2008 Lunar Reconnaissance Orbiter

LUNAR EXPLORATION NEUTRON DETECTOR RDR NASA LEVEL 1 SOFTWARE INTERFACE SPECIFICATION

June 10, 2016

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# DOCUMENT CHANGE LOG

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<td>Averaged Lend Counts Data</td>
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<td>ALF</td>
<td>Averaged Lend Flux Data</td>
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<tr>
<td>CHK</td>
<td>Converted Housekeeping Data</td>
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<tr>
<td>CODMAC</td>
<td>Committee on Data Management and Computation</td>
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<td>DLD</td>
<td>Derived Lend Data</td>
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<tr>
<td>DLX</td>
<td>Extended Derived Lend Data</td>
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<tr>
<td>EDR</td>
<td>Experiment Data Record</td>
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<tr>
<td>IKI</td>
<td>Institute for Space Research</td>
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<tr>
<td>JPL</td>
<td>Jet Propulsion Laboratory</td>
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<td>LEND</td>
<td>Lunar Exploration Neutron Detector</td>
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<tr>
<td>LRO</td>
<td>Lunar Reconnaissance Orbiter</td>
</tr>
<tr>
<td>MSB</td>
<td>Most Significant Byte</td>
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<td>NASA</td>
<td>National Aeronautics and Space Administration</td>
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<td>PDS</td>
<td>Planetary Data System</td>
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<td>PI</td>
<td>Principal Investigator</td>
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<td>RDR</td>
<td>Reduced Data Record</td>
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<td>RSCI</td>
<td>Rectified Science Data</td>
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<td>SETN</td>
<td>Sensor Epithermal Neutron</td>
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<td>SHEN</td>
<td>Sensor High Energy Neutron</td>
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<td>SIS</td>
<td>Software Interface Specification</td>
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<td>STN</td>
<td>Sensor Thermal Neutron</td>
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1. INTRODUCTION

1.1 Purpose and Scope

The purpose of this Data Product SIS is to provide users of the Lunar Exploration Neutron Detector (LEND) Reduced Data Record (RDR) (NASA Level 1) data product with a detailed description of the product and a description of how it was generated, including data sources and destinations. The RDR product contains calibrated and averaged neutron spectra from the Lunar Reconnaissance Orbiter (LRO) LEND. This SIS is intended to provide enough information to enable users to read and understand the data product. The users for whom this SIS is intended are the scientists who will analyze the data, including those associated with the 2008 Lunar Reconnaissance Orbiter and those in the general planetary science community.

1.2 Contents

This Data Product SIS describes how the RDR data product is acquired by the LEND instrument, and how it is processed, formatted, labeled, and uniquely identified. The document discusses standards used in generating the product and software that may be used to access the product. The data product structure and organization is described in sufficient detail to enable a user to read the product. Finally, an example of a product label is provided.

1.3 Applicable Documents and Constraints

This Data Product SIS is responsive to the following LRO documents:

1. Lunar Reconnaissance Orbiter Project Data Management and Archive Plan, 431-PLAN-00182


5. Data processing of LEND collimated sensors, Boynton et al., June 8, 2016.

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


Finally, this SIS is meant to be consistent with the contract negotiated between the
2008 Lunar Reconnaissance Orbiter and the LEND Principal Investigator (PI) in which reduced data records and documentation are explicitly defined as deliverable products.

1.4 Relationships with Other Interfaces

The LEND Archive Volume SIS describes how the data products specified by this document will be made available through the PDS. The LEND RDR data products are dependent on the LEND EDR data products as specified in Applicable Document [4]. Any changes to the EDR data products will necessitate changes in this document and in the RDR data products.

2. DATA PRODUCT CHARACTERISTICS AND ENVIRONMENT

2.1 Instrument Overview

The Lunar Exploration Neutron Detector, LEND, was designed and built by P.I. Igor Mitrofanov at the Russian Space Institute for incorporation into NASA’s Lunar Reconnaissance Orbiter (LRO) as a large orbital neutron telescope for mapping the Moon’s neutron albedo. LEND is the follow-on instrument from the High Energy Neutron Detector (HEND) onboard Mars Odyssey, although LEND incorporates a set of collimated detectors to improve spatial resolution. The methods and procedures of LEND data processing and analysis are based on existing procedures that have been developed for analysis of HEND data. The following paragraphs will briefly describe the LEND instrument.

LEND has eight $^3$He sensors for detecting thermal and epithermal neutrons. Four of the $^3$He sensors un-collimated and four are collimated. As seen in Figure 2.1. LEND Instrument Overview, external sensors STN1-3 (Sensor Thermal Neutrons) and SETN (Sensor EpiThermal Neutrons) are the un-collimated sensors that detect thermal and epithermal neutrons. STN-3 and SETN both have open fields of view. The combination of these two sensors will allow the measurement of local density of thermal and epithermal neutrons around the spacecraft. STN 1 and 2 are located near the midpoint of the instrument and have the thick mass of the collimation module just between them. For sensors on the +X and -X sides, the collimation material absorbs all external particles coming from directions −X and +X, respectively. The velocity vector of LRO will correspond to one of these directions: therefore, sensors STN 1 and 2 will detect neutrons with velocities ($V_n + V_{orb}$) and ($V_n - V_{orb}$), respectively, and will operate as a Doppler filter to separate the flux of external neutrons from the Moon from the local spacecraft background. The full set of four sensors, SETN and STN 1-3, will provide the data to characterize the neutron component of lunar radiation background at the altitude of LRO separately from the neutron component of local background produced by LRO itself.

The collimated sensors of epithermal neutrons, CSETN1-4, are also $^3$He counters, that are installed inside the collimating module, which effectively absorbs external neutrons outside of instrument Field of View. Absorbing neutrons is very difficult; one of the best absorbing materials is $^{10}$B, and its absorption efficiency becomes much higher when neutrons are slower. The LEND collimators have external layers of polyethylene for moderation of impacting neutrons and internal layers of $^{10}$B for their efficiency. These sensors are also enclosed by Cd shields that absorb all neutrons with energies below ~0.4
eV, which mainly correspond to thermal neutrons. The neutron collimator provides the instrument Field of View (FOV): epithermal neutrons of direct flux inside the FOV are recorded by the detector, while the majority of neutrons outside the FOV are absorbed by the collimator. This collimation technique provides mapping of epithermal neutrons from the Moon’s surface with the horizontal resolution of 5 km for LRO at an altitude of 50 km.

The final LEND sensor is the Sensor for High Energy Neutrons (SHEN), which is a stilbene scintillator that produces a flash of light each time a high energy neutron in the energy range 0.3 – 15.0 MeV collides with a hydrogen nucleus and creates a recoil proton. Special shape-sensitive electronics distinguish proton counts from electron counts, and an active anti-coincidence shield eliminates external charged particles. This sensor is installed inside the central hole of the collimation unit, and its Field of View corresponds to 40° (HWHM). The SHEN sensor outputs data in 16 energy channels from 300 keV to more than 15 MeV, and is the source of the SC1-3 spectra.

LEND operates autonomously, collecting data throughout the lunar orbit. LEND generates approximately 0.26 Gbits of measurement data per day. In order to perform early calibration measurements, LEND became active shortly after the first mid course correction (MCC) burn. Operationally, LEND is simple and has only three instrument modes: MEASUREMENTS, STAND-BY, and OFF. While in MEASUREMENTS mode, instrument electronics and detector high voltage are both ‘on’ and the instrument generates measurement and housekeeping data. In STAND-BY mode, instrument electronics are ‘on’, detector high voltage is ‘off’, and only housekeeping data are generated. While in OFF mode, the instrument is ‘off’, the instrument external heater is ‘on’, and only external temperature data are generated.

For further information about the LEND instrument and the LEND experiment please see Applicable Document [3].
Figure 2.1. LEND Instrument Overview
2.2 Data Product Overview

The LEND RDR data product contains six types of data.

- **LEND_CONVERTED_HK_DATA** (CHK) is a time-series of Neutron Detector engineering and housekeeping data that has been reduced to yield data in engineering units.
- **LEND_RECTIFIED_SCIENCE_DATA** (RSCI) is a time-series of Neutron Detector science data that includes timing and spatial information associated with the data collection interval.
- **DERIVED_LEND_DATA** (DLD) is a time series of Neutron Detector science data that has been processed to account for instrument warm up and efficiency saturation effects, variation of Galactic Cosmic Ray (GCR) flux, clearance for Solar Particle Events (SPE), separation between charged particles and neutrons, temperature and altitude corrections.
- **EXTENDED_DERIVED_LEND_DATA** (DLX) is a time series of Neutron Detector science data that contains supplemental values useful for interpretation of DLD data, including uncertainties for neutron counts on each detector.
- **AVERAGED_LEND_COUNTS_DATA** (ALD) is Neutron Detector science data that has been processed by normalizing and averaging derived data to yield science data in a counts/second format for each Lunar map pixel.
- **AVERAGED_LEND_FLUX_DATA** (ALF) is Neutron Detector science data that has been processed by normalizing and averaging derived data to yield orbital epithermal and fast neutron fluxes.

2.3 Data Processing

The specific data formats for the RDR products are described in Section 3 with Detailed Data Product Specifications on page 15. Data volume is a function of collection rate as parameterized by collection interval. The nominal collection interval is 1 second or 86400 records per day per file. Collection Interval can be changed in the middle of a time series file, which can be determined by noting the difference between record timestamps. There is one RSCI and Derived record for
each LEND EDR Science data record. Since the ALD records are averaged there are far fewer Averaged records than Derived records.

### 2.3.1 Data Processing Level

The LEND RDR data products contain individual spatially and temporally rectified or derived LEND spectra and associated data as well as normalized and averaged LEND spectra corresponding to NASA Processing Level 1B (CODMAC Level 4) and 1C (CODMAC Level 5), respectively. See Applicable Document [1] for a full explanation of NASA and CODMAC data processing levels.

### 2.3.2 Data Product Generation

A process termed “ingest” occurs on the LEND Science Operations Center computer which receives data from the LRO Mission Operation Center. The ingest process verifies the consistency of the data, and sorts it into the relevant database tables. As the data is sorted, the timing and spatial information is associated with the data for each collection interval. This is done by a sub-routine of the “ingest” process that calls the appropriate SPICE kernel information for the time period of interest. The “ingest” process also calls a number of database trigger functions to calculate engineering unit values from the raw housekeeping DN values as the housekeeping data are sorted into the database. See Appendix 5.2 Engineering Conversions for the conversion equations for each type of housekeeping data. Once the science and housekeeping data have been stored, the LEND_CONVERTED_HK_DATA and the LEND_RECTIFIED_SCIENCE_DATA are produced. In the event of an error whose fix changes released data, it is expected the data will be reprocessed by the revised software and made available.

#### 2.3.2.1. DERIVED_LEND_DATA and EXTENDED_DERIVED_LEND_DATA

No spacecraft background subtraction is made for this data set. The time series measurements of each of the un-collimated LEND neutron signals are corrected for altitude.

Once the altitude correction has been made to the data, it is examined to determine if data collection occurred during a solar particle event. Solar particle events (SPEs) significantly influence the LEND detectors’ counting rates, often increasing the counting rates by several orders of magnitude. Any data collected during times of intense solar activity are flagged and excluded from further routine data processing. The exclusion of data collected during SPEs is based on visual inspection of the data combined with information from Earth observation of solar activity (i.e. GOES spacecraft). The visual inspections and comparisons with other data sets do not guarantee that every collection interval that has been influenced by heightened solar activity has been excluded. It is possible that weak traces of SPEs may remain in the data. Collection intervals with significant solar activity are marked with a “1” in the SUN_ACTIVITY portion of the DERIVED_LEND_DATA record.
Measurements obtained with the nadir angle of the spacecraft greater than 1.9° are ignored, and a value of -1 is assigned to its count rate in the corresponding derived record.

In addition, raw counts from each of the detectors are examined for ‘outlier’ values, which could be produced either due to some micro-discharge in the HV circuit of a counter, or due to some corruptions in the instrument memory. Measurements are defined as outlier events based upon a specific count threshold for each detector (11 cps for CSETN1-4; 30 cps for SETN; and 49 cps for STN1-3), and a value of -1 is assigned to its count rate in the corresponding derived record.

There may be times when a single or multiple detectors do not have high voltage applied. During these periods the count for that detector will be assigned a value of -1 and that data should be disregarded. This does not have an effect on the other remaining detectors.

Data is also corrected for instrument warm-up, separation of charged particles and neutrons, and variation of galactic cosmic rays. For complete details refer to (data reduction paper, or Applicable document 5).

