

**LUNAR CRATER OBSERVATION AND SENSING
SATELLITE (LCROSS)
ARCHIVE VOLUME
SOFTWARE INTERFACE SPECIFICATION**

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ACRONYMS AND ABBREVIATIONS

| | |
|--------|--|
| ASCII | American Standard Code for Information Interchange |
| CD-ROM | Compact Disk - Read-Only Memory |
| CD-WO | Write-Once Compact Disk |
| ISO | International Standards Organization |
| JPL | Jet Propulsion Laboratory |
| NSSDC | National Space Science Data Center |
| PDS | Planetary Data System |
| PSG | Project Science Group |
| SDVT | Science Data Validation Team |
| SIS | Software Interface Specification |
| TBD | To Be Determined |

GLOSSARY

Archive – An archive consists of one or more data sets along with all the documentation and ancillary information needed to understand and use the data. An archive is a logical construct independent of the medium on which it is stored.

Archive Volume, Archive Volume Set – A volume is a unit of media on which data products are stored; for example, one CD-ROM or DVD-ROM. An *archive volume* is a volume containing all or part of an archive; that is, data products plus documentation and ancillary files. When an archive spans multiple volumes, they are called an *archive volume set*. Usually the documentation and some ancillary files are repeated on each volume of the set, so that a single volume can be used alone.

Catalog Information – Descriptive information about a data set (e.g. mission description, spacecraft description, instrument description), expressed in Object Description Language (ODL) which is suitable for loading into a PDS catalog.

Data Product – A labeled grouping of data resulting from a scientific observation, usually stored in one file. A product label identifies, describes, and defines the structure of the data. An example of a data product is a planetary image, a spectrum table, or a time series table.

Data Set – An accumulation of data products. A data set together with supporting documentation and ancillary files is an archive.

Standard Data Product – A data product generated in a predefined way using well-understood procedures, processed in "pipeline" fashion. Data products that are generated in a nonstandard way are sometimes called *special data products*.

1. Introduction

1.1. Purpose and Scope

This Software Interface Specification is intended to be used by those who wish to understand the format and content of the Lunar Crater Observation and Sensing Satellite (LCROSS) Science Data Archive. Typically, these individuals would be software engineers, data analysts, or planetary scientists.

The specifications in this document apply to all LCROSS standard product archive volumes that are generated by the LCROSS Project.

1.2. Content Overview

The LCROSS instruments were selected to provide multiple, complementary observations. These instruments are:

| Name | Type | Observations of | Data Products |
|------|---------------------------|---|---|
| VIS | Visible Camera | Context, plume morphology | Raw images only w/ metadata |
| NIR1 | Near-IR Camera | Context, plume morphology | Raw and calibrated images w/ metadata |
| NIR2 | Near-IR Camera | Context, plume morphology; impact location | |
| MIR1 | Mid-IR Camera | Pre-impact terrain; Ejecta Blanket; impact location | Raw and calibrated images w/ metadata |
| MIR2 | Mid-IR Camera | Pre-impact terrain; Ejecta Blanket | |
| NSP1 | Near-IR Spectrometer | Ice, Vapor, Grain Size, Hydrates | Raw and calibrated reflectance spectra w/ metadata; flash (high speed, low spectral resolution) spectra |
| NSP2 | Near-IR Spectrometer | Ice, Vapor, Grain Size, Hydrates | Raw and calibrated absorption spectra w/ metadata |
| VSP | Visible & UV Spectrometer | H ₂ O ⁺ (619 nm); OH (308nm); Search organics | Raw and calibrated reflectance spectra w/ metadata |
| TLP | Photometer | Flash light curve | Raw and calibrated voltage history w/ metadata |

The resulting images and spectra will be delivered as an integrated archive by the LCROSS Science Team, facilitated by the LCROSS Principle Investigator, Payload Scientist and Software Lead.

