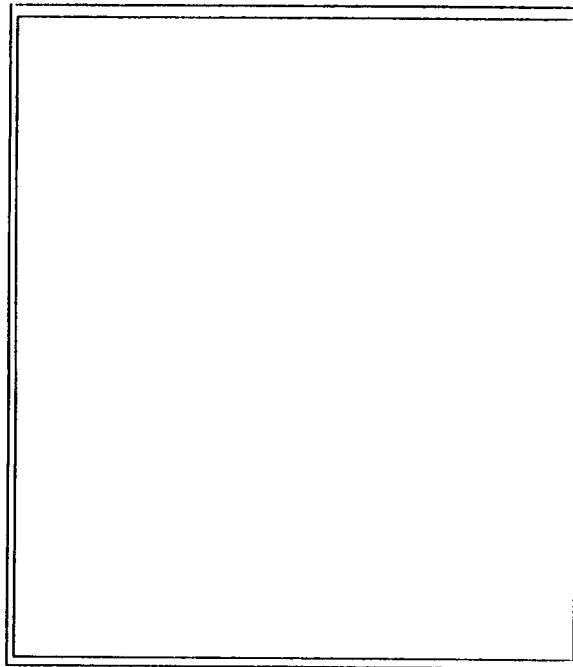




Mars Exploration Program - Operations Concept -



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 - Vehicle Prime
 - Realtime Systems Management
 - Crew Prime
 - Realtime Exploration Functions
 - Crew Health Maintenance
 - Daily Planning and Resource Mgmt.
 - Preventive/Unscheduled Maintenance
 - Crew Backup
 - Realtime Systems Management
 - Ground Prime
 - Supplying Mission Objectives
 - Sustaining Engineering
 - Mission Critical Software Reconfigure
 - Crew Training
 - Procedures Development/Verification
 - Uncrewed Operations
 - Ground Backup
 - Contingency Support
 - Ground and Crew Share
 - Exploration



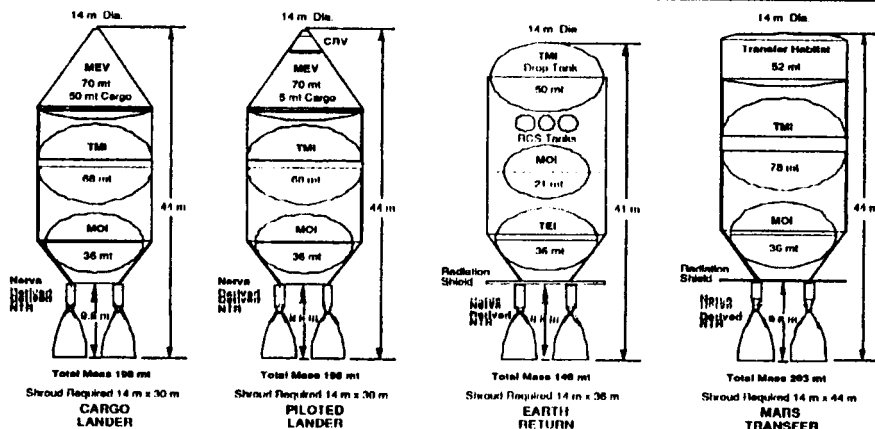
Mars Exploration Program - Mission Transportation Elements -



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Mars Transfer Stage System Groundrules

- NTR Propulsion (2 Engines-50 klbs. Thrust Each)
- Transit Habitat for 6 Crew / 360 Days
- Lunar HLLV Derivative
- No Radiation Disk Shield for Cargo Missions
- Mars Orbit - 250 km x 1 Sol Elliptical
- Separate Power Generation for Transfer Hab
- Automated Rendezvous for Mars Orbital Ops
- Storable RCS System for Vehicle Elements
- MEV for 6 Crew and 5 mt to Surface
- Zero-g Mars Transit
- Direct Entry Capability at Earth Return