2.3.2.2 AVERAGED_LEND_COUNTS_DATA and AVERAGED_LEND_FLUX_DATA

Background subtracted, non-SPE influenced time series data are used to create temporally and spatially binned counting rate data for each of the five un-collimated LEND neutron signals and one for the four collimated sensors. The creation of spatially averaged counting rates requires the time series collection interval data to be distributed between the .5-degree x .5-degree latitude longitude map cells. The time series data distribution is accomplished by registering each collection interval to the projection of the spacecraft orbital trajectory on the surface of the Moon. The spacecraft trajectory projection during a single ~ 1 second collection interval is fit with a straight line. The projected straight line spacecraft trajectory is used to determine the fraction \((k_1, k_2, k3)\) of the data collection interval that resides inside each .5x.5 degree map cell. Equation 2 describes how data collection intervals are split along the length of the trajectory:

\[
k_i = \frac{l_i}{L}
\]

Eq. 2

Where

\(l_i\) - length of a part of trajectory projection which belongs to \(i\)-th map cell,

\(L\) – total length of trajectory projection on the Lunar surface.

The fractions \(k_i\) of each collection interval within a given map cell are used to calculate the total number of counts and collection time in each map cell. The following equations describe the process in detail:
\[ E_i = \sum_{j=0}^{n} S_j k_{ij} \]

\[ T_i^{\text{exposure}} = \sum_{j=0}^{n} t_j k_{ij} \]

\[ F_i = \frac{E_i}{T_i^{\text{exposure}}} \]

Eq. 3a., 3b. and 3c

where

- \( S_j \) – count in \( j \)-th collection interval calculated from Equation 1,
- \( t_j \) – duration of \( j \)-th collection interval,
- \( k_{ij} \) – fraction of \( j \)-th collection interval length in \( i \)-th map cell,
- \( n \) – total number of LEND collection intervals within the temporal interval,
- \( E_i \) – total counts accumulated in \( i \)-th map cell,
- \( T_i^{\text{exposure}} \) – total exposure time for \( i \)-th map cell,
- \( F_i \) – average counting rate in \( i \)-th map cell (counts/sec).

Once the reduction algorithms for creating the ALF product have been derived and verified they will be included here.

### 2.3.3 Data Flow

The LEND-RDR data products will be made available in sequential data releases at three month intervals as specified in applicable document [1] (Appendix 4, Lunar Reconnaissance Orbiter Archive Delivery Schedule).

The release schedule for LEND data product archives is strictly within the nominal six-month period for data processing, data validation, archive generation, delivery to the PDS, validation of the delivery by PDS, and PDS archive release to the public. Once released by the PDS, the LEND data will be available online through a set of PDS search and retrieval tools that will provide access to data from all LRO instruments.

### 2.3.4 Labeling and Identification

The data set ID provided by the PDS for the LEND RDR data products are:

LRO-M-LEND-5-RDR-V1.0

The version number is incremented should the entire RDR data set be revised.

The file naming convention for LEND RDR data files will be the PRODUCT_TYPE value followed by an eight-digit date specifier in the format YYYYMMDD, e.g. LEND_RDR_RSCL_20081223.DAT. The RDR products will have detached PDS labels in a separate file of the same name, extension .LBL.
2.3.5 Data Product Revisions

Individual RDR products may be revised during the course of the mission. A product’s revision status is recorded in its PDS label using the keyword PRODUCT_VERSION_ID. The value of this keyword is "1.0" for the first version of a product. The value is incremented with each product revision. Also, the label keyword PRODUCT_CREATION_TIME is updated with each product revision.

The PDS label also includes a RELEASE_ID keyword to indicate the number of the data release in which the product was included. The first release of the mission has a RELEASE_ID value of "0001"; the second release three months later has a value of "0002", and so on. This keyword is not updated for a revised product; it always shows the ID of the release in which the product first appeared.

PRODUCT_VERSION_ID, PRODUCT_CREATION_TIME, and RELEASE_ID appear in the index table for the RDR archive so that the set of revised products can be easily identified.

2.4 Standards Used in Generating Data Products

2.4.1 PDS Standards

The LEND RDR data product complies with Planetary Data System standards for file formats and labels, as specified in the PDS Standards Reference [4].

2.4.2 Time Standards

Time series data in the LEND RDR data products are sorted according to the value of the spacecraft clock. Time series records are tagged by spacecraft time which contains the 5 MSB of the spacecraft clock, 4 bytes of seconds and 1 byte of subsecond. The LEND Instrument contains its own internal clock. Values from this clock are also included in the dataset, the units of which are in 0.016 seconds since the last power on of the instrument.

2.4.3 Coordinate Systems

This data set conforms to the LRO coordinate system conventions.

2.4.4 Data Storage Conventions

Binary files are all fixed-length, stored in most-significant-byte-first (big-endian) format. In text files each record is terminated with a carriage return followed by a line feed.

2.5 Data Validation

LEND RDR products will be validated by the LEND Team for science content and for compliance with PDS archive standards [Applicable Document 4].

3. DETAILED DATA PRODUCT SPECIFICATIONS

The RDR data product shall be grouped into directories with one directory per flight day. Flight day is defined to be midnight-to-midnight UTC. Within each directory shall be the four labels corresponding to the individual parts of the data product. The labels will point to one data file each, and contain pointers to format labels.
detailing the column layout of the data files. In the DATA directory of the RDR archive, data for each flight day will be in a subdirectory named in the format YYYYMMDD, indicating the date at the end of the data acquisition period.

3.1 LEND Converted HK Data

3.1.1 Data Product Structure and Organization

The CHK data product is a collection engineering readings collected from 12 temperature sensors aboard the LEND instrument. This data product reports the engineering readings as physical unit of degrees Celsius. The physical units are derived from the digital number readings reported in the EDR HK data product. The CHK data product is structured as a single 15-column, time ordered data file.

This product is organized as a single data file containing converted housekeeping data collected over a single measurement day's activities, with a detached ASCII text PDS label file (See Appendix 5.3 EXAMPLE - LEND Converted HK Data Label) for each binary data file. The data folders will be labeled by Earth date in a format of YYYYMMDD, indicating the date at the end of the collection day.

3.1.2 Data Format

The data format for the CHK is a 15-column binary table. Columns range from 2 to 23 bytes in width. Column structure and start byte are described in Appendix 5.3. The number of rows in a data table will depend on the number of collection intervals during the measurement period. We would expect approximately 86400 data records per file, but there may be some variations due to short data gaps.

3.1.3 Labels and Headers

Each data file is described by a PDS label in a separate file with the same name, extension “.LBL”. A label file is stored in the same directory as the data file it describes. In most cases, the PDS label includes a pointer to another file that contains the column definitions, in order to avoid repeating the lengthy definitions in every label. These column definition files have the extension “.FMT” and are stored in the LABEL directory of the RDR archive.

The data files themselves do not contain any embedded headers.

3.2 LEND Rectified Science Data

3.2.1 Data Product Structure and Organization

The RSCI data product is a time-series collection of neutron spectra readings collected from the 9 neutron detectors aboard the LEND instrument along with the timing and spatial information associated with each collection interval. The RSCI data product is structured as a single 45-column, time ordered data file for each collection day.

This product is organized as a single data file containing neutron spectra collected over a single measurement day's activities, with a detached ASCII text PDS label file (See Appendix 5.4 EXAMPLE – LEND Rectified Science Data Label) for each binary data file. The data folders will be labeled by Earth date in a format of YYYYMMDD, indicating the date at the end of the collection day.
3.2.2 Data Format
The data format for the RSCI is a 45-column binary table. Columns range from 1 to 32 bytes in width. Column structure and start byte are described in Appendix 5.4. The number of rows in a data table will depend on the number of collection intervals during the measurement period. We would expect approximately 86400 data records per file, but there may be some variations due to short data gaps.

3.2.3 Labels and Headers
Each data file is described by a PDS label in a separate file with the same name, extension “.LBL”. A label file is stored in the same directory as the data file it describes. In most cases, the PDS label includes a pointer to another file that contains the column definitions, in order to avoid repeating the lengthy definitions in every label. These column definition files have the extension “.FMT” and are stored in the LABEL directory of the RDR archive.

The data files themselves do not contain any embedded headers.

3.3 Derived LEND Data
3.3.1 Data Product Structure and Organization
The Derived data product is a time-series collection of neutron counts and backgrounds derived from the 9 neutron detectors aboard the LEND instrument. The derived data product is structured as a single 27-column, time ordered data file for each collection day.

The Extended Derived data product is a time-series collection of neutron count uncertainties derived from the 9 neutron detectors aboard the LEND instrument, as well as a calculated sum of neutron counts and uncertainty across the four collimated sensors of epithermal neutrons, CSETN1-4. The extended derived data product is structured as a single 12-column, time ordered data file for each collection day.

These products are organized as two data file sets, one containing neutron counts for the 9 neutron detectors collected over a single measurement day's activities, with a detached ASCII text PDS label file (See Appendix 5.5 EXAMPLE – Derived LEND Data Label) and the second containing neutron count uncertainties and supplemental data values with detached ASCII text PDS label file (See Appendix 5.5 EXAMPLE – Derived LEND Data Label). The data folders will be labeled by Earth date in a format of YYYYMMDD, indicating the date at the end of the collection day.

3.3.2 Data Format
The data format for the Derived data is a 27-column binary table, and the data format for the Extended Derived data is a 12-column binary table. Columns range from 1 to 23 bytes in width for both data formats. Column structure and start byte are described in Appendix 5.5 and 5.6, respectively. The number of rows in a data table will depend on the number of collection intervals during the measurement period. We would expect approximately 86400 data records per file, but there may be some variations due to short data gaps.

3.3.3 Labels and Headers
Each data file is described by a PDS label in a separate file with the same name, extension “.LBL”. A label file is stored in the same directory as the data file it
describes. In most cases, the PDS label includes a pointer to another file that contains the column definitions, in order to avoid repeating the lengthy definitions in every label. These column definition files have the extension “.FMT” and are stored in the LABEL directory of the RDR archive.

The data files themselves do not contain any embedded headers.

3.4 Averaged LEND Data

3.4.1 Data Product Structure and Organization

The Averaged data products are a collection of averaged, normalized neutron counting rates and errors for the neutron spectra collected by the 9 neutron detectors aboard the LEND instrument. Orbital Epithermal and Fast neutron fluxes are given in a separate product. The averaged data products are structured as a single 23-column and 11 column, data file for each of the poles and for the equatorial region.

These products are organized as two data file sets, one containing averaged, normalized neutron counting rates for the 9 neutron detectors collected over a single measurement period, with a detached ASCII text PDS label file (See Appendix 5.7) and the second containing the thermal, epithermal and fast fluxes with detached ASCII text PDS label file (See Appendix 5.8).

3.4.2 Data Format

The data formats for the two averaged data sets are a 23-column binary table, for the counts, and an 11-column binary table, for the fluxes. Column structures and start bytes are described in Appendix 5.7 for the counts, and 5.8 for the fluxes. The number of data records per file should not vary since the temporal and spatial binning of data used to create the two averaged products has been set.

3.4.3 Labels and Headers

Each data file is described by a PDS label in a separate file with the same name, extension “.LBL”. A label file is stored in the same directory as the data file it describes. In most cases, the PDS label includes a pointer to another file that contains the column definitions, in order to avoid repeating the lengthy definitions in every label. These column definition files have the extension “.FMT” and are stored in the LABEL directory of the RDR archive.

The data files themselves do not contain any embedded headers.

4. APPLICABLE SOFTWARE

4.1 Applicable PDS Software Tools

PDS-labeled images and tables can be viewed with the program NASAView, developed by the PDS and available for a variety of computer platforms from the PDS website http://pdsproto.jpl.nasa.gov/Distribution/license.html. There is no charge for NASAView.
4.2 LEND Software Tools

The LEND team is supplying a data viewer for the RDR data sets. It will be included in the SOFTWARE directory of the Archive. PDS products may be viewed with the program LRO_LEND_PDS_VIEWER, developed by the University of Arizona Lunar Planetary Lab. The LRO_LEND_PDS_VIEWER Data Viewer is a software tool for browsing and displaying LRO LEND PDS data files in tabular or graphical format, and label/format files in text format. The tool validates and reads LRO LEND PDS EDR and RDR files. PDS files may be acquired through the PDS Geosciences Node. There is no charge for LRO_LEND_PDS_VIEWER. A setup file is available for download at http://pds-geosciences.wustl.edu/missions/lro/lend.htm under Online Tools. Running the setup file will install the software and create a Start Menu and desktop icon for launching the tool. Installation requires roughly 5.4 MB of disk space. This software can be run from a Windows based system that has Java 1.6 or greater installed. You may download the Java Runtime environment for Windows free at http://java.com/en/download/inc/windows_upgrade_xpi.jsp

A user guide for the software may be displayed from its help menu.
5. Appendix

5.1 LEND RDR Data Columns

This table lists the columns in all LEND RDR data files in alphabetical order. The format of each type of data file, including column positions, sizes, data types, units, and full descriptions, can be found in the format files (*.FMT) in the LABEL directory.

