LROC EDR/CDR/RDR
ARCHIVE VOLUME
SOFTWARE INTERFACE SPECIFICATION

Version 1.11

June 8, 2010

SCHOOL OF EARTH & SPACE EXPLORATION
ARIZONA STATE UNIVERSITY

Signature Page

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TABLES AND FIGURES

DOCUMENT CHANGE LOG

Date	Change	Affected Portions
2007/06/11	Initial draft	All sections
2007/06/26	Suggested changes/edits and comments/questions per Chris Isbell	Per tracked changes
2008/03/17	Updated to reflect change in naming scheme for product files.	Section 2.2
2008/03/28	Incorporated comments/suggestion from Eric Eliason and Stan Scott.	Sections 1.2, 1.3, 2.1, 2.3, 2.4, 2.5, 2.6, 4.2, and 4.4
2008/05/21	Incorporating edits from SIS review	Signature page, Section 2.2 and 2.3.1
2008/06/17	Updates to information recorded in index.cat file	Section 2.3.1
2008/06/17	Updates to incorporate RDR archive releases	Numerous sections
2008/11/03	Completion of changes post PDS review	
2008/12/01	Clarification of duplicate copies of data; updated description of data set and volume labeling for clarity.	Section 4.3, 4.4
2009/03/04	General update	all
2009/06/01	Updated fields for index.tab and cumindex.tab	Section 2.3.1
2010/01/31	Corrected description of volume name.	Section 4.4
2010/03/12	Updated information in table of calibration files.	Section 2.7
2010/06/08	Added two new fields to INDEX.TAB and CUMINDEX.TAB to denote LRO node crossing and spacecraft flight direction (Section 2.3). Minor corrections in other sections.	Section 2.3.1, Section 1.2, Section 2.3.2,

TBR/TBD ITEMS

Section	Description

ACRONYMS AND ABBREVIATIONS

ASCII	American Standard Code for Information Interchange
BDR	Basic Data Recorder
CDR	Calibrated Data Record
CD-ROM	Compact Disk - Read-Only Memory
CD-WO	Write-Once Compact Disk
CODMAC	Committee on Data Management, Archiving, and Computing
DVD	Digital Versatile Disk
EDR	Engineering Data Record
GSFC	Goddard Space Flight Center
IOC	Initial Operating Capability
ISO	International Standards Organization
JPL	Jet Propulsion Laboratory
LRO	Lunar Reconnaissance Orbiter
LROC	Lunar Reconnaissance Orbiter Camera
MDR	Multispectral Data Record
MET	Mission Elapsed Time
MOC	Mission Operations Center
NAC	Narrow Angle Camera
NAC_DEM	NAC Digital Elevation Models
NAC_LS	NAC Landing Site Campaign
NAC_POLE	NAC Polar Mosaic Campaign
NSSDC	National Space Science Data Center
PDS	Planetary Data System
PSG	Project Science Group
RDR	Resampled Data Record
SDP	Special Data Record
SDVT	Science Data Validation Team
SIS	Software Interface Specification
SOC	Science Operations Center
TBD	To Be Determined

TBR	To Be Reviewed
WAC	Wide Angle Camera
WAC_UV	WAC Ultraviolet Imaging Subsystem
WAC_VIS	WAC Visible Imaging Subsystem

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. The LROC EDR/CDR Archive will be stored, distributed, and archived solely on computer disk for the foreseeable future (there will be no formal hard-copy archive such as CD-ROM or DVD-ROM).

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 Reconnaissance Orbiter Camera (LROC) EDR/CDR/RDR Archive.

The specifications in this document apply to all LROC EDR/CDR/RDR standard product archive volumes that are generated by the LROC Project.

1.2. Content Overview

The Lunar Reconnaissance Orbiter Camera (LROC) acquires data from two identical Narrow Angle Cameras (NAC) and one Wide Angle Camera (WAC).

The NACs are panchromatic line scanners that can each obtain images up to 5064 pixels wide (including masked pixels) and 52,224 lines long. NAC images can also be acquired in 2x crosstrack summation mode resulting in an image 2532 pixels wide and up to 52,224 lines long.