The LCROSS data sets have the following data set identifiers assigned by PDS.

| Data Set Contents | PDS Data Set ID |
|--|-------------------------------|
| Raw visible camera (VIS) images | LCROSS-E/L-VIS-2-RAW-V1.0 |
| Raw near infrared camera 1 (NIR1) images | LCROSS-E/L-NIR1-2-RAW-V1.0 |
| Calibrated near infrared camera 1 (NIR1) images | LCROSS-E/L-NIR1-3-CAL-V1.0 |
| Raw near infrared camera 2 (NIR2) images | LCROSS-E/L-NIR2-2-RAW-V1.0 |
| Calibrated near infrared camera 2 (NIR2) images | LCROSS-E/L-NIR2-3-CAL-V1.0 |
| Raw mid infrared camera 1 (MIR1) images | LCROSS-E/L-MIR1-2-RAW-V1.0 |
| Calibrated mid infrared camera 1 (MIR1) images | LCROSS-E/L-MIR1-3-CAL-V1.0 |
| Raw mid infrared camera 2 (MIR2) images | LCROSS-E/L-MIR2-2-RAW-V1.0 |
| Calibrated mid infrared camera 2 (MIR2) images | LCROSS-E/L-MIR2-3-CAL-V1.0 |
| Raw, pre-hadamard transformation NSP1 data | LCROSS-E/L-NSP1-2-PREHAD-V1.0 |
| Raw near infrared spectrometer 1 (NSP1) spectra | LCROSS-E/L-NSP1-2-RAW-V1.0 |
| Calibrated near infrared spectrometer 1 (NSP1) spectra | LCROSS-E/L-NSP1-3-CAL-V1.0 |
| Raw near infrared spectrometer 1 (NSP1) flash spectra | LCROSS-E/L-NSP1-FL-2-RAW-V1.0 |
| Calibrated near ir spectrometer 1 (NSP1) flash spectra | LCROSS-E/L-NSP1-FL-3-CAL-V1.0 |
| Raw, pre-hadamard transformation NSP2 data | LCROSS-X-NSP2-2-PREHAD-V1.0 |
| Raw near infrared spectrometer 2 (NSP2) spectra | LCROSS-X-NSP2-2-RAW-V1.0 |
| Calibrated near infrared spectrometer 2 (NSP2) spectra | LCROSS-X-NSP2-3-CAL-V1.0 |
| Raw near infrared spectrometer 1 (NSP1) flash spectra | LCROSS-X-NSP2-FL-2-RAW-V1.0 |
| Calibrated near ir spectrometer 1 (NSP1) flash spectra | LCROSS-X-NSP2-FL-3-CAL-V1.0 |
| Raw visible and UV spectrometer (VSP) spectra | LCROSS-E/L-VSP-2-RAW-V1.0 |
| Calibrated visible and UV spectrometer (VSP) spectra | LCROSS-E/L-VSP-3-CAL-V1.0 |
| Raw total luminance photometer (TLP) data | LCROSS-L-TLP-2-RAW-V1.0 |
| Calibrated total luminance photometer (TLP) data | LCROSS-L-TLP-3-CAL-V1.0 |

This Software Interface Specification (SIS) describes the format, content, and generation of the LCROSS Science Data Archive. Section 2, Archive Volume Generation, describes the procedure for transferring data products to archive media. Section 3, Archive Volume Contents, describes the structure of the archive volumes and the contents of each file. Section 4, Archive Volume Format, describes the file formats used on the archive volumes. Finally, Section 5, Support Staff and Cognizant Persons, lists the individuals responsible for generating the archive volumes.

1.3. Applicable Documents and Constraints

This Archive Volume SIS is intended to be consistent with the following documents:

1. LCROSS Project Archive Generation, Validation and Transfer Plan, 04.05.PDSArchivePlan.01.v1.
2. LCROSS Science Team and PDS Geosciences, Imaging, and NAIF Nodes Interface Control Document (ICD), Version 1.1, October 18, 2007.
3. Lunar CRater Observation and Sensing Satellite (LCROSS) Project Planetary Data System Data Product Software Interface Specification, 02.01.MP.01.v12.
4. *Planetary Data System Archive Preparation Guide*, August 29, 2006, Version 1.1, JPL D-31224.
5. *Planetary Data System Standards Reference*, March 20, 2006, Version 3.7. JPL D-7669, Part 2.
6. ISO 9660-1988, Information Processing - Volume and File Structure of CD-ROM for Information Exchange, April 15, 1988.

1.4. Relationships with Other Interfaces

This document describes the output of the LCROSS Science Data Processing Pipeline, and changes to this document could impact tools implementing that pipeline. Due to the relatively low volume of data produced by LCROSS, this pipeline will be implemented partially by automation and partially by hand.

This Archive Volume SIS could be affected by changes to the design of the LCROSS Science standard data products (Applicable Document #3).