<table>
<thead>
<tr>
<th>Column Name</th>
<th>Data Type</th>
<th>Length in bytes</th>
<th>Description</th>
<th>Appears In</th>
</tr>
</thead>
<tbody>
<tr>
<td>COLLECTION_DURATION</td>
<td>MSB_UNSIGNED_INTEGER</td>
<td>4</td>
<td>&quot;Value of “collection time” register, length of time in seconds.&quot;</td>
<td>DLD</td>
</tr>
<tr>
<td>CSETN_ERR</td>
<td>IEEE_REAL</td>
<td>4</td>
<td>&quot;The statistical error of relative count rate in the sum of CSETN1-4 detector.&quot;</td>
<td>ALD</td>
</tr>
<tr>
<td>CSETN_EXPOSURE</td>
<td>IEEE_REAL</td>
<td>4</td>
<td>&quot;Exposure time of given map pixel for this detector, sec.&quot;</td>
<td>ALD</td>
</tr>
<tr>
<td>CSETN_RATE</td>
<td>IEEE_REAL</td>
<td>4</td>
<td>&quot;The relative count rate (after normalization) which is accumulated in given map pixel by sum of CSETN1-4 detectors.&quot;</td>
<td>ALD</td>
</tr>
<tr>
<td>CSETN_SUM_COUNTS</td>
<td>IEEE_REAL</td>
<td>4</td>
<td>&quot;Calculated sum of corrected counts in 4 CSETN detectors.”</td>
<td>DLX</td>
</tr>
<tr>
<td>CSETN_SUM_SIGMA</td>
<td>IEEE_REAL</td>
<td>4</td>
<td>&quot;Sigma value of calculated sum of corrected counts in 4 CSETN detectors.”</td>
<td>DLX</td>
</tr>
<tr>
<td>CSETN1_BKGD</td>
<td>IEEE_REAL</td>
<td>4</td>
<td>&quot;Background counts for CSETN1 detector (counts).&quot;</td>
<td>DLD</td>
</tr>
<tr>
<td>Column Name</td>
<td>Data Type</td>
<td>Length in bytes</td>
<td>Description</td>
<td>Appears In</td>
</tr>
<tr>
<td>------------------</td>
<td>-------------------</td>
<td>-----------------</td>
<td>-----------------------------------------------------------------------------</td>
<td>------------</td>
</tr>
<tr>
<td>CSETN1_COUNTS</td>
<td>IEEE_REAL</td>
<td>4</td>
<td>&quot;Counts gathered in CSETN1 detector during frame interval. A negative in this column indicates it should not be used.&quot;</td>
<td>DLD</td>
</tr>
<tr>
<td>CSETN1_SIGMA</td>
<td>IEEE_REAL</td>
<td>4</td>
<td>“Sigma value of corrected counts in CSETN1 detector.”</td>
<td>DLX</td>
</tr>
<tr>
<td>CSETN1_SPECTRUM</td>
<td>MSB_UNSIGNED_INTEGER</td>
<td>32</td>
<td>&quot;Spectrum from collimated counter of epithermal neutrons CSETN1.&quot;</td>
<td>RSCI</td>
</tr>
<tr>
<td>CSETN2_BKGD</td>
<td>IEEE_REAL</td>
<td>4</td>
<td>&quot;Background counts for CSETN2 detector (counts).&quot;</td>
<td>DLD</td>
</tr>
<tr>
<td>CSETN2_COUNTS</td>
<td>IEEE_REAL</td>
<td>4</td>
<td>&quot;Counts gathered in CSETN2 detector during frame interval. A negative in this column indicates it should not be used.&quot;</td>
<td>DLD</td>
</tr>
<tr>
<td>CSETN2_SIGMA</td>
<td>IEEE_REAL</td>
<td>4</td>
<td>“Sigma value of corrected counts in CSETN2 detector.”</td>
<td>DLX</td>
</tr>
<tr>
<td>CSETN2_SPECTRUM</td>
<td>MSB_UNSIGNED_INTEGER</td>
<td>32</td>
<td>&quot;Spectrum from collimated counter of epithermal neutrons CSETN2.&quot;</td>
<td>RSCI</td>
</tr>
<tr>
<td>CSETN3_BKGD</td>
<td>IEEE_REAL</td>
<td>4</td>
<td>&quot;Background counts for CSETN3 detector (counts).&quot;</td>
<td>DLD</td>
</tr>
<tr>
<td>Column Name</td>
<td>Data Type</td>
<td>Length in bytes</td>
<td>Description</td>
<td>Appears In</td>
</tr>
<tr>
<td>----------------------</td>
<td>------------------</td>
<td>-----------------</td>
<td>-----------------------------------------------------------------------------</td>
<td>-------------</td>
</tr>
<tr>
<td>CSETN3_COUNTS</td>
<td>IEEE_REAL</td>
<td>4</td>
<td>&quot;Counts gathered in CSETN3 detector during frame interval. A negative in this column indicates it should not be used.&quot;</td>
<td>DLD</td>
</tr>
<tr>
<td>CSETN3_SIGMA</td>
<td>IEEE_REAL</td>
<td>4</td>
<td>&quot;Sigma value of corrected counts in CSETN3 detector.&quot;</td>
<td>DLX</td>
</tr>
<tr>
<td>CSETN3_SPECTRUM</td>
<td>MSB_UNSIGNED_INTEGER</td>
<td>32</td>
<td>&quot;Spectrum from collimated counter of epithermal neutrons CSETN3.&quot;</td>
<td>RSCI</td>
</tr>
<tr>
<td>CSETN4_BKGD</td>
<td>IEEE_REAL</td>
<td>4</td>
<td>&quot;Background counts for CSETN4 detector (counts).&quot;</td>
<td>DLD</td>
</tr>
<tr>
<td>CSETN4_COUNTS</td>
<td>IEEE_REAL</td>
<td>4</td>
<td>&quot;Counts gathered in CSETN4 detector during frame interval. A negative in this column indicates it should not be used.&quot;</td>
<td>DLD</td>
</tr>
<tr>
<td>CSETN4_SIGMA</td>
<td>IEEE_REAL</td>
<td>4</td>
<td>&quot;Sigma value of corrected counts in CSETN4 detector.&quot;</td>
<td>DLX</td>
</tr>
<tr>
<td>CSETN4_SPECTRUM</td>
<td>MSB_UNSIGNED_INTEGER</td>
<td>32</td>
<td>&quot;Spectrum from collimated counter of epithermal neutrons CSETN4.&quot;</td>
<td>RSCI</td>
</tr>
<tr>
<td>DATA_COLLECTION_TIME</td>
<td>MSB_UNSIGNED_INTEGER</td>
<td>2</td>
<td>&quot;Value of “collection time” register, length of time in seconds.&quot;</td>
<td>RSCI, CHK</td>
</tr>
<tr>
<td>Column Name</td>
<td>Data Type</td>
<td>Length in bytes</td>
<td>Description</td>
<td>Appears In</td>
</tr>
<tr>
<td>-----------------------------</td>
<td>----------------------</td>
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<td>-----------------------------------------------------------------------------</td>
<td>-------------</td>
</tr>
<tr>
<td>EPITHERMAL_FLUX1</td>
<td>IEEE_REAL</td>
<td>4</td>
<td>&quot;Orbital epithermal neutron flux in energy range [0.4 eV - 100 eV] (n/cm²sec).&quot;</td>
<td>ALF</td>
</tr>
<tr>
<td>EPITHERMAL_FLUX2</td>
<td>IEEE_REAL</td>
<td>4</td>
<td>&quot;Orbital epithermal neutron flux in energy range [0.10 keV - 1.0 keV] (n/cm²sec).&quot;</td>
<td>ALF</td>
</tr>
<tr>
<td>EPITHERMAL_FLUX3</td>
<td>IEEE_REAL</td>
<td>4</td>
<td>&quot;Orbital epithermal neutron flux in energy range [10 keV - 1.0 MeV] (n/cm²sec).&quot;</td>
<td>ALF</td>
</tr>
<tr>
<td>FAST_FLUX1</td>
<td>IEEE_REAL</td>
<td>4</td>
<td>&quot;Orbital fast neutron flux in energy range [1 MeV - 2.5 MeV] (n/cm²sec).&quot;</td>
<td>ALF</td>
</tr>
<tr>
<td>FAST_FLUX2</td>
<td>IEEE_REAL</td>
<td>4</td>
<td>&quot;Orbital fast neutron flux in energy range [2.5 MeV - 7.5 MeV] (n/cm²sec).&quot;</td>
<td>ALF</td>
</tr>
<tr>
<td>FAST_FLUX3</td>
<td>IEEE_REAL</td>
<td>4</td>
<td>&quot;Orbital fast neutron flux in energy range [7.5 MeV - 10 MeV] (n/cm²sec).&quot;</td>
<td>ALF</td>
</tr>
<tr>
<td>FRAME_NUMBER</td>
<td>MSB_UNSIGNED_INTEGER</td>
<td>4</td>
<td>&quot;Sequential counter of accumulation intervals.&quot;</td>
<td>RSCI</td>
</tr>
<tr>
<td>INSTR_BORESIGHT_MOON_X</td>
<td>IEEE_REAL</td>
<td>8</td>
<td>&quot;Sub instrument boresight X in Lunar fixed coordinates at the middle of the pixel.&quot;</td>
<td>RSCI</td>
</tr>
<tr>
<td>Column Name</td>
<td>Data Type</td>
<td>Length in bytes</td>
<td>Description</td>
<td>Appears In</td>
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<td>-----------------------------------</td>
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</tr>
<tr>
<td>INSTR_BORESIGHT_MOON_Y</td>
<td>IEEE_REAL</td>
<td>8</td>
<td>&quot;Sub instrument boresight Y in Lunar fixed coordinates at the middle of the pixel.&quot;</td>
<td>RSCI</td>
</tr>
<tr>
<td>INSTR_BORESIGHT_MOON_Z</td>
<td>IEEE_REAL</td>
<td>8</td>
<td>&quot;Sub instrument boresight Z in Lunar fixed coordinates at the middle of the pixel.&quot;</td>
<td>RSCI</td>
</tr>
<tr>
<td>INTERSECTING</td>
<td>BOOLEAN</td>
<td>1</td>
<td>&quot;True if the pointing vector intersects Moon.&quot;</td>
<td>RSCI</td>
</tr>
<tr>
<td>LATITUDE</td>
<td>IEEE_REAL</td>
<td>8</td>
<td>&quot;Sub spacecraft latitude in Mars fixed coordinates at the middle of the pixel.&quot;</td>
<td>RSCI</td>
</tr>
<tr>
<td>LEND_TIME</td>
<td>MSB_UNSIGNED_INTEGER</td>
<td>4</td>
<td>&quot;LEND internal time (incrementation frequency - 62500 Hz)&quot;</td>
<td>CHK, RSCI</td>
</tr>
<tr>
<td>LOCAL_HOUR</td>
<td>MSB_UNSIGNED_INTEGER</td>
<td>1</td>
<td>&quot;Local Sun hour at the sub-spacecraft point.&quot;</td>
<td>RSCI, DLD</td>
</tr>
<tr>
<td>LOCAL_MINUTE</td>
<td>MSB_UNSIGNED_INTEGER</td>
<td>1</td>
<td>&quot;Local Sun minute at the sub-spacecraft point.&quot;</td>
<td>RSCI, DLD</td>
</tr>
<tr>
<td>LONGITUDE</td>
<td>IEEE_REAL</td>
<td>8</td>
<td>&quot;Sub spacecraft longitude in Mars fixed coordinates at the middle of the pixel.&quot;</td>
<td>RSCI</td>
</tr>
<tr>
<td>Column Name</td>
<td>Data Type</td>
<td>Length in bytes</td>
<td>Description</td>
<td>Appears In</td>
</tr>
<tr>
<td>---------------------------------</td>
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<td>-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------</td>
<td>------------</td>
</tr>
<tr>
<td>LRO_ORBIT_NUMBER</td>
<td>MSB_UNSIGNED_INTEGER</td>
<td>4</td>
<td>&quot;Orbit number common to all instruments aboard LRO. This orbit number is incremented by one as the spacecraft passes through the orbital descending node.&quot;</td>
<td>RSCI</td>
</tr>
<tr>
<td>LRO_TIME</td>
<td>MSB_UNSIGNED_INTEGER</td>
<td>8</td>
<td>&quot;5 upper bytes of LRO time.&quot;</td>
<td>RSCI, DLD, DLX</td>
</tr>
<tr>
<td>LUNARCENTIC_EAST_LONGITUDE</td>
<td>IEEE_REAL</td>
<td>4</td>
<td>&quot;Longitude in Lunar fixed coordinates at the center of the given map pixel.&quot;</td>
<td>DLD, ALD, ALF</td>
</tr>
<tr>
<td>LUNARCENTIC_LATITUDE</td>
<td>IEEE_REAL</td>
<td>4</td>
<td>&quot;Latitude in Lunar fixed coordinates at the center of the given map pixel.&quot;</td>
<td>DLD, ALD, ALF</td>
</tr>
<tr>
<td>LUNARPOS_INSTR_X</td>
<td>IEEE_REAL</td>
<td>8</td>
<td>&quot;The X position of the sub-spacecraft point as seen from the spacecraft in the instrument frame at the middle of the pixel. If no spacecraft orientation data was available, then all elements of are set to zero.&quot;</td>
<td>RSCI</td>
</tr>
<tr>
<td>LUNARPOS_INSTR_Y</td>
<td>IEEE_REAL</td>
<td>8</td>
<td>&quot;The Y position of the sub-spacecraft point as seen from the spacecraft in the instrument frame at the middle of the pixel. If no spacecraft orientation data was available, then all elements of are set to zero.&quot;</td>
<td>RSCI</td>
</tr>
<tr>
<td>LUNARPOS_INSTR_Z</td>
<td>IEEE_REAL</td>
<td>8</td>
<td>&quot;The Z position of the sub-spacecraft point as seen from the spacecraft in the instrument frame at the middle of the pixel. If no spacecraft orientation data was available, then all elements of are set to zero.&quot;</td>
<td>RSCI</td>
</tr>
<tr>
<td>LUNARVEL_INSTR_X</td>
<td>IEEE_REAL</td>
<td>8</td>
<td>&quot;Contains the inertial spacecraft velocity direction X rotated to the instrument frame at the middle of the pixel. If no spacecraft orientation data was available&quot;</td>
<td>RSCI</td>
</tr>
<tr>
<td>Column Name</td>
<td>Data Type</td>
<td>Length in bytes</td>
<td>Description</td>
<td>Appears In</td>
</tr>
<tr>
<td>-----------------------------</td>
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<td>----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------</td>
<td>------------</td>
</tr>
<tr>
<td>LUNARVEL_INSTR_Y</td>
<td>IEEE_REAL</td>
<td>8</td>
<td>&quot;Contains the inertial spacecraft velocity direction Y rotated to the instrument frame at the middle of the pixel. If no spacecraft orientation data was available for the request time, then all elements are set to zero.&quot;</td>
<td>RSCI</td>
</tr>
<tr>
<td>LUNARVEL_INSTR_Z</td>
<td>IEEE_REAL</td>
<td>8</td>
<td>&quot;Contains the inertial spacecraft velocity direction Z rotated to the instrument frame at the middle of the pixel. If no spacecraft orientation data was available for the request time, then all elements are set to zero.&quot;</td>
<td>RSCI</td>
</tr>
<tr>
<td>NADIR_POINTING</td>
<td>MSB_UNSIGNED_INTEGER</td>
<td>1</td>
<td>&quot;1 (instrument is nadir pointing); 0 (anything other than nadir pointing).&quot;</td>
<td>DLD</td>
</tr>
<tr>
<td>PARAMETERS_CHANGED</td>
<td>MSB_UNSIGNED_INTEGER</td>
<td>1</td>
<td>&quot;Number of the instrument parameters that were changed by commands after previous frame.&quot;</td>
<td>RSCI</td>
</tr>
<tr>
<td>POINTING</td>
<td>BOOLEAN</td>
<td>1</td>
<td>&quot;True if pointing data was available.&quot;</td>
<td>RSCI</td>
</tr>
<tr>
<td>SCALT</td>
<td>IEEE_REAL</td>
<td>8</td>
<td>&quot;Lunarcentric altitude of the sub-spacecraft point in Lunar-fixed rotating frame at the middle of the pixel.&quot;</td>
<td>RSCI</td>
</tr>
<tr>
<td>Column Name</td>
<td>Data Type</td>
<td>Length in bytes</td>
<td>Description</td>
<td>Appears In</td>
</tr>
<tr>
<td>----------------------</td>
<td>------------</td>
<td>-----------------</td>
<td>-----------------------------------------------------------------------------</td>
<td>------------</td>
</tr>
<tr>
<td>SCPOS_INERT_X</td>
<td>IEEE_REAL</td>
<td>8</td>
<td>&quot;The geometric position X of the spacecraft with respect to the Moon in the 'LUNARIAU' inertial frame at the input epoch 'et' at the middle of the pixel.&quot;</td>
<td>RSCI</td>
</tr>
<tr>
<td>SCPOS_INERT_Y</td>
<td>IEEE_REAL</td>
<td>8</td>
<td>&quot;The geometric position Y of the spacecraft with respect to the Moon in the 'LUNARIAU' inertial frame at the input epoch 'et' at the middle of the pixel.&quot;</td>
<td>RSCI</td>
</tr>
<tr>
<td>SCPOS_INERT_Z</td>
<td>IEEE_REAL</td>
<td>8</td>
<td>&quot;The geometric position Z of the spacecraft with respect to the Moon in the 'LUNARIAU' inertial frame at the input epoch 'et' at the middle of the pixel.&quot;</td>
<td>RSCI</td>
</tr>
<tr>
<td>SCPOS_MOON_X</td>
<td>IEEE_REAL</td>
<td>8</td>
<td>&quot;Spacecraft position X in Lunar fixed coordinates at the middle of the pixel.&quot;</td>
<td>RSCI</td>
</tr>
<tr>
<td>SCPOS_MOON_Y</td>