The WAC is a push-frame seven band multispectral imager with two sets of optics (UV and Visible). It operates in two basic modes: monochromatic and multi-spectral. In monochromatic mode the camera obtains images through one bandpass (typically 645 nm) as a series of 1024 pixel by 14 line framelets. In multispectral mode the WAC acquires 5 visible bandpasses (415, 566, 604, 643, 689 nm) as a series of 704 pixels by 14 line framelets and 2 UV bandpasses (321 and 360 nm) as a series of 128 pixels by 4 line framelets (4x4 binned from 512 x 16 pixels).

This Software Interface Specification (SIS) describes the format, content, and generation of the LROC EDR/CDR/RDR 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. Lunar Reconnaissance Orbiter Project Data Management and Archive Plan, 431-PLAN-00182. Check with the LRO Project Configuration Management Office to ensure the document is the most current version prior to use.
2. LROC Data Management and Archive Plan, LROC_SOC_PLAN_0001.
3. LROC EDR/CDR Data Product SIS, LROC_SOC_SPEC_0001.
4. LROC RDR Data Product SIS, LROC_SOC_SPEC_0004.

This SIS is also consistent with the following Planetary Data System documents:

5. *Planetary Data System Archive Preparation Guide*, August 29, 2006, Version 1.1, JPL D-31224.
6. *Planetary Data System Standards Reference*, March 20, 2006, Version 3.7. JPL D-7669, Part 2.
7. *Planetary Data System Data Dictionary Document*, August 28, 2002, JPL D-7116, Rev. E

1.4. Relationships with Other Interfaces

This EDR/CDR/RDR Archive Volume SIS could be affected by changes to the design of the LROC standard data products [Applicable Document 3 and 4].

2. Archive Volume Contents

This section describes the contents of the LROC EDR/CDR/RDR 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	Instrument Team
AAREADME.HTM	Hypertext version of AAREADME.TXT	Instrument Team
ERRATA.TXT	A cumulative listing of comments and updates concerning all archive volumes published to date	Instrument Team
VOLDESC.CAT	A description of the contents of this volume in a PDS format readable by both humans and computers	Instrument Team

2.2. Data Directory Contents and Naming

2.2.1. EDR Data

LROC EDR products will be organized by flight day. Flight day is defined to be midnight-to-midnight UTC. Data for each flight day will be organized into a directory structure with the following naming convention:

/MISSION_PHASE/YYYYDOY/INTRUMENT/

where *MISSION_PHASE* can take the value of `COM`, `MAP` or `EXT` (corresponding to the commissioning, mapping and extended mission phase); *YYYYDOY* is the year and day-of-year of acquisition, and *INSTRUMENT* can take the value `NAC` or `WAC`.

Individual EDR files will follow the naming convention:

[TARGET][MET][INSTRUMENT][PRODUCT].img

Where *[TARGET]* is a single character denoting the observation target [(M)oon, (E)arth, (C)alibration or (S)tar]; *[MET]* is a nine digit number reflecting the Mission Elapsed Time of acquisition (with a single digit for partition which denotes a reset of the MET); *[INSTRUMENT]* is a single character denoting the instrument, e.g. (R)ight NAC, (L)eft NAC, (M)onochrome WAC, (C)olor WAC, (V)is WAC, or (U)v WAC; and *[PRODUCT]* is a single character to denote (E)dr. The following are example of possible EDR image filenames:

M010368000RE.IMG

M010368000ME.IMG

C001123200LE.IMG

This schematic shows an example of the nesting of directories for data acquired beginning at midnight February 1, 2009 through midnight February 3, 2009.

<VOLUME ROOT>

|----- MAP/

| |

| |----- 2009032/

| | |------ NAC/

| | |------ WAC/

| |

| |----- 2009033/

| | |------ NAC/

| | |------ WAC/

2.2.2. CDR Data Directory

LROC CDR products will be organized by flight day. Flight day is defined to be midnight-to-midnight UTC. Data for each flight day will be organized into a directory structure with the following naming convention:

/MISSION_PHASE/YYYYDOY/INTRUMENT/

where *MISSION_PHASE* can take the value of `COM`, `MAP` or `EXT` (corresponding to the commissioning, mapping and extended mission phase); *YYYYDOY* is the year and day-of-year of acquisition, and *INSTRUMENT* can take the value `NAC` or `WAC`.