2. Archive Volume Contents

This section describes the contents of the LCROSS Science Data Archive volumes, including the file names, file contents, file types, and organization responsible for providing the files.

2.1. Root Directory Contents

Files in the Root Directory include an overview of the archive, a description of the volume for the PDS Catalog, and a list of errata or comments about the archive. The following files are contained in the Root Directory.

| File Name | File Contents | File Provided By |
|--------------|---|------------------|
| AAREADME.TXT | Volume content and format information | LCROSS |
| AAREADME.LBL | A PDS detached label that describes both AAREADME.TXT and AAREADME.HTM (optional, could be attached to AAREADME.TXT). | LCROSS |
| ERRATA.TXT | A cumulative listing of comments and updates concerning all archive volumes published to date | PDS Node |

| | | |
|-------------|---|--------|
| VOLDESC.CAT | A description of the contents of this volume in a PDS format readable by both humans and computers | LCROSS |
| DATA | Directory containing data files. There may be more than one data directory. | LCROSS |
| DOCUMENT | Directory containing the Data Product SIS, Archive Volume SIS, and other documentation | LCROSS |
| CATALOG | Directory containing text descriptions of the data set, instrument, spacecraft, mission, personnel, and references, which will become part of the PDS Catalog | LCROSS |
| CALIB | Directory containing calibration plans, reports, and data (optional) | LCROSS |
| EXTRAS | Directory containing release data in non-PDS formats including FITS versions of all images and animations indicating how the instrument fields of view moved during the experiment. | LCROSS |

2.2. Data Directory Contents and Naming

The Data directory contains one subdirectory for each payload data collection period during the mission. These are:

| Directory | Description |
|---------------------------|--|
| 20090620022900_QUICKLOOK | Initial payload activation and instrument checkout |
| 20090622034600_STARFIELD | Telescope aperture door deployment and confirmation of gross instrument orientation before the lunar swingby |
| 20090623121800_SWINGBY | Calibration data collection for all instruments except TLP |
| 20090801094900_EARTHLOOK1 | Observations of the Earth |
| 20090817074500_MIRLOOK | Observations of the Moon and Earth intended primarily to generate a point-spread function to evaluate and correct MIR2 focus |
| 20090918180600_EARTHLOOK2 | Observations of the Earth |
| 20091009015100_SEPARATION | Images of the Centaur immediately after separation from the LCROSS Shepherding Spacecraft. |
| 20091009104100_PREIMPACT | Pre-impact instrument checkout and calibration |
| 20091009113022_IMPACT | Data collection from 1 minute before centaur impact to shepherding spacecraft impact and the end of the mission |

Where the numbers at the start of each directory name describes the start of the data collection period in UTC as <year><month><day><hour><minute><second>.

Each payload activation directory contains a PDS data set collection, one per instrument, like so:

| Directory | Description |
|-----------|--|
| VIS | Directory containing data collected by the Visible Light Camera |
| NIR1 | Directory containing data collected by Near Infrared Camera 1 |
| NIR2 | Directory containing data collected by Near Infrared Camera 2 |
| MIR1 | Directory containing data collected by Mid Infrared Camera 1 |
| MIR2 | Directory containing data collected by Mid Infrared Camera 2 |
| NSP1 | Directory containing data collected by Near Infrared Spectrometer 1 |
| NSP2 | Directory containing data collected by Near Infrared Spectrometer 2 |
| VSP | Directory containing data collected by the Visible and UV Spectrometer |
| TLP | Directory containing data collected by the Photometer |

Each data set directory contains one or more subdirectories. Each subdirectory differs from the others by the level of processing of the files contained in them. The following table describes each of these directories. Note <Timestamp> is the UTC time when the image was captured.

| Directory | Description | Sample Filename(s) |
|-----------|--|---------------------------------|
| VIS/ | Directory containing data collected by the Visible Light Camera | |
| RAW/ | Level 0 images in PDS format (integer pixels); 3 channels (RGB) | VIS_RAW_<timestamp>.img |
| NIR1/ | Directory containing data collected by Near Infrared Camera 1 | |
| RAW/ | Level 0 images in PDS format (integer pixels); 3 channels (RGB) | LCROSS_NIR1_RAW_<timestamp>.img |
| CAL/ | Level 1 (calibrated) images in PDS format (floating point pixels); 3 channels (RGB); pixel values represent radiance | LCROSS_NIR1_CAL_<timestamp>.img |
| NIR2/ | Directory containing data collected by Near Infrared Camera | |
| RAW/ | Level 0 images in PDS format (integer pixels); 3 channels (RGB) | LCROSS_NIR2_RAW_<timestamp>.img |
| CAL/ | Level 1 (calibrated) images in PDS format (floating point pixels); 3 channels (RGB); | LCROSS_NIR2_CAL_<timestamp>.img |