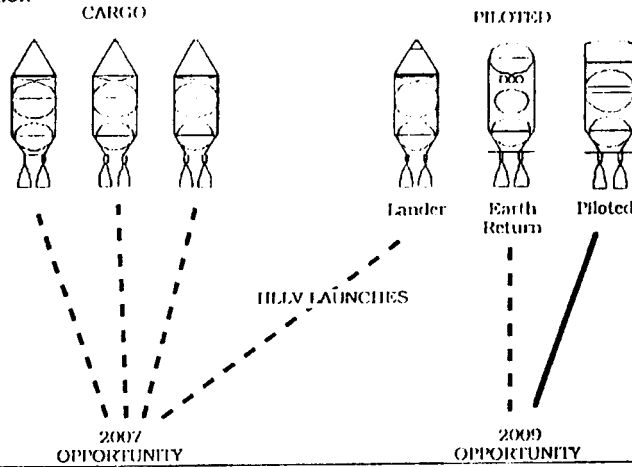




Mars Exploration Program - Launch Vehicle Considerations -



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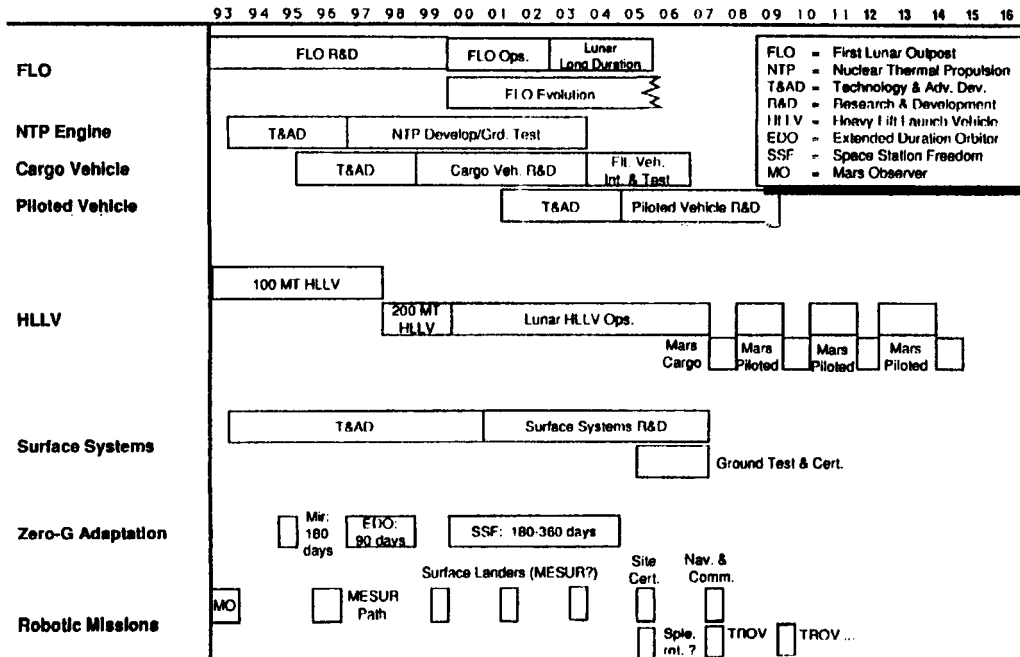
- HLLV Requirements**
- HLLV Derivatives - FLO or Early HLLV
 - 200 mt Class IMLEO Launch Capability
 - Shroud Size Options (Cylindrical Section): 14m x 30m or 10m x 50m
 - Launch Window - ~90 days: 2-4 Launches per Mars Opportunity



Mars Exploration Program - Mars Program Schedule (2007 Cargo Launch) -



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Mars Exploration Program - Study Plan -



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- Continue ExPO development of the Reference Mission
- Consider, compare, and contrast alternative reference mission concepts defined by non-ExPO teams
- Study system and subsystem implementation concepts to improve database