Individual CDR files will follow the naming convention:

[TARGET][MET][INSTRUMENT][PRODUCT].img

Where *[TARGET]* is a single character denoting the observation target [(M)oon, (E)arth, (C)alibration or (S)tar]; *[MET]* is a nine digit number reflecting the Mission Elapsed Time of

acquisition (with a single digit for partition which denotes a reset of the MET); *[INSTRUMENT]* is a single character denoting the instrument, e.g. (R)ight NAC, (L)eft NAC, (M)onochrome WAC, (C)olor WAC, (V)is WAC, or (U)v WAC; and *[PRODUCT]* is a single character to denote (C)dr. The following are example of possible EDR image filenames:

M010368000LC.IMG

T001011239MC.IMG

M001021249MC.IMG

C001123200RC.IMG

This schematic shows an example of the nesting of directories for data acquired beginning at midnight February 1, 2009 through midnight February 3, 2009.

<VOLUME ROOT>

|----- MAP/

| |

| |----- 2009032/

| | |------ NAC/

| | |------ WAC/

| |

| |----- 2009033/

| | |------ NAC/

| | |------ WAC/

2.2.3. RDR Data Directory

LROC RDR products will be organized into directories by product type, as defined in the LROC RDR Data Product SIS [Applicable Document 4]. Each product is described in the RDR Data Product SIS regarding number of files and format. The WAC Polar Movie will be organized by year and day-of-year of acquisition, each subdirectory being denoted using the format *YYYYDOY* for each subdirectory.

This schematic shows an example of the directories from an RDR data release.

<VOLUME ROOT>

|----- /BDR

|------ NAC_LS/

|----- NAC_POLE/

|----- WAC_GLOBAL/

|----- WAC_MOVIE

|------ 2009100

|------ 2009101

|------ 2009102

|------ /MDR

|----- WAC_VIS

|----- WAC_UV/

|------/SDP

|----- NAC_DEM

2.3. Index Directory Contents

Files in the Index Directory are provided to help the user locate products on current and previously released archive volumes. 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	Instrument Team
INDEX.TAB	A table listing all data products on this volume	Instrument Team
INDEX.LBL	A PDS detached label that describes INDEX.TAB	Instrument Team
CUMINDEX.TAB	A cumulative listing of all data products on this volume and on previous volumes in this set (only for data sets with multiple volumes)	Instrument Team
CUMINDEX.LBL	A PDS detached label that describes CUMINDEX.TAB	Instrument Team

2.3.1. EDR/CDR Index File Contents

The Index file for EDR/CDR will contain the information as described in the following table.

Field Name	Description
VOLUME_ID	Volume identification
FILE_SPECIFICATION_NAME	The full name of a file including a path name, relative to a PDS volume
INSTRUMENT_HOST_ID	Always "LRO"
INSTRUMENT_ID	Always “LROC”
ORIGINAL_PRODUCT_ID	File name of the original LROC observation
PRODUCT_ID	Unique identification associated with the product

PRODUCT_VERSION_ID	Version number of this product (v1.1)
TARGET_NAME	The name of the target for this product (MOON, EARTH, CAL, STAR)
ORBIT_NUMBER	LRO orbit number when observation was acquired
SLEW_ANGLE	Angle of LRO when observation acquired for the observation
MISSION_PHASE_NAME	The mission phase at the time the image was acquired (COM, MAP or EXT)
RATIONALE_DESC	Science observation rationale
DATA_QUALITY_ID	Set to an 8-bit value that encodes data quality information
PREROLL_START_TIME	UTC time when image command begins.
START_TIME	UTC time when first image line of target was acquired.
STOP_TIME	UTC time when last image line/frame of target was acquired.
SPACECRAFT_CLOCK_PREROLL_COUNT	S/C clock count when the observation first line of the preroll (1024 lines) was acquired.
SPACECRAFT_CLOCK_START_COUNT	S/C clock count when first image line/frame of target was acquired.
SPACECRAFT_CLOCK_STOP_COUNT	S/C clock count when last image line/frame of target was acquired.
START_SCLK_SECONDS	The spacecraft SCLK seconds value at the start of a NAC or WAC observation.
START_SCLK_TICKS	The spacecraft SCLK ticks value at the start of a NAC or WAC observation.
STOP_SCLK_SECONDS	The spacecraft SCLK seconds value at the end of a NAC or WAC observation.
STOP_SCLK_TICKS	The spacecraft SCLK ticks value at the end of a NAC or WAC observation.
LINE_EXPOSURE_DURATION	Indicates the time elapsed during the acquisition of one image line of data for the NAC LEFT or RIGHT.
EXPOSURE_DURATION	Indicates the time elapsed during the acquisition of one frame of data for the WAC.
FRAME_ID	For NAC observations, denotes “LEFT” or “RIGHT” barrel.
DAC_RESET	Records the commanded DAC reset level for either the NAC LEFT or NAC RIGHT
CHANNEL_A_OFFSET	Records the commanded NAC channel A offset for either the NAC LEFT or NAC RIGHT
CHANNEL_B_OFFSET	Records the commanded NAC channel B offset for either the NAC LEFT or NAC RIGHT