| | | |
|---------|--|---|
| | pixel values represent radiance | |
| MIR1/ | Directory containing data collected by Mid Infrared Camera 1 | |
| RAW/ | Level 0 images in PDS format (integer pixels); single channel | LCROSS_MIR1_RAW_<timestamp>.img |
| CAL/ | Level 1 (calibrated) images in PDS format (floating point pixels); 1 channel; pixel value represent temperature. | LCROSS_MIR1_CAL_<timestamp>.img |
| MIR2/ | Directory containing data collected by Mid Infrared Camera 2 | |
| RAW/ | Level 0 images in PDS format (integer pixels); single channel | LCROSS_MIR2_CAL_<timestamp>.img |
| CAL/ | Level 1 (calibrated) images in PDS format (floating point pixels); 1 channel; pixel value represent temperature | LCROSS_MIR2_CAL_<timestamp>.img |
| NSP1/ | Directory containing data collected by Near Infrared Spectrometer 1 | |
| CAL/ | Level 1 spectra after hadamard transform in an ascii table format | LCROSS_NSP1_CAL_<timestamp>.tab |
| PREHAD/ | Level 0 spectra before hadamard transform in an ascii table format | NSP1_DNL_<timestamp>.tab |
| FL_CAL/ | Level 1 low resolution spectra in an ascii table format | LCROSS_NSP1_FL_CAL_*.TAB LCROSS_NSP1_FL_CAL_META_*.TAB |
| FL_RAW/ | Level 0 low resolution spectra in an ascii table format | LCROSS_NSP1_FL_RAW_*.TAB LCROSS_NSP1_FL_RAW_META_*.TAB |
| RAW/ | Level 0 spectra after hadamard transform in an ascii table format | NSP1_RAW_<timestamp>.tab |
| NSP2/ | Directory containing data collected by Near Infrared Spectrometer 2 | |
| CAL/ | Level 1 spectra after hadamard transform in an ascii table format | LCROSS_NSP2_CAL_<timestamp>.tab |
| DNL/ | Level 0 spectra before hadamard transform in an ascii table format | NSP2_DNL_<timestamp>.tab |
| FL_CAL/ | Level 1 low resolution spectra in an ascii table format | LCROSS_NSP2_FL_CAL_<timestamp>.TAB LCROSS_NSP2_FL_CAL_META_*.TAB |

| | | |
|---------|--|---|
| FL_RAW/ | Level 0 low resolution spectra in an ascii table format | LCROSS_NSP2_FL_RAW_<timestamp>.TAB LCROSS_NSP2_FL_RAW_META_*.TAB |
| RAW/ | Level 0 spectra after hadamard transform in an ascii table format | NSP2_RAW_<timestamp>.tab |
| VSP/ | Directory containing data collected by the Visible and UV Spectrometer | |
| RAW/ | Level 0 spectra in an ascii table format | VSP_RAW_<timestamp>.tab |
| CAL/ | Level 1 spectra in an ascii table format | VSP_CAL_<timestamp>.tab |
| TLP/ | Directory containing data collected by the Photometer | |
| RAW/ | Single file containing raw, level 0 values | TLP_RAW_<timestamp>.tab |
| CAL/ | Single file containing raw, level 1 values representing temperature-corrected detector voltage | TLP_CAL_<timestamp>.tab |

Here's an example to tie these tables together. The first image in the Near Infrared Camera #1 dataset taken during the impact period is LCROSS_NIR1_CAL_20091009113033466.IMG. The image was taken at 11:30:33.466 on 10/9/2009, which is encoded in the filename, and it's a calibrated image. Both of these are apparent from the filename. This file has a corresponding label file called LCROSS_NIR1_CAL_20091009113033466.LBL.