<td>IEEE_REAL</td>
<td>8</td>
<td>&quot;Spacecraft position Y in Lunar fixed coordinates at the middle of the pixel.&quot;</td>
<td>RSCI</td>
</tr>
<tr>
<td>SCPOS_MOON_Z</td>
<td>IEEE_REAL</td>
<td>8</td>
<td>&quot;Spacecraft position Z in Lunar fixed coordinates at the middle of the pixel.&quot;</td>
<td>RSCI</td>
</tr>
<tr>
<td>SCVEL_INERT_X</td>
<td>IEEE_REAL</td>
<td>8</td>
<td>&quot;The geometric velocity X of the spacecraft with respect to Moon in the 'LUNARIAU' inertial frame at the input epoch 'et' at the middle of the pixel.&quot;</td>
<td>RSCI</td>
</tr>
<tr>
<td>SCVEL_INERT_Y</td>
<td>IEEE_REAL</td>
<td>8</td>
<td>&quot;The geometric velocity Y of the spacecraft with respect to Moon in the 'LUNARIAU' inertial frame at the input epoch 'et' at the middle of the pixel.&quot;</td>
<td>RSCI</td>
</tr>
<tr>
<td>Column Name</td>
<td>Data Type</td>
<td>Length in bytes</td>
<td>Description</td>
<td>Appears In</td>
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<td>------------------</td>
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<td>-----------------------------------------------------------------------------</td>
<td>------------</td>
</tr>
<tr>
<td>SCVEL_INERT_Z</td>
<td>IEEE_REAL</td>
<td>8</td>
<td>&quot;The geometric velocity $Z$ of the spacecraft with respect to Moon in the 'LUNARIAU' inertial frame at the input epoch 'et' at the middle of the pixel.&quot;</td>
<td>RSCI</td>
</tr>
<tr>
<td>SETN_BKGD</td>
<td>IEEE_REAL</td>
<td>4</td>
<td>&quot;Background counts for SETN detector (counts).&quot;</td>
<td>DLD</td>
</tr>
<tr>
<td>SETN_COUNTS</td>
<td>IEEE_REAL</td>
<td>4</td>
<td>&quot;Counts gathered in SETN detector during frame interval. A negative in this column indicates it should not be used.&quot;</td>
<td>DLD</td>
</tr>
<tr>
<td>SETN_ERR</td>
<td>IEEE_REAL</td>
<td>4</td>
<td>&quot;The statistical error of relative count rate in SETN detector.&quot;</td>
<td>ALD</td>
</tr>
<tr>
<td>SETN_EXPOSURE</td>
<td>IEEE_REAL</td>
<td>4</td>
<td>&quot;Exposure time of given map pixel for this detector, sec.&quot;</td>
<td>ALD</td>
</tr>
<tr>
<td>SETN_RATE</td>
<td>IEEE_REAL</td>
<td>4</td>
<td>&quot;The relative count rate (after normalization) which is accumulated in given map pixel by SETN detector.&quot;</td>
<td>ALD</td>
</tr>
<tr>
<td>SETN_SIGMA</td>
<td>IEEE_REAL</td>
<td>4</td>
<td>“Sigma value of corrected counts in SETN detector.”</td>
<td>DLX</td>
</tr>
<tr>
<td>SETN_SPECTRUM</td>
<td>MSB_UNSIGNED_INTEGER</td>
<td>32</td>
<td>&quot;Spectrum from uncollimated counter of epithermal neutrons SETN&quot;</td>
<td>RSCI</td>
</tr>
<tr>
<td>Column Name</td>
<td>Data Type</td>
<td>Length in bytes</td>
<td>Description</td>
<td>Appears In</td>
</tr>
<tr>
<td>---------------------</td>
<td>--------------------</td>
<td>-----------------</td>
<td>-----------------------------------------------------------------------------</td>
<td>------------</td>
</tr>
<tr>
<td>SHEN_BKGD</td>
<td>IEEE_REAL</td>
<td>4</td>
<td>&quot;Background counts for all channels of gamma channel of Inner Scintillator (counts).&quot;</td>
<td>DLD</td>
</tr>
<tr>
<td>SHEN_COUNTS</td>
<td>IEEE_REAL</td>
<td>4</td>
<td>&quot;Counts gathered in high channels of gamma channel of Inner Scintillator during frame interval. A negative in any channel indicates it should not be used.&quot;</td>
<td>DLD</td>
</tr>
<tr>
<td>SHEN_ERR</td>
<td>IEEE_REAL</td>
<td>64</td>
<td>&quot;The statistical error of relative count rate in neutron channel of stilbene detector.&quot;</td>
<td>ALD</td>
</tr>
<tr>
<td>SHEN_EXPOSURE</td>
<td>IEEE_REAL</td>
<td>64</td>
<td>&quot;Exposure time of given map pixel for this detector, sec.&quot;</td>
<td>ALD</td>
</tr>
<tr>
<td>SHEN_RATE</td>
<td>IEEE_REAL</td>
<td>64</td>
<td>&quot;The relative count rate (after normalization) which is observed in given map pixel by neutron channel of stilbene detector.&quot;</td>
<td>ALD</td>
</tr>
<tr>
<td>SHEN1_SPECTRUM</td>
<td>MSB_UNSIGNED_INTEGER</td>
<td>32</td>
<td>&quot;Charged particle spectra for stilbene.&quot;</td>
<td>RSCI</td>
</tr>
<tr>
<td>SHEN2_SPECTRUM</td>
<td>MSB_UNSIGNED_INTEGER</td>
<td>32</td>
<td>&quot;Neutron spectra for stilbene.&quot;</td>
<td>RSCI</td>
</tr>
<tr>
<td>SHEN3_SPECTRUM</td>
<td>MSB_UNSIGNED_INTEGER</td>
<td>32</td>
<td>&quot;Gamma spectra for stilbene.&quot;</td>
<td>RSCI</td>
</tr>
<tr>
<td>Column Name</td>
<td>Data Type</td>
<td>Length in bytes</td>
<td>Description</td>
<td>Appears In</td>
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<td>------------------</td>
<td>---------------</td>
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<td>-----------------------------------------------------------------------------</td>
<td>------------</td>
</tr>
<tr>
<td>SPARE</td>
<td>IEEE_REAL</td>
<td>4</td>
<td>“Place holder”</td>
<td>ALD</td>
</tr>
<tr>
<td>START_UTC_TIME</td>
<td>CHARACTER</td>
<td>23</td>
<td>&quot;UTC time at the start of the averaged frames, stored as yyyy-mm-ddThh:mm:ss.sss.&quot;</td>
<td>ALD, ALF</td>
</tr>
<tr>
<td>STN1_BKGD</td>
<td>IEEE_REAL</td>
<td>4</td>
<td>&quot;Background counts for STN1 detector (counts).&quot;</td>
<td>DLD</td>
</tr>
<tr>
<td>STN1_COUNTS</td>
<td>IEEE_REAL</td>
<td>4</td>
<td>&quot;Counts gathered in STN1 detector during frame interval. A negative in this column indicates it should not be used.&quot;</td>
<td>DLD</td>
</tr>
<tr>
<td>STN1_ERR</td>
<td>IEEE_REAL</td>
<td>4</td>
<td>&quot;The statistical error of relative count rate in STN1 detector.&quot;</td>
<td>ALD</td>
</tr>
<tr>
<td>STN1_EXPOSURE</td>
<td>IEEE_REAL</td>
<td>4</td>
<td>&quot;Exposure time of given map pixel for this detector, sec.&quot;</td>
<td>ALD</td>
</tr>
<tr>
<td>STN1_RATE</td>
<td>IEEE_REAL</td>
<td>4</td>
<td>&quot;The relative count rate (after normalization) which is accumulated in given map pixel by STN1 detector.&quot;</td>
<td>ALD</td>
</tr>
<tr>
<td>STN1_SIGMA</td>
<td>IEEE_REAL</td>
<td>4</td>
<td>&quot;Sigma value of corrected counts in STN1 detector.”</td>
<td>DLX</td>
</tr>
<tr>
<td>Column Name</td>
<td>Data Type</td>
<td>Length in bytes</td>
<td>Description</td>
<td>Appears In</td>
</tr>
<tr>
<td>-------------------</td>
<td>--------------------------</td>
<td>-----------------</td>
<td>-----------------------------------------------------------------------------</td>
<td>-------------</td>
</tr>
<tr>
<td>STN1_SPECTRUM</td>
<td>MSB_UNSIGNED_INTEGER</td>
<td>32</td>
<td>&quot;Spectrum from uncollimated counter of thermal and epithermal neutrons STN1&quot;</td>
<td>RSCI</td>
</tr>
<tr>
<td>STN2_BKGD</td>
<td>IEEE_REAL</td>
<td>4</td>
<td>&quot;Background counts for STN2 detector (counts).&quot;</td>
<td>DLD</td>
</tr>
<tr>
<td>STN2_COUNTS</td>
<td>IEEE_REAL</td>
<td>4</td>
<td>&quot;Counts gathered in STN2 detector during frame interval. A negative in this column indicates it should not be used.&quot;</td>
<td>DLD</td>
</tr>
<tr>
<td>STN2_ERR</td>
<td>IEEE_REAL</td>
<td>4</td>
<td>&quot;The statistical error of relative count rate in STN2 detector.&quot;</td>
<td>ALD</td>
</tr>
<tr>
<td>STN2_EXPOSURE</td>
<td>IEEE_REAL</td>
<td>4</td>
<td>&quot;Exposure time of given map pixel for this detector, sec.&quot;</td>
<td>ALD</td>
</tr>
<tr>
<td>STN2_RATE</td>
<td>IEEE_REAL</td>
<td>4</td>
<td>&quot;The relative count rate (after normalization) which is accumulated in given map pixel by STN2 detector.&quot;</td>
<td>ALD</td>
</tr>
<tr>
<td>STN2_SIGMA</td>
<td>IEEE_REAL</td>
<td>4</td>
<td>&quot;Sigma value of corrected counts in STN2 detector.&quot;</td>
<td>DLX</td>
</tr>
<tr>
<td>STN2_SPECTRUM</td>
<td>MSB_UNSIGNED_INTEGER</td>
<td>32</td>
<td>&quot;Spectrum from uncollimated counter of thermal and epithermal neutrons STN2.&quot;</td>
<td>RSCI</td>
</tr>
<tr>
<td>Column Name</td>
<td>Data Type</td>
<td>Length in bytes</td>
<td>Description</td>
<td>Appears In</td>
</tr>
<tr>
<td>---------------------</td>
<td>-----------------------</td>
<td>-----------------</td>
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<td>-------------</td>
</tr>
<tr>
<td>STN3_BKGD</td>
<td>IEEE_REAL</td>
<td>4</td>
<td>&quot;Background counts for STN3 detector (counts).&quot;</td>
<td>DLD</td>
</tr>
<tr>
<td>STN3_COUNTS</td>
<td>IEEE_REAL</td>
<td>4</td>
<td>&quot;Counts gathered in STN3 detector during frame interval. A negative in this column indicates it should not be used.&quot;</td>
<td>DLD</td>
</tr>
<tr>
<td>STN3_ERR</td>
<td>IEEE_REAL</td>
<td>4</td>
<td>&quot;The statistical error of relative count rate in STN3 detector.&quot;</td>
<td>ALD</td>
</tr>
<tr>
<td>STN3_EXPOSURE</td>
<td>IEEE_REAL</td>
<td>4</td>
<td>&quot;Exposure time of given map pixel for this detector, sec.&quot;</td>
<td>ALD</td>
</tr>
<tr>
<td>STN3_RATE</td>
<td>IEEE_REAL</td>
<td>4</td>
<td>&quot;The relative count rate (after normalization) which is accumulated in given map pixel by STN3 detector.&quot;</td>
<td>ALD</td>
</tr>
<tr>
<td>STN3_SIGMA</td>
<td>IEEE_REAL</td>
<td>4</td>
<td>&quot;Sigma value of corrected counts in STN3 detector.&quot;</td>
<td>DLX</td>
</tr>
<tr>
<td>STN3_SPECTRUM</td>
<td>MSB_UNSIGNED_INTEGER</td>
<td>32</td>
<td>&quot;Spectrum from uncollimated counter of thermal and epithermal neutrons STN3.&quot;</td>
<td>RSCI</td>
</tr>
<tr>
<td>STOP_UTC_TIME</td>
<td>CHARACTER</td>
<td>23</td>
<td>&quot;UTC time at the end of the averaged frames, stored as yyyy-mm-ddThh:mm:ss.sss.&quot;</td>
<td>ALD, ALF</td>
</tr>
<tr>
<td>Column Name</td>
<td>Data Type</td>
<td>Length in bytes</td>
<td>Description</td>
<td>Appears In</td>
</tr>
<tr>
<td>------------------------</td>
<td>--------------</td>
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<td>-----------------------------------------------------------------------------</td>
<td>------------</td>
</tr>
<tr>
<td>SUB_SCPOS_MOON_X</td>
<td>IEEE_REAL</td>
<td>8</td>
<td>&quot;Sub spacecraft vector X in Lunar fixed coordinates at the middle of the pixel.&quot;</td>
<td>RSCI</td>
</tr>
<tr>
<td>SUB_SCPOS_MOON_Y</td>
<td>IEEE_REAL</td>
<td>8</td>
<td>&quot;Sub spacecraft vector Y in Lunar fixed coordinates at the middle of the pixel.&quot;</td>
<td>RSCI</td>
</tr>
<tr>
<td>SUB_SCPOS_MOON_Z</td>
<td>IEEE_REAL</td>
<td>8</td>
<td>&quot;Sub spacecraft vector Z in Lunar fixed coordinates at the middle of the pixel.&quot;</td>
<td>RSCI</td>
</tr>
<tr>
<td>SUN_ACTIVITY</td>
<td>BOOLEAN</td>
<td>1</td>
<td>&quot;1 (active sun during frame interval); 0 (no active sun during frame interval).&quot;</td>
<td>DLD</td>
</tr>
<tr>
<td>TEMPERATURES_0</td>
<td>IEEE_REAL</td>
<td>4</td>
<td>&quot;Temperature reading of scintillator in Celsius.&quot;</td>
<td>CHK</td>
</tr>
<tr>
<td>TEMPERATURES_1</td>
<td>IEEE_REAL</td>
<td>4</td>
<td>&quot;Temperature reading of FPGA electronics board in Celsius.&quot;</td>
<td>CHK</td>
</tr>
<tr>
<td>TEMPERATURES_10</td>
<td>IEEE_REAL</td>
<td>4</td>
<td>&quot;Temperature reading control board #1 in Celsius.&quot;</td>
<td>CHK</td>
</tr>
<tr>
<td>TEMPERATURES_11</td>
<td>IEEE_REAL</td>
<td>4</td>
<td>&quot;Temperature reading mounting point in Celsius.&quot;</td>
<td>CHK</td>
</tr>
<tr>
<td>Column Name</td>
<td>Data Type</td>
<td>Length in bytes</td>
<td>Description</td>
<td>Appears In</td>
</tr>
<tr>
<td>---------------------</td>
<td>--------------</td>
<td>-----------------</td>
<td>-----------------------------------------------------------------------------</td>
<td>------------</td>
</tr>
<tr>
<td>TEMPERATURES_2</td>
<td>IEEE_REAL</td>
<td>4</td>
<td>&quot;Temperature reading of the low voltage board in Celsius.&quot;</td>
<td>CHK</td>
</tr>
<tr>
<td>TEMPERATURES_3</td>
<td>IEEE_REAL</td>
<td>4</td>
<td>&quot;Temperature reading outer detector #2 (SETN) in Celsius.&quot;</td>
<td>CHK</td>
</tr>
<tr>
<td>TEMPERATURES_4</td>
<td>IEEE_REAL</td>
<td>4</td>
<td>&quot;Temperature reading outer detector #3 (STN2) in Celsius.&quot;</td>
<td>CHK</td>
</tr>
<tr>
<td>TEMPERATURES_5</td>
<td>IEEE_REAL</td>
<td>4</td>
<td>&quot;Temperature reading in outer detector #2 (STN3) in Celsius.&quot;</td>
<td>CHK</td>
</tr>
<tr>
<td>TEMPERATURES_6</td>
<td>IEEE_REAL</td>
<td>4</td>
<td>&quot;Temperature reading in outer detector #1 (STN1) in Celsius.&quot;</td>
<td>CHK</td>
</tr>
<tr>
<td>TEMPERATURES_7</td>
<td>IEEE_REAL</td>
<td>4</td>
<td>&quot;Temperature reading high voltage board #2 in Celsius.&quot;</td>
<td>CHK</td>
</tr>
<tr>
<td>TEMPERATURES_8</td>
<td>IEEE_REAL</td>
<td>4</td>
<td>&quot;Temperature reading high voltage board #1 in Celsius.&quot;</td>
<td>CHK</td>
</tr>
<tr>
<td>TEMPERATURES_9</td>
<td>IEEE_REAL</td>
<td>4</td>
<td>&quot;Temperature reading control board #2 in Celsius.&quot;</td>
<td>CHK</td>
</tr>
<tr>
<td>Column Name</td>
<td>Data Type</td>
<td>Length in bytes</td>
<td>Description</td>
<td>Appears In</td>
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<td>------------</td>
<td>-------------</td>
<td>----------------</td>
<td>-----------------------------------------------------------------------------------------------</td>
<td>------------</td>
</tr>
<tr>
<td>THERMAL</td>
<td>IEEE_REAL</td>
<td>4</td>
<td>&quot;Orbital epithermal neutron flux in energy range [&lt;0.4 eV] (n/cm^2sec).&quot;</td>
<td>ALF</td>
</tr>
<tr>
<td>UTC</td>
<td>CHARACTER</td>
<td>23</td>
<td>&quot;UTC time at the middle of the collection interval, stored as yyyy-mm-ddThh:mm:ss.sss.&quot;</td>
<td>CHK, RSCI, DLD, DLX</td>
</tr>
</tbody>
</table>
5.2 Engineering Conversions