INSTRUMENT_MODE_CODE	The command 8-bit value indicating what mode the NAC or WAC operate during image acquisition.
INSTRUMENT_MODE_ID	WAC observing mode: BW, COLOR, VIS or UV
BAND_CODE	The commanded 8-bit value specifying which WAC bands to acquire for each frame.
BACKGROUND_OFFSET	Records the commanded background offset for WAC observations.
WAC_FILTER_NAME	Numerical designation of the WAC optical filters in nanometers (415, 566, 604, 643, 689, 321, 360).
NUMBER_OF_FRAMES	Records the commanded number of frames for a WAC observation.
INTERFRAME_TIME	Set to the value of the interframe delay between WAC framelets.
INTERFRAME_CODE	Records the commanded interframe gap code for a WAC observation.
MODE_POLAR	Records the commanded mode for the POLAR flag on WAC observation.
COMPAND_SELECT_CODE	Records the commanded value designating which companding table to utilize for WAC or NAC observations.
MODE_COMPRESSION	Recordes the command flag controlling if compression is enabled or disabled for a WAC or NAC observation.
MODE_TEST	Records the commanded flag controlling if a TEST image is to be acquired.
TEMPERATURE_SCS	Temperature of LROC SCS
TEMPERATURE_FPA	Temperature of NAC focal plane array
TEMPERATURE_FPGA	Temperature of NAC FPGA
TEMPERATURE_TELESCOPE	Temperature of NAC Telescope
BEGIN_TEMPERATURE_SCS	Temperature of LROC SCS at the beginning of a WAC observation.
MIDDLE_TEMPERATURE_SCS	Temperature of LROC SCS at the middle of a WAC observation.
END_TEMPERATURE_SCS	Temperature of LROC SCS at the end of a WAC observation.
BEGIN_TEMPERATURE_FPA	Temperature of WAC focal plane array at the beginning of an observation.
MIDDLE_TEMPERATURE_FPA	Temperature of WAC focal plane array at the middle of an observation.
END_TEMPERATURE_FPA	Temperature of WAC focal plane array at the end of an observation.
ORBIT_NODE	A character denoting the orbit node for LRO: character

	A for ascending node portion of the orbit; character D for descending node portion of the orbit
LRO_FLIGHT_ORIENTATION	Denotes the LRO spacecraft X-axis relative to the velocity vector: +X (positive X axis aligned with velocity vector) or –X (negative X axis aligned with velocity vector).
Information about the image array	
IMAGE_LINES	Number of image lines
LINE_SAMPLES	Number of line samples
SAMPLE_BITS	The number of Bits per Pixel
Geometry information for the observation	
SCALED_PIXEL_WIDTH	The cross-scan image resolution in meters/pixel at the center of the Observation
SCALED_PIXEL_HEIGHT	The down-scan image resolution in meters/pixel at the center of the Observation
RESOLUTION	The calculated pixel resolution at the center of a NAC or WAC observation.
EMISSION_ANGLE	The emission angle at the center of the observation
INCIDENCE_ANGLE	The incidence angle at the center of the observation
PHASE_ANGLE	The phase angle at the center of the observation
NORTH_AZIMUTH	The angle in degrees clockwise from the reference axis of the observation (a line from the center to the right edge of the observation) to the direction to the north pole of the target body.
SUB_SOLAR_AZIMUTH	The angle in degrees clockwise from the reference axis of the observation (a line from the center to the right edge of the observation) to the direction to the sub-solar point on the target body.
SUB_SOLAR_LATITUDE	The planetocentric latitude of the sub-solar point in degrees.
SUB_SOLAR_LONGITUDE	The planetocentric longitude of the sub-solar point in degrees
SUB_SPACECRAFT_LATITUDE	The planetocentric latitude of the sub-spacecraft point in degrees.
SUB_SPACECRAFT_LONGITUDE	The planetocentric longitude of the sub-spacecraft point in degrees.
SOLAR_DISTANCE	The distance from the center of the image on the target body to the center of the Sun in kilometers.
SOLAR_LONGITUDE	The value of the angle between the body_Sun line at the time of interest and the body_Sun line at the vernal equinox.
CENTER_LONGITUDE	The planetocentric longitude coordinate at the center of