This file appears within the DATA\20091009113022_IMPACT\NIR1\CAL directory within the volume. Note that the directory name contains the data collection period (IMPACT) preceded by a timestamp indicating when that data collection period started. That start time is just before the time the image was taken, which is consistent. Within the 20091009113022_IMPACT directory, there is a NIR1 directory containing only NIR1 images and all of them. Within that, there are two directories, CAL and RAW.

2.3. Index Directory Contents

Files in the Index Directory are provided to help the user locate products on this archive volume and on previously released volumes in the archive. An index table lists information about all the data products for a data set on the archive volume. The following files are contained in the Index Directory.

| File Name | File Contents | File Provided By |
|--------------|---|------------------|
| INDXINFO.TXT | A description of the contents of this directory | LCROSS |

| | | |
|--------------------------|---|--------|
| VIS_RAW_INDEX.TAB, .LBL | List of all raw VIS data products, with PDS label | LCROSS |
| NIR1_RAW_INDEX.TAB, .LBL | List of all raw NIR1 data products, with PDS label | LCROSS |
| NIR1_CAL_INDEX.TAB, .LBL | List of all calibrated NIR1 data products, with PDS label | LCROSS |
| NIR2_RAW_INDEX.TAB, .LBL | List of all raw NIR2 data products, with PDS label | LCROSS |
| NIR2_CAL_INDEX.TAB, .LBL | List of all calibrated NIR2 data products, with PDS label | LCROSS |
| MIR1_RAW_INDEX.TAB, .LBL | List of all raw MIR1 data products, with PDS label | LCROSS |
| MIR1_CAL_INDEX.TAB, .LBL | List of all calibrated MIR1 data products with PDS label | LCROSS |
| MIR2_RAW_INDEX.TAB, .LBL | List of all raw MIR2 data products, with PDS label | LCROSS |
| MIR2_CAL_INDEX.TAB, .LBL | List of all calibrated MIR2 data products, with PDS label | LCROSS |
| NSP1_RAW_INDEX.TAB, .LBL | List of all raw NSP1 data products, with PDS label | LCROSS |
| NSP1_CAL_INDEX.TAB, .LBL | List of all calibrated NSP1 data products, with PDS label | LCROSS |
| NSP2_RAW_INDEX.TAB, .LBL | List of all raw NSP2 data products, with PDS label | LCROSS |
| NSP2_CAL_INDEX.TAB, .LBL | List of all calibrated NSP2 data products, with PDS label | LCROSS |
| VSP_RAW_INDEX.TAB, .LBL | List of all raw VSP data products, with PDS label | LCROSS |
| VSP_CAL_INDEX.TAB, LBL | List of all calibrated VSP data products, with PDS label | LCROSS |
| TLP_RAW_INDEX.TAB, LBL | List of all raw TLP data products, with PDS label | LCROSS |
| TLP_CAL_INDEX.TAB, .LBL | List of all calibrated TLP data products, with PDS label | LCROSS |

Each index table will include at minimum the following columns.

- VOLUME_ID
- PATH_NAME
- FILE_NAME (name of PDS label that points to data)
- PRODUCT_ID
- PRODUCT_CREATION_TIME
- MISSION_PHASE_NAME
- START_TIME
- STOP_TIME
- SPACECRAFT_CLOCK_START_COUNT
- SPACECRAFT_CLOCK_STOP_COUNT

2.4. Document Directory Contents

The Document Directory contains documentation to help the user understand and use the archive data. The following files are contained in the Document Directory.

| File Name | File Contents | File Provided By |
|------------------|---|-------------------------|
| DOCINFO.TXT | A description of the contents of this directory | LCROSS |
| DPSIS..HTM | The Data Product SIS as text or hypertext | LCROSS |
| DPSIS.PDF | The Data Product SIS as a PDF file | LCROSS |
| DPSIS.LBL | A PDS label that describes both DPSIS.HTM and DPSIS.PDF | PDS |
| ARCHSIS.HTM | The Archive Volume SIS (this document) as text or hypertext | LCROSS |
| ARCHSIS.PDF | The Archive Volume SIS (this document) as a PDF file | LCROSS |
| ARCHSIS.LBL | A PDS label that describes both ARCHSIS.HTM and ARCHSIS.PDF. | PDS |
| OPS.HTM | LCROSS Measurement and Operations Specification as hypertext | LCROSS |
| OPS.PDF | LCROSS Measurement and Operations Specification as PDF | LCROSS |
| OPS.LBL | A PDS label that describes both OPS.HTM and OPS.PDF. | PDS |
| CALRPT.HTM | Instrument Calibration Summary as hypertext | LCROSS |
| CALRPT.PDF | Instrument Calibration Summary as PDF | LCROSS |
| CALRPT.LBL | A PDS detached label that describes both CALRPT.HTM and CALRPT.PDF. | PDS |
| SCIPLAN.HTM | Mission Science Plan as hypertext | LCROSS |
| SCIPLAN.PDF | Mission Science Plan as PDF | LCROSS |
| SCIPLAN.LBL | A PDS detached label that describes both SCIPLAN.HTM and SCIPLAN.PDF. | PDS |