if counts are between 0 to 220, then:
Temp = Counts*a1 + a0

if counts are between 221 to 255, then:
Temp = (Counts - 256)*a1 + a0

For sensor #7
if counts are between 0 to 150
Temp = Counts*a1 + a0
if counts are between 151 to 255
Temp = (Counts - 256)*a1 + a0

<table>
<thead>
<tr>
<th>sensor</th>
<th>a0</th>
<th>a1</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>-16,19047</td>
<td>0,47619</td>
</tr>
<tr>
<td>2</td>
<td>-16,82242</td>
<td>0,46728</td>
</tr>
<tr>
<td>3</td>
<td>-17,61904</td>
<td>0,47619</td>
</tr>
<tr>
<td>4</td>
<td>-21,90476</td>
<td>0,47619</td>
</tr>
<tr>
<td>5</td>
<td>-21,17117</td>
<td>0,45045</td>
</tr>
<tr>
<td>6</td>
<td>-21,42857</td>
<td>0,47619</td>
</tr>
<tr>
<td>7</td>
<td>9,04255</td>
<td>0,53191</td>
</tr>
<tr>
<td>8</td>
<td>-17,12962</td>
<td>0,46296</td>
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<td>9</td>
<td>-17,92452</td>
<td>0,47169</td>
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<tr>
<td>10</td>
<td>-18,09523</td>
<td>0,47619</td>
</tr>
<tr>
<td>11</td>
<td>-26,12612</td>
<td>0,45045</td>
</tr>
<tr>
<td>12</td>
<td>-20,09345</td>
<td>0,46728</td>
</tr>
</tbody>
</table>
5.3 EXAMPLE - LEND Converted HK Data Label