	the observation.
CENTER_LATITUDE	The planetocentric latitude coordinate at the center of the observation.
UPPER_RIGHT_LONGITUDE LOWER_RIGHT_LONGITUDE LOWER_LEFT_LONGITUDE UPPER_LEFT_LONGITUDE	The longitude values of the original four corners of the observation.
UPPER_RIGHT_LATITUDE LOWER_RIGHT_LATITUDE LOWER_LEFT_LATITUDE UPPER_LEFT_LATITUDE	The latitude values of the original four corners of the observation.
SPACECRAFT_ALTITUDE	This field represents the center altitude for the observation on the LRO ellipsoid reference.
TARGET_CENTER_DISTANCE	The distance from the spacecraft to the target body's center in kilometers
TARGET_NAME	String representing the target body observed in the image.

2.3.2. RDR Index File Contents

The Index file for RDR products will contain the information as described in the following table.

Field Name	Description
DATA_SET_ID	Data set identification
FILE_NAME_SPECIFICATION	Path & file name of product
INSTRUMENT_HOST_ID	Always "LRO"
PRODUCT_ID	The product identification value
PRODUCT_VERSION_ID	Version number of this product
TARGET_NAME	The name of the target for this product (MOON, EARTH, CAL, STAR)
RATIONALE_DESC	Description of the rationale for this product
SOFTWARE_NAME	Name of the software used to create this product
PRODUCT_CREATION_TIME	Creation date and time stamp for this product
Information about the image array	
IMAGE_LINES	Number of image lines
LINE_SAMPLES	Number of line samples
SAMPLE_BITS	The number of Bits per Pixel
BANDS	The number of bands in the image

Information about the image map projection	
MAP_PROJECTION_TYPE	Identifies the projection characteristic of a given map.
PROJECTION_LATITUDE_TYPE	Identifies the type of latitude that is sampled in equal increments by successive image lines.
COORDINATE_SYSTEM_NAME	Provides full name of the coordinate system to which the state vectors are referenced.
POSITIVE_LONGITUDE_DIRECTION	Identifies the direction of longitude for a body.
CENTER_LONGITUDE	Provides the reference latitude of the map projection.
CENTER_LATITUDE	Provides the reference longitude of the map projection.
MAP_RESOLUTION	Identifies the resolution of a map projection in pixels/degree at the center latitude and longitude of the projection.
MAP_SCALE	Identifies the scale of a map projection in meters/pixel at the center latitude and longitude of the projection.
MAXIMUM_LATITUDE	The northernmost latitude of the map
MINIMUM_LATITUDE	The southernmost latitude of the map
EASTERNMOST_LONGITUDE	The easternmost longitude of the map
WESTERNMOST_LONGITUDE	The westernmost longitude of the map

2.4. Extras Directory Contents

The Extras Directory contains reduced scale thumbnail (browse) PNG formatted images corresponding to individual NAC images. WAC thumbnail images are not provided due to the interleaving of spectral bands that would make such image un-intelligible.

2.5. 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	Instrument Team
DPSIS.TXT or .HTM	The Data Product SIS as text or hypertext	Instrument Team
DPSIS.PDF	The Data Product SIS as a PDF file	Instrument Team
DPSIS.LBL	A PDS detached label that describes both DPSIS.TXT(HTM) and DPSIS.PDF	Instrument Team
ARCHSIS.TXT or .HTM	The Archive Volume SIS (this document) as text or hypertext	Instrument Team
ARCHSIS.PDF	The Archive Volume SIS (this document) as a PDF file	Instrument Team
ARCHSIS.LBL	A PDS detached label that describes both ARCHSIS.TXT(HTM) and ARCHSIS.PDF.	Instrument Team