2.5. Catalog Directory Contents

The files in the Catalog Directory provide a top-level understanding of the mission, spacecraft, instruments, and data sets. The files in this directory are coordinated with the PDS data engineer, who is responsible for loading them into the PDS catalog. PDS provides a template for each type of catalog file, but the contents are provided by instrument and mission personnel. The following files are found in the Catalog Directory.

| File Name | File Contents | File Provided By |
|------------------|---|-------------------------|
| CATINFO.TXT | A description of the contents of this directory | PDS Node |
| VIS_RAW_DS.CAT | Raw VIS data set description | LCROSS |
| NIR1_RAW_DS.CAT | Raw NIR1 data set description | LCROSS |
| NIR1_CAL_DS.CAT | Calibrated NIR1 data set description | LCROSS |
| NIR2_RAW_DS.CAT | Raw NIR2 data set description | LCROSS |
| NIR2_CAL_DS.CAT | Calibrated NIR2 data set description | LCROSS |
| MIR1_RAW_DS.CAT | Raw MIR1 data set description | LCROSS |
| MIR1_CAL_DS.CAT | Calibrated MIR1 data set description | LCROSS |
| MIR2_RAW_DS.CAT | Raw MIR2 data set description | LCROSS |
| MIR2_CAL_DS.CAT | Calibrated MIR2 data set description | LCROSS |

| | | |
|--------------------|---|----------|
| NSP1_RAW_DS.CAT | Raw NSP1 data set description | LCROSS |
| NSP1_CAL_DS.CAT | Calibrated NSP1 data set description | LCROSS |
| NSP1_FL_RAW_DS.CAT | Raw flash mode spectra | LCROSS |
| NSP1_FL_CAL_DS.CAT | Calibrated flash mode spectra | LCROSS |
| NSP1_PREHAD_DS.CAT | Raw mask data used to generate NSP1_RAW_DS | LCROSS |
| NSP2_RAW_DS.CAT | Raw NSP2 data set description | LCROSS |
| NSP2_CAL_DS.CAT | Calibrated NSP2 data set description | LCROSS |
| NSP2_FL_RAW_DS.CAT | Raw flash mode spectra | LCROSS |
| NSP2_FL_CAL_DS.CAT | Calibrated flash mode spectra | LCROSS |
| NSP2_PREHAD_DS.CAT | Raw mask data used to generate NSP2_RAW_DS | LCROSS |
| VSP_RAW_DS.CAT | Raw VSP data set description | LCROSS |
| VSP_CAL_DS.CAT | Calibrated VSP data set description | LCROSS |
| TLP_RAW_DS.CAT | Raw TLP data set description | LCROSS |
| TLP_CAL_DS.CAT | Calibrated TLP data set description | LCROSS |
| INSTHOST.CAT | LCROSS instrument host (i.e., spacecraft) description | LCROSS |
| VIS_INST.CAT | VIS instrument description | LCROSS |
| NIR1_INST.CAT | NIR1 instrument description | LCROSS |
| NIR2_INST.CAT | NIR2 instrument description | LCROSS |
| MIR1_INST.CAT | MIR1 instrument description | LCROSS |
| MIR2_INST.CAT | MIR2 instrument description | LCROSS |
| NSP1_INST.CAT | NSP1 instrument description | LCROSS |
| NSP2_INST.CAT | NSP2 instrument description | LCROSS |
| VSP_INST.CAT | VSP instrument description | LCROSS |
| TLP_INST.CAT | TLP instrument description | LCROSS |
| MISSION.CAT | LCROSS mission description | LCROSS |
| PERSON.CAT | Personnel information (Team and PDS personnel responsible for generating the archive) | LCROSS |
| REF.CAT | Complete citations of references mentioned in other *.CAT files | PDS Node |