PDS_VERSION_ID = "PDS3"
LABEL_REVISION_NOTE = "2008-01-15, LEND Team, initial release;"

/*** FILE FORMAT ***/
FILE_RECORDS = 86400
RECORD_TYPE = FIXED_LENGTH
RECORD_BYTES = 77

/*** GENERAL DATA DESCRIPTION PARAMETERS ***/
PRODUCT_ID = "LEND_RDR_CHK_20090228_DAT"
PRODUCT_VERSION_ID = "1.0"
PRODUCT_TYPE = "LEND_RDR_CHK"
SOFTWARE_NAME = "GEN_LEND_RDR"
SOFTWARE_VERSION_ID = "1.0.0"
INSTRUMENT_HOST_NAME = "LUNAR RECONNAISSANCE ORBITER"
INSTRUMENT_NAME = "LUNAR EXPLORATION NEUTRON DETECTOR"
INSTRUMENT_ID = "LEND"
DATA_SET_ID = "LRO-L-LEND-4/5-RDR-V1.0"
MISSION_PHASE_NAME = "MAPPING"
TARGET_NAME = "MOON"
START_TIME = 2009-02-28T00:00:00
STOP_TIME = 2009-02-28T23:59:59
SPACECRAFT_CLOCK_START_COUNT = "2311228"
SPACECRAFT_CLOCK_STOP_COUNT = "2397627"
^TABLE = "LEND_RDR_CHK_20090228.DAT"
OBJECT = TABLE
  COLUMNS = 15
  INTERCHANGE_FORMAT = BINARY
  ROW_BYTES = 77
  ROWS = 86400
  DESCRIPTION = "This table contains instrument parameters and housekeeping values as observed by the Lunar Reconnaissance Orbiter (LRO) Lunar Exploration Neutron Detector (LEND).

  Detailed descriptions for the parameters defined below are contained in the 'LRO_LEND_RDR_SIS' document.

  The complete column definitions are contained in an external file found in the LABEL directory of the archive volume."

^STRUCTURE = "LEND_RDR_CHK.FMT"
END_OBJECT = TABLE
END
5.3.1 Example - LEND_RDR_CHK.FMT

OBJECT = COLUMN
    COLUMN_NUMBER = 1
    NAME = LEND_TIME
    DATA_TYPE = MSB_UNSIGNED_INTEGER
    BYTES = 4
    START_BYTE = 1
    DESCRIPTION = "LEND internal time (incrementation frequency - 62500 Hz)"
END_OBJECT = COLUMN

OBJECT = COLUMN
    COLUMN_NUMBER = 2
    NAME = UTC
    DATA_TYPE = CHARACTER
    BYTES = 23
    START_BYTE = 5
    DESCRIPTION = "UTC time of measurement period"
END_OBJECT = COLUMN

OBJECT = COLUMN
    COLUMN_NUMBER = 3
    NAME = TEMPERATURES_0
    DATA_TYPE = IEEE_REAL
    BYTES = 4
    START_BYTE = 28
    DESCRIPTION = "Temperature reading of scintillator in Celsius."
END_OBJECT = COLUMN

OBJECT = COLUMN
    COLUMN_NUMBER = 4
    NAME = TEMPERATURES_1
    DATA_TYPE = IEEE_REAL
    BYTES = 4
    START_BYTE = 32
    DESCRIPTION = "Temperature reading of FPGA electronics board in Celsius."
END_OBJECT = COLUMN

OBJECT = COLUMN
    COLUMN_NUMBER = 5
    NAME = TEMPERATURES_2
    DATA_TYPE = IEEE_REAL
    BYTES = 4
    START_BYTE = 36
    DESCRIPTION = "Temperature reading of the low voltage board in Celsius."
END_OBJECT = COLUMN

OBJECT = COLUMN
    COLUMN_NUMBER = 6
    NAME = TEMPERATURES_3
    DATA_TYPE = IEEE_REAL
    BYTES = 4
    START_BYTE = 40
DESCRIPTION = "Temperature reading outer detector #2 (SETN) in Celsius."

END_OBJECT = COLUMN

OBJECT = COLUMN
  COLUMN_NUMBER = 7
  NAME = TEMPERATURES_4
  DATA_TYPE = IEEE_REAL
  BYTES = 4
  START_BYTE = 44
  DESCRIPTION = "Temperature reading outer detector #3 (STN2) in Celsius."
END_OBJECT = COLUMN

OBJECT = COLUMN
  COLUMN_NUMBER = 8
  NAME = TEMPERATURES_5
  DATA_TYPE = IEEE_REAL
  BYTES = 4
  START_BYTE = 48
  DESCRIPTION = "Temperature reading in outer detector #2 (STN3) in Celsius."
END_OBJECT = COLUMN

OBJECT = COLUMN
  COLUMN_NUMBER = 9
  NAME = TEMPERATURES_6
  DATA_TYPE = IEEE_REAL
  BYTES = 4
  START_BYTE = 52
  DESCRIPTION = "Temperature reading in outer detector #1 (STN1) in Celsius."
END_OBJECT = COLUMN

OBJECT = COLUMN
  COLUMN_NUMBER = 10
  NAME = TEMPERATURES_7
  DATA_TYPE = IEEE_REAL
  BYTES = 4
  START_BYTE = 56
  DESCRIPTION = "Temperature reading high voltage board #2 in Celsius."
END_OBJECT = COLUMN

OBJECT = COLUMN
  COLUMN_NUMBER = 11
  NAME = TEMPERATURES_8
  DATA_TYPE = IEEE_REAL
  BYTES = 4
  START_BYTE = 60
  DESCRIPTION = "Temperature reading high voltage board #1 in Celsius."
END_OBJECT = COLUMN

OBJECT = COLUMN
  COLUMN_NUMBER = 12
  NAME = TEMPERATURES_9
<table>
<thead>
<tr>
<th>Name</th>
<th>Data Type</th>
<th>Bytes</th>
<th>Start Byte</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>TEMPERATURES_10</td>
<td>IEEE_REAL</td>
<td>4</td>
<td>68</td>
<td>Temperature reading control board #2 in Celsius.</td>
</tr>
<tr>
<td>DATA_COLLECTION_TIME</td>
<td>MSB_UNSIGNED_INTEGER</td>
<td>2</td>
<td>76</td>
<td>Value of 'collection time' register, time in seconds.</td>
</tr>
</tbody>
</table>
5.4 EXAMPLE – LEND Rectified Science Data Label

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PDS_VERSION_ID = "PDS3"
LABEL_REVISION_NOTE = "2008-01-15, LEND Team, initial release;"

/*** FILE FORMAT ***/
FILE_RECORDS = 86400
RECORD_TYPE = FIXED_LENGTH
RECORD_BYTES = 594

/*** GENERAL DATA DESCRIPTION PARAMETERS ***/
PRODUCT_ID = "LEND_RDR_RSCI_20090228_DAT"
PRODUCT_VERSION_ID = "1.0"
PRODUCT_TYPE = "LEND_RDR_RSCI"
SOFTWARE_NAME = "GEN_LEND_RDR"
SOFTWARE_VERSION_ID = "1.0.0"
INSTRUMENT_HOST_NAME = "LUNAR RECONNAISSANCE ORBITER"
INSTRUMENT_NAME = "LUNAR EXPLORATION NEUTRON DETECTOR"
INSTRUMENT_ID = "LEND"
DATA_SET_ID = "LRO-L-LEND-4/5-RDR-V1.0"

MISSION_PHASE_NAME = "PRIMARY MISSION"
TARGET_NAME = "MOON"
START_TIME = 2009-02-28T00:00:00
STOP_TIME = 2009-02-28T23:59:59
SPACECRAFT_CLOCK_START_COUNT = "2311228"
SPACECRAFT_CLOCK_STOP_COUNT = "2397627"
^TABLE = "LEND_RDR_RSCI_20090228.DAT"

