Failure Modes and Effect Analysis
(FMEA)
for the
CRaTER Project

32-04009
Rev 01

Record of Changes

Revision	***ECO***	***Date***	***Author***	***Description of Changes***
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Purpose

The purpose of this Failure Modes and Effects (FMEA) document is to explore the ways or modes the CRaTER instrument can fail and assess the consequences of each of these failures.

1. Scope

By direction from LRO Mission Assurance, The CRaTER Instrument FMEA is conducted at the interface level to the spacecraft.

2. Applicable and Reference Documents

The following applicable and reference documents are mentioned in this document.

- 431-REF-000370 Performing a Failure Mode and effects Analysis
- 32-04003 CRaTER Reliability Assessment
- NASA Ref. Pub 1358 Sys. Eng. "Toolbox" for Design Oriented Engineers (Dec 1994
- Mil-Std-1629A Procedures for Performing FMECA (Nov 1980)

3. General Approach

The general approach for this FMEA is taken from GSFC Flight Assurance Procedure 431-REF-000370.

4. Mission Success Criteria Discussion

LRO is a Class C+ mission and CRaTER functionality in not considered being part of its minimum success criteria. Therefore, given the analysis does not show any credible failures propagating beyond its interfaces, the CRaTER instrument severity codes are limited to 3 & 4 (significant and minor).

Therefore, it is considered an acceptable level of risk that the instrument is single string by design and contains multiple single point failure modes.

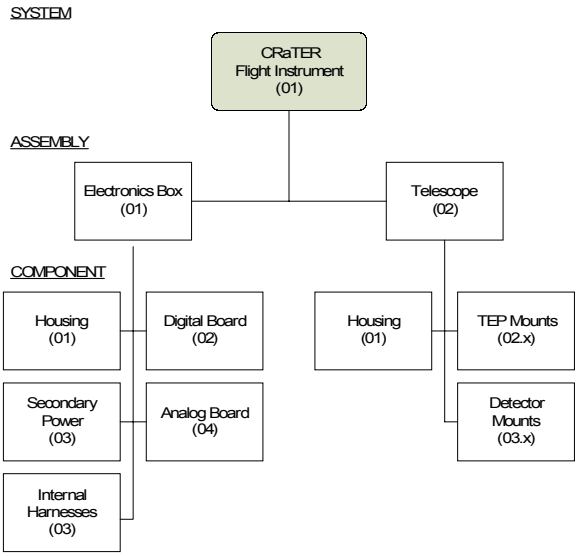
5. CRaTER FMEA

5.1 System and Requirements

The system under review is the CRaTER flight instrument mounted to the LRO spacecraft. The instrument design is rather simple, in that there is only one operational mode. While there are several commands that effect the processing and filtering of the science data, the instrument is either turned on or it is turned off. While turned off, it draws no power and produces no data. It is the responsibility of the spacecraft to keep it within its acceptable environmental limits during this period. While it is on, it is expected to operate within its full design specification.

A loss of functionality of one of the 6 detectors or it's analog processing chains will be considered as "degraded science" and assigned a severity category of minor (Cat 4). Single failure modes that cause loss of acceptable data from all six detectors will be assigned a severity category of Significant (Cat 3).

5.2 Hardware Subsystem Level for Analysis



The encoding scheme for the system is as follows:

01-xx-yy.z

Where ***xx*** designates the assembly, ***yy.z*** the component (z for cases where there are more then one of the same components, i.e. multiple detectors)

5.3 Design Requirements to be Verified

The design requirements that will be assessed are the electrical, mechanical and thermal interfaces to the spacecraft. Where the failure mode does not violate any of these requirements, but only results in a worse case of degradation or loss of the CRaTER instrument's science data, a brief explanation will be given in the worksheet.

5.4 Ground Rule assumption and Mission Phases

These are taken directly from the typical set shown in section 5.1.9 of 431-REF-000370, with the LRO Mission Assurance directed refinement that the FMEA is conducted at the interface level to the Spacecraft. Given that modification, mission phases considered are from Spacecraft I&T thru the on-orbit science mission phase.

The most significant assumptions are that only one failure mode exists at a time and all other conditions are nominal.

5.5 Functional and Reliability Block Diagrams

These can be found in 32-04003 *CRaTER Reliability Assessments*.

5.6 Work Sheets

See Appendix A for Completed Worksheets

5.7 Problem Areas

5.8 Recommended Corrective Actions

6. Acronyms

- MIL-STD Military Standard
- MLI Multi-Layer Insulation
- NASA National Aeronautics and Space Administration

7. Appendix A – Worksheets

See daughter document 32-04009.01