2.6. Calib Directory Contents

The Calib Directory contains calibration files used to process the data products, or calibration data needed to use the data products. The following files are contained in the Calib Directory.

| File Name | File Contents | File Provided By |
|---------------|--|------------------|
| CALINFO.TXT | A description of the contents of this directory | LCROSS |
| CALRPT.HTM | Instrument Calibration Summary as hypertext | LCROSS |
| CALRPT_files/ | Directory containing images for CALARPT.HTM | LCROSS |
| CALRPT.PDF | Instrument Calibration Summary as PDF | LCROSS |
| NSP1_CAL.TXT | NSP1 full-resolution mode calibration coefficients | LCROSS |

| | | |
|-----------------|--|--------|
| NSP1_FL_CAL.TXT | NSP1 low-resolution mode calibration coefficients | LCROSS |
| NSP2_CAL.TXT | NSP2 full-resolution mode calibration coefficients | LCROSS |
| VSP_CAL.TXT | VSP calibration coefficients | LCROSS |

2.7. Extras Directory Contents

The Extras Directory contains documentation, utility programs, or other materials that the user may find helpful, but that are beyond the scope of the required elements of the archive. The contents of this directory are exempt from PDS requirements for labeling, etc. The following files are contained in the Extras Directory.

| File Name | File Contents | File Provided By |
|--------------|---|------------------|
| EXTRINFO.TXT | A description of the contents of this directory | LCROSS |
| CALIB/ | Extra calibration files | LCROSS |
| FITS/ | FITS versions of all image files | LCROSS |
| MOVIES/ | Movies and animations intended help explain the context of the observations | LCROSS |

3. Archive Volume Format

This section describes the format of LCROSS Science Data Archive Volumes. Data that comprise the Archive will be formatted in accordance with Planetary Data System specifications [Applicable Documents 4 and 5].

3.1. File Formats

This section describes file formats for the kinds of files contained on Archive Volumes.

3.1.1. Document File Format

Document files with the .TXT suffix exist in the Root, Index, Software, Catalog, Document and Label directories. They are ASCII files which may have embedded PDS labels. Lines in a .TXT file end with a carriage return character (ASCII 13) and a line feed character (ASCII 10). This allows the files to be readable under various operating systems.

Documents in the Document directory may contain formatting and figures that cannot be rendered as ASCII text. Therefore each document is given in two formats, hypertext and PDF. The hypertext file contains ASCII text plus hypertext markup language (HTML) commands that enable it to be viewed in a Web browser such as Netscape Navigator or Microsoft Internet Explorer. The hypertext file may be accompanied by ancillary files such as images and style sheets that are incorporated into the document by the Web browser. The second format, PDF (Portable Document Format) is a proprietary format of Adobe Systems Incorporated that is frequently used for distributing documents. Adobe offers free software, Acrobat Reader, for viewing PDF files (<http://www.adobe.com>).

3.1.2. Tabular File Format

Tabular files (.TAB suffix) exist in the Index and Data directories. Tabular files are ASCII files formatted for direct reading into many database management systems on various computers. All fields are separated by commas, and character fields are enclosed in double quotation marks ("). (Character fields are padded with spaces to keep quotation marks in the same columns of successive records.) Character fields are left justified, and numeric fields are right justified. The "start byte" and "bytes" values listed in the labels do not include the commas between fields or the quotation marks surrounding character fields. The records are of fixed length, and the last two bytes of each record contain the ASCII carriage return and line feed characters. This allows a table to be treated as a fixed length record file on computers that support this file type and as a text file with embedded line delimiters on those that don't.

All tabular files are described by PDS labels, either embedded at the beginning of the file or detached. If detached, the PDS label file has the same name as the data file it describes, with the extension .LBL; for example, the file INDEX.TAB is accompanied by the detached label file INDEX.LBL in the same directory.

3.1.3. PDS Label Format

All data files in the archive have PDS labels, either embedded at the beginning of the file or detached in a separate file. For examples of PDS labels for each type of data product, see the Data Product SIS [Applicable Document 3].

A PDS label, whether embedded or detached from its associated file, consists of lines of ASCII text in the form of keyword = value statements that provide descriptive information about the data file. The label is intended to be readable both by humans and by software. Details of the syntax and semantics of PDS labels can be found in the PDS Standards Reference (Applicable Document 5), and definitions of the keywords used in the label can be found by using the PDS Data Dictionary Lookup web service at http://pds.jpl.nasa.gov/tools/data_dictionary_lookup.cfm. Lines of text in detached labels end with a carriage return character (ASCII 13) and a line feed character (ASCII 10). This allows the files to be read under various operating systems.