OBJECT = TABLE
COLUMNS = 46
INTERCHANGE_FORMAT = BINARY
ROW_BYTES = 594
ROWS = 86400
DESCRIPTION = "This table contains neutron spectra and associated timing and spatial information for each collection interval (frame) as observed by the Lunar Reconnaissance Orbiter (LRO) Lunar Exploration Neutron Detector (LEND) during a single measurement day. Detailed descriptions for the parameters defined below are contained in the 'LRO_LEND_RDR_SIS' document. The complete column definitions are contained in an external file found in the LABEL directory of the archive volume."
^STRUCTURE = "LEND_RDR_RSCI.FMT"
END_OBJECT = TABLE
END
```
5.4.1 Example LEND_RDR_RSCI.FMT

OBJECT = COLUMN
  COLUMN_NUMBER = 1
  NAME = LRO_TIME
  DATA_TYPE = MSB_UNSIGNED_INTEGER
  BYTES = 8
  START_BYTE = 1
  DESCRIPTION = "5 upper bytes of LRO time."
END_OBJECT = COLUMN

OBJECT = COLUMN
  COLUMN_NUMBER = 2
  NAME = LEND_TIME
  DATA_TYPE = MSB_UNSIGNED_INTEGER
  BYTES = 4
  START_BYTE = 9
  DESCRIPTION = "LEND internal time (incremention frequency = 62500 Hz)"
END_OBJECT = COLUMN

OBJECT = COLUMN
  COLUMN_NUMBER = 3
  NAME = UTC
  DATA_TYPE = CHARACTER
  BYTES = 23
  START_BYTE = 13
  DESCRIPTION = "UTC time at the middle of the collection interval, stored as yyyy-mm-ddThh:mm:ss.sss."
END_OBJECT = COLUMN

OBJECT = COLUMN
  COLUMN_NUMBER = 4
  NAME = FRAME_NUMBER
  DATA_TYPE = MSB_UNSIGNED_INTEGER
  BYTES = 4
  START_BYTE = 36
  DESCRIPTION = "Sequential counter of accumulation intervals."
END_OBJECT = COLUMN

OBJECT = COLUMN
  COLUMN_NUMBER = 5
  NAME = LRO_ORBIT_NUMBER
  DATA_TYPE = MSB_UNSIGNED_INTEGER
  BYTES = 4
  START_BYTE = 40
  DESCRIPTION = "Orbit number common to all instruments aboard LRO. This orbit number is incremented by one as the spacecraft passes through the orbital descending node."
END_OBJECT = COLUMN

OBJECT = COLUMN
  COLUMN_NUMBER = 6
  NAME = LATITUDE
  DATA_TYPE = IEEE_REAL
BYTES = 8
START_BYTE = 44
UNIT = DEGREE
DESCRIPTION = "Sub spacecraft latitude in Lunar fixed coordinates at the middle of the pixel."

END_OBJECT = COLUMN

OBJECT = COLUMN
COLUMN_NUMBER = 7
NAME = LONGITUDE
DATA_TYPE = IEEE_REAL
BYTES = 8
START_BYTE = 52
UNIT = DEGREE
DESCRIPTION = "Sub spacecraft longitude in Lunar fixed coordinates at the middle of the frame interval."

END_OBJECT = COLUMN

OBJECT = COLUMN
COLUMN_NUMBER = 8
NAME = SCPOS_INERT_X
DATA_TYPE = IEEE_REAL
BYTES = 8
START_BYTE = 60
UNIT = KILOMETER
DESCRIPTION = "The geometric position X of the spacecraft with respect to the Moon in the 'LUNARIAU' inertial frame at the input epoch 'et' at the middle of the frame interval."

END_OBJECT = COLUMN

OBJECT = COLUMN
COLUMN_NUMBER = 9
NAME = SCPOS_INERT_Y
DATA_TYPE = IEEE_REAL
BYTES = 8
START_BYTE = 68
UNIT = KILOMETER
DESCRIPTION = "The geometric position Y of the spacecraft with respect to the Moon in the 'LUNARIAU' inertial frame at the input epoch 'et' at the middle of the frame interval."

END_OBJECT = COLUMN

OBJECT = COLUMN
COLUMN_NUMBER = 10
NAME = SCPOS_INERT_Z
DATA_TYPE = IEEE_REAL
BYTES = 8
START_BYTE = 76
UNIT = KILOMETER
DESCRIPTION = "The geometric position Z of the spacecraft with respect to the Moon in the 'LUNARIAU' inertial frame at the input epoch 'et' at the middle of the frame interval."

END_OBJECT = COLUMN

OBJECT = COLUMN
COLUMN_NUMBER = 11
NAME = SCVEL_INERT_X
DATA_TYPE = IEEE_REAL
BYTES = 8
START_BYTE = 84
UNIT = "KILOMETER/SECOND"
DESCRIPTION = "The geometric velocity X of the spacecraft with respect to Moon in the 'LUNARIAU' inertial frame at the input epoch 'et' at the middle of the frame interval."
END_OBJECT = COLUMN

OBJECT = COLUMN
COLUMN_NUMBER = 12
NAME = SCVEL_INERT_Y
DATA_TYPE = IEEE_REAL
BYTES = 8
START_BYTE = 92
UNIT = "KILOMETER/SECOND"
DESCRIPTION = "The geometric velocity Y of the spacecraft with respect to Moon in the 'LUNARIAU' inertial frame at the input epoch 'et' at the middle of the frame interval."
END_OBJECT = COLUMN

OBJECT = COLUMN
COLUMN_NUMBER = 13
NAME = SCVEL_INERT_Z
DATA_TYPE = IEEE_REAL
BYTES = 8
START_BYTE = 100
UNIT = "KILOMETER/SECOND"
DESCRIPTION = "The geometric velocity Z of the spacecraft with respect to Moon in the 'LUNARIAU' inertial frame at the input epoch 'et' at the middle of the frame interval."
END_OBJECT = COLUMN

OBJECT = COLUMN
COLUMN_NUMBER = 14
NAME = LUNARPOS_INSTR_X
DATA_TYPE = IEEE_REAL
BYTES = 8
START_BYTE = 108
UNIT = KILOMETER
DESCRIPTION = "The X position of the sub-spacecraft point as seen from the spacecraft in the instrument frame at the middle of the frame interval. If no spacecraft orientation data was available, then all elements of are set to zero."
END_OBJECT = COLUMN

OBJECT = COLUMN
COLUMN_NUMBER = 15
NAME = LUNARPOS_INSTR_Y
DATA_TYPE = IEEE_REAL
BYTES = 8
START_BYTE = 116
UNIT = KILOMETER
DESCRIPTION = "The Y position of the sub-spacecraft point as seen from the spacecraft in the instrument frame at the middle of the frame interval. If no spacecraft orientation data was available, then all elements of are set to zero."
END_OBJECT = COLUMN

OBJECT = COLUMN
COLUMN_NUMBER = 16
NAME = LUNARPOS_INSTR_Z
DATA_TYPE = IEEE_REAL
BYTES = 8
START_BYTE = 124
UNIT = KILOMETER
DESCRIPTION = "The Z position of the sub-spacecraft point as seen from the spacecraft in the instrument frame at the middle of the frame interval. If no spacecraft orientation data was available, then all elements of are set to zero."
END_OBJECT = COLUMN

OBJECT = COLUMN
COLUMN_NUMBER = 17
NAME = LUNARVEL_INSTR_X
DATA_TYPE = IEEE_REAL
BYTES = 8
START_BYTE = 132
UNIT = "KILOMETER/SECOND"
DESCRIPTION = "Contains the inertial spacecraft velocity direction X rotated to the instrument frame at the middle of the frame interval. If no spacecraft orientation data was available for the request time, then all elements are set to zero."
END_OBJECT = COLUMN

OBJECT = COLUMN
COLUMN_NUMBER = 18
NAME = LUNARVEL_INSTR_Y
DATA_TYPE = IEEE_REAL
BYTES = 8
START_BYTE = 140
UNIT = "KILOMETER/SECOND"
DESCRIPTION = "Contains the inertial spacecraft velocity direction Y rotated to the instrument frame at the middle of the frame interval. If no spacecraft orientation data was available for the request time, then all elements are set to zero."
END_OBJECT = COLUMN

OBJECT = COLUMN
COLUMN_NUMBER = 19
NAME = LUNARVEL_INSTR_Z
DATA_TYPE = IEEE_REAL
BYTES = 8
START_BYTE = 148
UNIT = "KILOMETER/SECOND"
DESCRIPTION = "Contains the inertial spacecraft velocity direction
Z rotated to the instrument frame at the middle of the frame
interval. If
no spacecraft orientation data was available for the request time,
then all elements are set to zero."
END_OBJECT = COLUMN

OBJECT = COLUMN
COLUMN_NUMBER = 20
NAME = SCPOS_MOON_X
DATA_TYPE = IEEE_REAL
BYTES = 8
START_BYTE = 156
UNIT = KILOMETER
DESCRIPTION = "Spacecraft position X in Lunar fixed coordinates at
the middle of the frame interval."
END_OBJECT = COLUMN

OBJECT = COLUMN
COLUMN_NUMBER = 21
NAME = SCPOS_MOON_Y
DATA_TYPE = IEEE_REAL
BYTES = 8
START_BYTE = 164
UNIT = KILOMETER
DESCRIPTION = "Spacecraft position Y in Lunar fixed coordinates at
the middle of the frame interval."
END_OBJECT = COLUMN

OBJECT = COLUMN
COLUMN_NUMBER = 22
NAME = SCPOS_MOON_Z
DATA_TYPE = IEEE_REAL
BYTES = 8
START_BYTE = 172
UNIT = KILOMETER
DESCRIPTION = "Spacecraft position Z in Lunar fixed coordinates at
the middle of the frame interval."
END_OBJECT = COLUMN

OBJECT = COLUMN
COLUMN_NUMBER = 23
NAME = INSTR_BORESIGHT_MOON_X
DATA_TYPE = IEEE_REAL
BYTES = 8
START_BYTE = 180
UNIT = KILOMETER
DESCRIPTION = "Sub instrument boresight X in Lunar fixed
coordinates at the middle of the frame interval."
END_OBJECT = COLUMN

OBJECT = COLUMN
COLUMN_NUMBER = 24
NAME = INSTR_BORESIGHT_MOON_Y
DATA_TYPE = IEEE_REAL
BYTES = 8
START_BYTE = 188
UNIT = KILOMETER
DESCRIPTION = "Sub instrument boresight Y in Lunar fixed coordinates at the middle of the frame interval."
END_OBJECT = COLUMN

OBJECT = COLUMN
  COLUMN_NUMBER = 25
  NAME = _INSTR_BORESIGHT_MOON_Z
  DATA_TYPE = IEEE_REAL
  BYTES = 8
  START_BYTE = 196
  UNIT = KILOMETER
  DESCRIPTION = "Sub instrument boresight Z in Lunar fixed coordinates at the middle of the frame interval."
END_OBJECT = COLUMN

OBJECT = COLUMN
  COLUMN_NUMBER = 26
  NAME = SUB_SCPOS_MOON_X
  DATA_TYPE = IEEE_REAL
  BYTES = 8
  START_BYTE = 204
  UNIT = KILOMETER
  DESCRIPTION = "Sub spacecraft vector X in Lunar fixed coordinates at the middle of the frame interval."
END_OBJECT = COLUMN

OBJECT = COLUMN
  COLUMN_NUMBER = 27
  NAME = SUB_SCPOS_MOON_Y
  DATA_TYPE = IEEE_REAL
  BYTES = 8
  START_BYTE = 212
  UNIT = KILOMETER
  DESCRIPTION = "Sub spacecraft vector Y in Lunar fixed coordinates at the middle of the frame interval."
END_OBJECT = COLUMN

OBJECT = COLUMN
  COLUMN_NUMBER = 28
  NAME = _SUB_SCPOS_MOON_Z
  DATA_TYPE = IEEE_REAL
  BYTES = 8
  START_BYTE = 220
  UNIT = KILOMETER
  DESCRIPTION = "Sub spacecraft vector Z in Lunar fixed coordinates at the middle of the frame interval."
END_OBJECT = COLUMN

OBJECT = COLUMN
  COLUMN_NUMBER = 29
  NAME = SCALT
  DATA_TYPE = IEEE_REAL
  BYTES = 8
START_BYTE = 228
UNIT = KILOMETER
DESCRIPTION = "Lunarcentric altitude of the sub-spacecraft point in Lunar-fixed rotating frame at the middle of the frame interval."
END_OBJECT = COLUMN

OBJECT = COLUMN
COLUMN_NUMBER = 30
NAME = LOCAL_HOUR
DATA_TYPE = MSB_UNSIGNEDINTEGER
BYTES = 1
START_BYTE = 236
UNIT = MINUTE
DESCRIPTION = "Local Sun hour at the sub-spacecraft point."
END_OBJECT = COLUMN

OBJECT = COLUMN
COLUMN_NUMBER = 31
NAME = LOCAL_MINUTE
DATA_TYPE = MSB_UNSIGNEDINTEGER
BYTES = 1
START_BYTE = 237
UNIT = MINUTE
DESCRIPTION = "Local Sun minute at the sub-spacecraft point."
END_OBJECT = COLUMN

OBJECT = COLUMN
COLUMN_NUMBER = 32
NAME = POINTING
DATA_TYPE = BOOLEAN
BYTES = 1
START_BYTE = 238
DESCRIPTION = "True if pointing data was available."
END_OBJECT = COLUMN

OBJECT = COLUMN
COLUMN_NUMBER = 33
NAME = INTERSECTING
DATA_TYPE = BOOLEAN
BYTES = 1
START_BYTE = 239
DESCRIPTION = "True if the pointing vector intersects Moon."
END_OBJECT = COLUMN

OBJECT = COLUMN
COLUMN_NUMBER = 34
NAME = DATA_COLLECTION_TIME
DATA_TYPE = MSB_UNSIGNEDINTEGER
BYTES = 2
START_BYTE = 240