2.6. 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. 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	Instrument Team
DS.CAT	Data set information for the PDS catalog	Instrument Team
INSTHOST.CAT	Instrument host (i.e. spacecraft) information for the PDS catalog	Spacecraft Team
INST.CAT	Instrument information for the PDS catalog	Instrument Team
MISSION.CAT	Mission information for the PDS catalog	Spacecraft Team
PERSON.CAT	Personnel information for the PDS catalog (Team and PDS personnel responsible for generating the archive)	Instrument Team
REF.CAT	References mentioned in other *.CAT files	Spacecraft Team / Instrument Team

2.7. Calib Directory Contents

The Calib Directory contains calibration files used to process the CDR 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	Instrument Team
NACL_LINCOEFF_0003.TXT	NAC-L Linearization Coefficients	Instrument Team
NACR_LINCOEFF_0003.TXT	NAC-R Linearization Coefficients	Instrument Team
NACL_MSKPIXEL_0001.TXT	NAC-L Masked Pixels	Instrument Team
NACR_MSKPIXEL_0001.TXT	NAC-R Masked Pixels	Instrument Team
NAC_RADRESP_0002.TXT	NAC Radiometric Responsivity	Instrument Team
WAC_RADRESP_0002.TXT	WAC Radiometric Responsivity	Instrument Team
NACL_AVGDRK.IMG	NAC-L Average Dark	Instrument Team
NACL_AVGDRK_SUM.IMG	NAC-L Average Dark Summed	Instrument Team
NACL_FLATFIELD.IMG	NAC-L Flat Field	Instrument Team
NACL_FLATFIELD_SUM.IMG	NAC-L Flat Field Summed	Instrument Team
NACL_LINOFFSET.IMG	NAC-L Linearization Offsets	Instrument Team
NACL_LINOFFSET_SUM.IMG	NAC-L Linearization Offsets Summed	Instrument Team
NACR_AVGDRK.IMG	NAC-R Average Dark	Instrument Team
NACR_AVGDRK_SUM.IMG	NAC-R Average Dark Summed	Instrument Team
NACR_FLATFIELD.IMG	NAC-R Flat Field	Instrument Team