3.1.4. Catalog File Format

Catalog files (suffix .CAT) exist in the Root and Catalog directories. Like PDS labels, they are text files formatted as keyword = value statements. They contain descriptions of the data set, instrument, spacecraft, and mission, as well as personnel contact information and references to published literature. They are called Catalog Files because they are loaded into the PDS online catalog to make the information available to users searching for data.

3.1.5. Science Data File Formats

Science data from the VIS, NIR1, NIR2, MIR1, and MIR2 cameras are stored as PDS images with detached labels. Data from the NSP1, NSP2, and VSP spectrometers and from the TLP are stored as ASCII tables with integer and single-precision floating-point data and with detached PDS labels.

For the VIS, NIR1 and NIR2 cameras, the data products are all 720x486 RGB images expressed in PDS IMG format with a detached label. The uncalibrated images will be 24-bit RGB (8 bits

per channel) images, pixel interleaved. The calibrated images will be single-precision floating point per channel, with the same resolution.

The VIS camera is intrinsically color, and the RGB channels are independent. The NIR cameras are black-and-white, but are transmitting their images to the DHU across a color NTSC channel. Therefore, the RGB channels should be identical except for NTSC transmission and A-to-D noise between the camera and the DHU.

The MIR1 and MIR2 images are single channel, 160x120, and 14 bits per pixel. The uncalibrated images will be 16 bits per pixel (the lower 14 bits of which hold data). The calibrated images are single precision floating point.

The NSP1, NSP2 and VSP spectrometer files are ASCII table (comma-separated value) files holding integers (uncalibrated) and single-precision floating point (calibrated) data.

The TLP files are ASCII TBL files holding integers (uncalibrated) and single-precision floating point (calibrated) data.]

For more information about the format and content of the data products, see the Data Product SIS [Applicable Document 3].

4. Archive Volume Generation

4.1. Data Transfer and Validation Methods

Science data provided by the LCROSS science team will meet the specifications detailed in the Data Product SISs.

The LCROSS science team, with the assistance of the PDS Geosciences Node, are responsible for the assembly and production not only of PDS formatted data, but of a complete PDS-compliant archive.

Before final delivery of the archive, the PDS will conduct both peer review and validation on the single submitted volume. The purpose of the peer review is to confirm that the archive will be useable by members of the science community, both present and future, who are not familiar with the mission and/or instruments. Reviewers include members of the PDS, representatives of the LCROSS science team, and members of the science community not associated with the mission.

Validation consists of two parts, science validation and PDS standards validation. The LCROSS team will perform validation for science content of the data. The PDS Nodes that receive the data products will perform validation for compliance with PDS standards, including checking for correct PDS syntax, for accepted standard values of keywords, and for internal consistency of label items.

4.2. Data Product Sizes and Delivery Rates

Data from all LCROSS instruments will be delivered to the PDS in one integrated archive that is expected to be approximately 30 Gb. This delivery will occur 6 months after the LCROSS impact, so the delivery is currently planned for 4/9/2010.

4.3. Interface Media Characteristics

All volumes in the LCROSS Science Data Archive conform to ISO 9660 standards [ISO 9660, 1988].

4.4. Backup and Duplicates

The LCROSS Science Team will deliver science data products to the Imaging and Geosciences Node and SPICE data products to the NAIF Node by electronic (FTP) transfer initiated by the receiving Node. It is expected that there will be only one delivery to PDS for this mission, as discussed in the Archive Plan. Until the electronic transfer has been received by PDS, it is the responsibility of the LCROSS Project to ensure that the archive volume contents are stored on electronic media with a reliable backup copy. Subsequent to the transfer, it is the responsibility of the PDS to ensure a reliable backup copy exists.

The PDS is responsible for ensuring that a copy of the LCROSS archive is delivered to the National Space Science Data Center (NSSDC) for permanent storage, in accordance with agreements in place between the PDS and NSSDC.

4.5. Labeling and Identification

There is a single archive labeled USA_NASA_ARC_LCRO_XXXX containing data from all mission phases for all instruments.

5. Support Staff and Cognizant Persons

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