Software Failures In **M**ars **C**limate **O**rbiter

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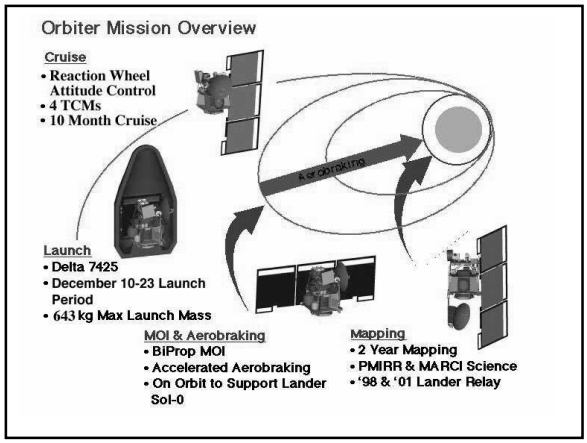
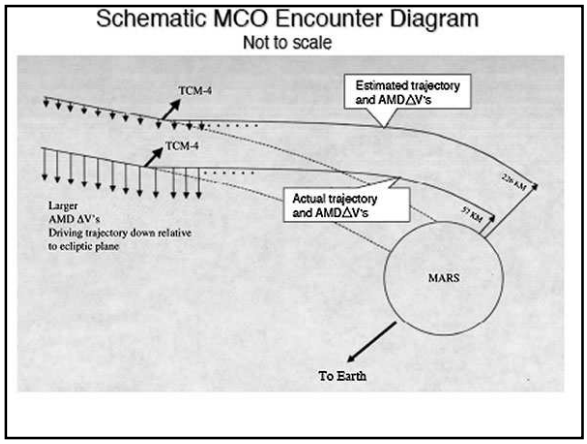
Introduction

- What is MCO?
- MCO objectives
  - Interplanetary weather satellite
  - Communication relay for Mars Polar Lander (MPL) mission



Mission Failure

- MCO mission was lost when it entered the Martian atmosphere on a lower than expected trajectory.



Root Cause

- Failure to use metric units in the coding of a ground software file called "small forces".
- The wrong units in the software underestimated the effect of the thrusters (mechanical force) by a factor of 4.45 which caused trajectory change of the craft.

Software Failures

- The Software Interface Specification (SIS) was not properly used
- End-to-end testing was not accomplished properly
- System engineering process did not adequately address transition from development to operations

Cost

- The cost was approximately $320 millions for both orbiter and the lander.
- Out of this,
  $193.1 million were for spacecraft development
  $91.7 million for launch, and
  $42.8 million for mission operations

Conclusions

- Verify the consistent use of units through out the design and operation
- Review the ground software applications including new and reused software packages for correct data transfer

Thank You