File Name	File Contents	File Provided By
NACR_FLATFIELD_SUM.IMG	NAC-R Flat Field Summed	Instrument Team
NACR_LINOFFSET.IMG	NAC-R Linearization Offsets	Instrument Team
NACR_LINOFFSET_SUM.IMG	NAC-R Linearization Offsets Summed	Instrument Team
WAC_BW_415_M1_FLAT.IMG	WAC BW 415 Mode1 Flatfield	Instrument Team
WAC_ BW_415_M1_O56_DRK.IMG	WAC BW 415 Mode1 Offset56 Dark	Instrument Team
WAC_ BW_415_M1_O68_DRK.IMG	WAC BW 415 Mode1 Offset68 Dark	Instrument Team
WAC_BW_415_M2_FLAT.IMG	WAC BW 415 Mode2 Flatfield	Instrument Team
WAC_ BW_415_M2_O56_DRK.IMG	WAC BW 415 Mode2 Offset56 Dark	Instrument Team
WAC_ BW_415_M2_O68_DRK.IMG	WAC BW 415 Mode2 Offset68 Dark	Instrument Team
WAC_ BW_415_M2_SPECPIX.IMG	WAC BW 415 Mode2 SpecialPixels	Instrument Team
WAC_ BW_566_M1_O56_DRK.IMG	WAC BW 556 Mode1 Offset56 Dark	Instrument Team
WAC_ BW_566_M1_O68_DRK.IMG	WAC BW 556 Mode1 Offset68 Dark	Instrument Team
WAC_ BW_566_M2_O56_DRK.IMG	WAC BW 556 Mode2 Offset56 Dark	Instrument Team
WAC_ BW_566_M2_O68_DRK.IMG	WAC BW 556 Mode2 Offset68 Dark	Instrument Team
WAC_BW_566_M1_FLAT.IMG	WAC BW 566 Mode1 Flatfield	Instrument Team
WAC_ BW_566_M1_SPECPIX.IMG	WAC BW 566 Mode1 SpecialPixels	Instrument Team
WAC_BW_566_M2_FLAT.IMG	WAC BW 566 Mode2 Flatfield	Instrument Team
WAC_ BW_566_M2_SPECPIX.IMG	WAC BW 566 Mode2 SpecialPixels	Instrument Team
WAC_BW_604_M1_FLAT.IMG	WAC BW 604 Mode1 Flatfield	Instrument Team
WAC_ BW_604_M1_O56_DRK.IMG	WAC BW 604 Mode1 Offset56 Dark	Instrument Team
WAC_ BW_604_M1_O68_DRK.IMG	WAC BW 604 Mode1 Offset68 Dark	Instrument Team
WAC_BW_604_M2_FLAT.IMG	WAC BW 604 Mode2 Flatfield	Instrument Team
WAC_ BW_604_M2_O56_DRK.IMG	WAC BW 604 Mode2 Offset56 Dark	Instrument Team
WAC_ BW_604_M2_O68_DRK.IMG	WAC BW 604 Mode2 Offset68 Dark	Instrument Team
WAC_ BW_604_M2_SPECPIX.IMG	WAC BW 604 Mode2 SpecialPixels	Instrument Team
WAC_BW_643_M1_FLAT.IMG	WAC BW 643 Mode1 Flatfield	Instrument Team
WAC_ BW_643_M1_O56_DRK.IMG	WAC BW 643 Mode1 Offset56 Dark	Instrument Team
WAC_ BW_643_M1_O68_DRK.IMG	WAC BW 643 Mode1 Offset68 Dark	Instrument Team
WAC_BW_643_M2_FLAT.IMG	WAC BW 643 Mode2 Flatfield	Instrument Team
WAC_ BW_643_M2_O68_DRK.IMG	WAC BW 643 Mode2 Offset68 Dark	Instrument Team
WAC_ BW_643_M2_SPECPIX.IMG	WAC BW 643 Mode2 SpecialPixels	Instrument Team
WAC_BW_689_M1_FLAT.IMG	WAC BW 689 Mode1 Flatfield	Instrument Team
WAC_ BW_689_M1_O56_DRK.IMG	WAC BW 689 Mode1 Offset56 Dark	Instrument Team
WAC_ BW_689_M1_O68_DRK.IMG	WAC BW 689 Mode1 Offset68 Dark	Instrument Team
WAC_ BW_689_M1_SPECPIX.IMG	WAC BW 689 Mode1 SpecialPixels	Instrument Team
WAC_BW_689_M2_FLAT.IMG	WAC BW 689 Mode2 Flatfield	Instrument Team
WAC_ BW_689_M2_O56_DRK.IMG	WAC BW 689 Mode2 Offset56 Dark	Instrument Team

File Name	File Contents	File Provided By
WAC_ BW_689_M2_O68_DRK.IMG	WAC BW 689 Mode2 Offset68 Dark	Instrument Team
WAC_ BW_689_M2_SPECPIX.IMG	WAC BW 689 Mode2 SpecialPixels	Instrument Team
WAC_COLOR_FLATFIELD.IMG	WAC COLOR Flatfield	Instrument Team
WAC_UV_SPECPIX.IMG	WAC UV SpecialPixels	Instrument Team
WAC_UV_O68_DRK.IMG	WAC UV Offset68 Dark	Instrument Team
WAC_UV_O56_DRK.IMG	WAC UV Offset56 Dark	Instrument Team
WAC_UV_FLATFIELD.IMG	WAC UV Flatfield	Instrument Team
WAC_COLOR_SPECPIX.IMG	WAC COLOR SpecialPixels	Instrument Team
WAC_COLOR_O68_DRK.IMG	WAC COLOR Offset68 Dark	Instrument Team
WAC_COLOR_O56_DRK.IMG	WAC COLOR Offset56 Dark	Instrument Team

3. Archive Volume Format

This section describes the format of LROC EDR 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 types of files contained on Archive Volumes.

3.1.1. Document File Format

Document files with the .TXT suffix exist in the Root, Index, Catalog, Document and Calibration 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 Firefox 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.

3.1.2. Tabular File Format

Tabular files (.TAB suffix) exist in the Index directory. 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

LROC EDR and CDR data files are all in the form of a binary image.

The LROC NAC image data consists of one series of contiguous lines up to 52,224 line with 5,000 samples in full resolution mode, or 104,448 lines with 5,000 samples in 2x crosstrack summation mode. The NAC EDR data will be delivered in 8-bit format. NAC CDR data will be delivered in 16-bit format.

The WAC EDR consists of series of framelets all acquired with identical camera settings for interframe delay, line exposure and filters acquired. WAC observations (monochromatic or color) are segmented into files that are no larger than 257 Megabytes in size. WAC EDR data will be delivered in 8-bit format. WAC CDR data will be delivered in 32-bit format.

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

LROC EDR products will be stored in the JPEG2000 format, after undergoing radiometric calibration, photometric calibration and geometric processing. Mosaic quadrangle with also undergo brightness equalization before mosaicking. RDR products will be stored in a variety of dimensions and resolutions.

For more information about the format and content of the data products, see the Data Product SIS [Applicable Document 4].

4. Archive Volume Generation

4.1. Data Transfer and Validation Methods

LROC EDR/CDR/RDR products are generated at the LROC Science Operation Center, located on the Arizona State University campus. EDR products are collected and assembled into EDR /CDR/RDR archive volumes by the LROC Team. Volumes are then electronically delivered to the LROC PDS Data Node, co-located at the ASU campus, according to the schedule in Section 4.2.

The LROC Team validates the EDR/CDR/RDR products for science content as part of the product generation process. The Imaging Node validation routines are incorporated into the LROC processing pipelines, which check for compliance with PDS standards and with the Data Product SIS and Archive Volume SIS documents.

EDR archives volumes are made available via Internet web access via the LROC Data Node.

4.2. Data Product Sizes and Delivery Rates

Table 1 summarizes expected sizes and production rates for the LROC Standard Products.

Table 1 – Standard Product Sizes and Delivery Rates

Product	Product Size	Production Rate	Expected Number of Products for Primary Mission	Expected Total Data Volume for Primary Mission
NAC EDR	3,000 GB	Every 3 months, first delivery at IOC + 6 Mo	4	12,000 GB
NAC CDR	6,000 GB	Every 3 months, first delivery at IOC + 6 Mo	4	24,000 GB
WAC EDR	2,000 GB	Every 3 months, first delivery at IOC + 6 Mo	4	8,000 GB
WAC CDR	4,000 GB	Every 3 months, first delivery at IOC + 6 Mo	4	16,000 GB
NAC LS	500 GB	Delivery at IOC + 18 Mo	1	500 GB
NAC POLE	293 GB	Delivery at IOC + 18 Mo	1	293 GB
WAC GLOBAL	27 GB	Delivery at IOC + 18 Mo	1	27 GB
WAC VIS WAC UV	639 GB	Delivery at IOC + 18 Mo	1	639 GB
WAC MOVIE	179 GB	Delivery at IOC + 18 Mo	1	179 GB
NAC DEM	25 GB	Delivery at IOC + 18 Mo	1	25 GB

IOC – Initial Operating Capability, which begins after Commissioning of spacecraft and instruments is complete.

4.3. Backup and Duplicates

Backup copies of LROC PDS products will be stored on the LROC SOC enterprise storage system, with each copy being located in two separate locations on the ASU campus. Tape archives of the enterprise storage system will be produced and stored offsite.

4.4. Labeling and Identification

Each LROC EDR/CDR/RDR archive data set will be identified by a unique data set ID formed according to the scheme LRO-L-LROC-2-EDR-V1.0, LRO-L-LROC-3-CDR-V1.0 or LRO-L-LROC-5-RDR-V1.0 where

LRO represents the Lunar Reconnaissance Orbiter mission,

L represents the Lunar observations,

LROC represents the instrument suite,

2/3/5 represents the CODMAC processing level,

EDR/CDR/RDR represents the product, and

Vx.x indicates the version of the data set, starting with the number 1.0, and incrementing by 0.1.

If the entire LROC EDR, CDR or RDR data set is revised, the data set ID version number will be incremented.

Data will be arranged and identified within unique archive volumes (Volume IDs) and will follow the scheme LROLRC_dnnn where:

LRO represent the Lunar Reconaissance Orbitor spcacraft,

LRC represents the Lunar Reconaissance Orbiter Camera,

d represents the type of data (0 for EDR/CDR, 1 for RDR),

nnn represents the nnnth release (where nn=01, 02, .. up to 999 releases)

5. Support Staff and Cognizant Persons

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Mark Robinson, LROC Principle Investigator, Arizona State University

Jacob Danton, LROC Software Developer, Arizona State University

Questions and comments regarding the LROC EDR Archive Volume may be directed to the LROC Data Node, Arizona State University, lroc-dn@ser.asu.edu.