UNIT = SECOND
DESCRIPTION = "Value of 'collection time' register, length of time in seconds."
END_OBJECT = COLUMN

OBJECT = COLUMN
COLUMN_NUMBER = 35
NAME = PARAMETERS_CHANGED
DATA_TYPE = MSB_UNSIGNED_INTEGER
BYTES = 1
START_BYTE = 242
DESCRIPTION = "Number of the instrument parameters that were changed by commands after previous frame."
END_OBJECT = COLUMN

OBJECT = COLUMN
COLUMN_NUMBER = 36
NAME = STN1_SPECTRUM
DATA_TYPE = MSB_UNSIGNED_INTEGER
BYTES = 32
START_BYTE = 243
UNIT = COUNTS
ITEMS = 16
ITEM_BYTES = 2
DESCRIPTION = "Spectrum from uncollimated counter of thermal and epithermal neutrons STN1"
END_OBJECT = COLUMN

OBJECT = COLUMN
COLUMN_NUMBER = 37
NAME = SETN_SPECTRUM
DATA_TYPE = MSB_UNSIGNED_INTEGER
BYTES = 32
START_BYTE = 275
UNIT = COUNTS
ITEMS = 16
ITEM_BYTES = 2
DESCRIPTION = "Spectrum from uncollimated counter of epithermal neutrons SETN"
END_OBJECT = COLUMN

OBJECT = COLUMN
COLUMN_NUMBER = 38
NAME = STN2_SPECTRUM
DATA_TYPE = MSB_UNSIGNED_INTEGER
BYTES = 32
START_BYTE = 307
UNIT = COUNTS
ITEMS = 16
ITEM_BYTES = 2
DESCRIPTION = "Spectrum from uncollimated counter of thermal and epithermal neutrons STN2."
END_OBJECT = COLUMN

OBJECT = COLUMN
COLUMN_NUMBER = 39
NAME = STN3_SPECTRUM
DATA_TYPE = MSB_UNSIGNED_INTEGER
BYTES = 32
START_BYTE = 339
UNIT = COUNTS
ITEMS = 16
ITEM_BYTES = 2
DESCRIPTION = "Spectrum from uncollimated counter of thermal
and epithermal neutrons STN3.

END_OBJECT = COLUMN

OBJECT = COLUMN
COLUMN_NUMBER = 40
NAME = CSETN1_SPECTRUM
DATA_TYPE = MSB_UNSIGNED_INTEGER
BYTES = 32
START_BYTE = 371
UNIT = COUNTS
ITEMS = 16
ITEM_BYTES = 2
DESCRIPTION = "Spectrum from collimated counter of epithermal neutrons CSETN1."
END_OBJECT = COLUMN

OBJECT = COLUMN
COLUMN_NUMBER = 41
NAME = CSETN2_SPECTRUM
DATA_TYPE = MSB_UNSIGNED_INTEGER
BYTES = 32
START_BYTE = 403
UNIT = COUNTS
ITEMS = 16
ITEM_BYTES = 2
DESCRIPTION = "Spectrum from collimated counter of epithermal neutrons CSETN2."
END_OBJECT = COLUMN

OBJECT = COLUMN
COLUMN_NUMBER = 42
NAME = CSETN3_SPECTRUM
DATA_TYPE = MSB_UNSIGNED_INTEGER
BYTES = 32
START_BYTE = 435
UNIT = COUNTS
ITEMS = 16
ITEM_BYTES = 2
DESCRIPTION = "Spectrum from collimated counter of epithermal neutrons CSETN3."
END_OBJECT = COLUMN

OBJECT = COLUMN
COLUMN_NUMBER = 43
NAME = CSETN4_SPECTRUM
DATA_TYPE = MSB_UNSIGNED_INTEGER
BYTES = 32
START_BYTE = 467
UNIT = COUNTS
ITEMS = 16
ITEM_BYTES = 2
DESCRIPTION = "Spectrum from collimated counter of epithermal neutrons CSETN4."
END_OBJECT = COLUMN

OBJECT = COLUMN
COLUMN_NUMBER = 44
NAME = SHEN1_SPECTRUM
DATA_TYPE = MSB_UNSIGNED_INTEGER
BYTES = 32
START_BYTE = 499
UNIT = COUNTS
ITEMS = 16
ITEM_BYTES = 2
DESCRIPTION = "Charge Particle spectra for stilbene."
END_OBJECT = COLUMN

OBJECT = COLUMN
COLUMN_NUMBER = 45
NAME = SHEN2_SPECTRUM
DATA_TYPE = MSB_UNSIGNED_INTEGER
BYTES = 32
START_BYTE = 531
UNIT = COUNTS
ITEMS = 16
ITEM_BYTES = 2
DESCRIPTION = " Neutron spectra for stilbene."
END_OBJECT = COLUMN

OBJECT = COLUMN
COLUMN_NUMBER = 46
NAME = SHEN3_SPECTRUM
DATA_TYPE = MSB_UNSIGNED_INTEGER
BYTES = 32
START_BYTE = 563
UNIT = COUNTS
ITEMS = 16
ITEM_BYTES = 2
DESCRIPTION = " Gamma spectra for stilbene."
END_OBJECT = COLUMN

5.5 EXAMPLE – Derived LEND Data Label

PDS_VERSION_ID = PDS3
DD_VERSION_ID = PDSCAT1R52 (Data Dictionary Version)
LABEL_REVISION_NOTE = "2008-01-15, LEND Team, initial release;"

/*** FILE FORMAT ***/
FILE_RECORDS = 86400
RECORD_TYPE = FIXED_LENGTH
RECORD_BYTES = 239

/*** GENERAL DATA DESCRIPTION PARAMETERS ***/
PRODUCT_ID = "LEND_RDR_DLD_20090228_DAT"
PRODUCT_VERSION_ID = "1.0"
SOFTWARE_NAME = "GEN_LEND_RDR"
SOFTWARE_VERSION_ID = "1.0.0"
INSTRUMENT_HOST_NAME = "Lunar Reconnaissance Orbiter"
INSTRUMENT_NAME = "Lunar Exploration Neutron Detector"
INSTRUMENT_ID = "LEND"
DATA_SET_ID = "LRO-LEND-4/5-RDR-V1.0"

MISSION_PHASE_NAME = "PRIMARY MISSION"
TARGET_NAME = "MOON"
START_TIME = 2009-02-28T00:00:00
STOP_TIME = 2009-02-28T23:59:59
SPACECRAFT_CLOCK_START_COUNT = "2311228"
SPACECRAFT_CLOCK_STOP_COUNT = "2397627"
TABLE = "LEND_RDR_DLD_20090228.DAT"

OBJECT = TABLE
   COLUMNS = 27
   INTERCHANGE_FORMAT = BINARY
   ROW_BYTES = 239
   ROWS = 86400
   DESCRIPTION = "This table contains backgrounds and background subtracted neutron counting data for each of the nine neutron sensors aboard the Lunar Reconnaissance Orbiter (LRO) Lunar Exploration Neutron Detector (LEND).

   Detailed descriptions for the parameters defined below are contained in the 'LRO_LEND_RDR_SIS' document.

   The complete column definitions are contained in an external file found in the LABEL directory of the archive volume.

   "
   "
   "
   "

   "

5.5.1. Example LEND_RDR_DLD.FMT

OBJECT = COLUMN
   COLUMN_NUMBER = 1
   NAME = LRO_TIME
   DATA_TYPE = MSB_UNSIGNED_INTEGER
   BYTES = 8
   START_BYTE = 1
   DESCRIPTION = "5 upper bytes of LRO time."
END_OBJECT = COLUMN

OBJECT = COLUMN
   COLUMN_NUMBER = 2
   NAME = UTC
   DATA_TYPE = CHARACTER
   BYTES = 23
   START_BYTE = 9
   DESCRIPTION = "UTC time at the middle of the collection interval, stored as yyyy-mm-ddThh:mm:ss.sss."
END_OBJECT = COLUMN
OBJECT = COLUMN
  COLUMN_NUMBER = 3
  NAME = LOCAL_HOUR
  DATA_TYPE = MSB_UNSIGNED_INTEGER
  BYTES = 1
  START_BYTE = 32
  UNIT = MINUTE
  DESCRIPTION = "Local Sun hour at the sub-spacecraft point."
END_OBJECT = COLUMN

OBJECT = COLUMN
  COLUMN_NUMBER = 4
  NAME = LOCAL_MINUTE
  DATA_TYPE = MSB_UNSIGNED_INTEGER
  BYTES = 1
  START_BYTE = 33
  UNIT = MINUTE
  DESCRIPTION = "Local Sun minute at the sub-spacecraft point."
END_OBJECT = COLUMN

OBJECT = COLUMN
  COLUMN_NUMBER = 5
  NAME = LUNARCENTRIC_LATITUDE
  DATA_TYPE = IEEE_REAL
  BYTES = 4
  START_BYTE = 34
  UNIT = DEGREE
  DESCRIPTION = "Latitude in LUNAR fixed coordinates at the middle of the frame."
END_OBJECT = COLUMN

OBJECT = COLUMN
  COLUMN_NUMBER = 6
  NAME = LUNARCENTIC_EAST_LONGITUDE
  DATA_TYPE = IEEE_REAL
  BYTES = 4
  START_BYTE = 38
  UNIT = DEGREE
  DESCRIPTION = "Longitude in Lunar fixed coordinates at the middle of the frame."
END_OBJECT = COLUMN

OBJECT = COLUMN
  COLUMN_NUMBER = 7
  NAME = COLLECTION_DURATION
  DATA_TYPE = MSB_UNSIGNED_INTEGER
  BYTES = 4
  START_BYTE = 42
  UNIT = SECOND
  DESCRIPTION = "Value of 'collection time' register, length of time in seconds."
END_OBJECT = COLUMN

OBJECT = COLUMN
  COLUMN_NUMBER = 8
  NAME = STN1_BKGD
DATA_TYPE = IEEE_REAL
BYTES = 4
START_BYTE = 46
UNIT = COUNTS
DESCRIPTION = "Background counts for STN1 detector (counts)."
END_OBJECT = COLUMN

OBJECT = COLUMN
COLUMN_NUMBER = 9
NAME = STN1_COUNTS
DATA_TYPE = IEEE_REAL
BYTES = 4
START_BYTE = 50
UNIT = COUNTS
DESCRIPTION = "Counts gathered in STN1 detector during frame interval. A negative in this column indicates it should not be used."
END_OBJECT = COLUMN

OBJECT = COLUMN
COLUMN_NUMBER = 10
NAME = SETN_BKGD
DATA_TYPE = IEEE_REAL
BYTES = 4
START_BYTE = 54
UNIT = COUNTS
DESCRIPTION = "Background counts for SETN detector (counts)."
END_OBJECT = COLUMN

OBJECT = COLUMN
COLUMN_NUMBER = 11
NAME = SETN_COUNTS
DATA_TYPE = IEEE_REAL
BYTES = 4
START_BYTE = 58
UNIT = COUNTS
DESCRIPTION = "Counts gathered in SETN detector during frame interval. A negative in this column indicates it should not be used."
END_OBJECT = COLUMN

OBJECT = COLUMN
COLUMN_NUMBER = 12
NAME = STN2_BKGD
DATA_TYPE = IEEE_REAL
BYTES = 4
START_BYTE = 62
UNIT = COUNTS
DESCRIPTION = "Background counts for STN2 detector (counts)."
END_OBJECT = COLUMN

OBJECT = COLUMN
COLUMN_NUMBER = 13
NAME = STN2_COUNTS
DATA_TYPE = IEEE_REAL
BYTES = 4
START_BYTE = 66
UNIT = COUNTS
DESCRIPTION = "Counts gathered in STN2 detector during frame interval.
A negative in this column indicates it should not be used."
END_OBJECT = COLUMN

OBJECT = COLUMN
COLUMN_NUMBER = 14
NAME = STN3_BKGD
DATA_TYPE = IEEE_REAL
BYTES = 4
START_BYTE = 70
UNIT = COUNTS
DESCRIPTION = "Background counts for STN3 detector (counts)."
END_OBJECT = COLUMN

OBJECT = COLUMN
COLUMN_NUMBER = 15
NAME = STN3_COUNTS
DATA_TYPE = IEEE_REAL
BYTES = 4
START_BYTE = 74
UNIT = COUNTS
DESCRIPTION = "Counts gathered in STN3 detector during frame interval.
A negative in this column indicates it should not be used."
END_OBJECT = COLUMN

OBJECT = COLUMN
COLUMN_NUMBER = 16
NAME = CSETN1_BKGD
DATA_TYPE = IEEE_REAL
BYTES = 4
START_BYTE = 78
UNIT = COUNTS
DESCRIPTION = "Background counts for CSETN1 collimated detector (counts)."
END_OBJECT = COLUMN

OBJECT = COLUMN
COLUMN_NUMBER = 17
NAME = CSETN1_COUNTS
DATA_TYPE = IEEE_REAL
BYTES = 4
START_BYTE = 82
UNIT = COUNTS
DESCRIPTION = "Counts gathered in CSETN1 collimated detector during frame interval. A negative in this column indicates it should not be used."
END_OBJECT = COLUMN

OBJECT = COLUMN
COLUMN_NUMBER = 18
NAME = CSETN2_BKGD
DATA_TYPE = IEEE_REAL
BYTES = 4
START_BYTE = 86
UNIT = COUNTS
DESCRIPTION = "Background counts for CSETN2 collimated
detector (counts)."
END_OBJECT = COLUMN

OBJECT = COLUMN
COLUMN_NUMBER = 19
NAME = CSETN2_COUNTS
DATA_TYPE = IEEE_REAL
BYTES = 4
START_BYTE = 90
UNIT = COUNTS
DESCRIPTION = "Counts gathered in CSETN2 collimated
detector during frame interval. A negative in this column
indicates it should not be used."
END_OBJECT = COLUMN

OBJECT = COLUMN
COLUMN_NUMBER = 20
NAME = CSETN3_BKGD
DATA_TYPE = IEEE_REAL
BYTES = 4
START_BYTE = 94
UNIT = COUNTS
DESCRIPTION = "Background counts for CSETN3 collimated
detector (counts)."
END_OBJECT = COLUMN

OBJECT = COLUMN
COLUMN_NUMBER = 21
NAME = CSETN3_COUNTS
DATA_TYPE = IEEE_REAL
BYTES = 4
START_BYTE = 98
UNIT = COUNTS
DESCRIPTION = "Counts gathered in CSETN3 collimated
detector during frame interval. A negative in this column
indicates it should not be used."
END_OBJECT = COLUMN

OBJECT = COLUMN
COLUMN_NUMBER = 22
NAME = CSETN4_BKGD
DATA_TYPE = IEEE_REAL
BYTES = 4
START_BYTE = 102
UNIT = COUNTS
DESCRIPTION = "Background counts for CSETN4 collimated
detector (counts)."
END_OBJECT = COLUMN

OBJECT = COLUMN
COLUMN_NUMBER = 23
NAME = CSETN4_COUNTS
DATA_TYPE = IEEE_REAL
BYTES = 4
START_BYTE = 106
UNIT = COUNTS
DESCRIPTION = "Counts gathered in CSETN4 collimated detector during frame interval. A negative in this column indicates it should not be used."
END_OBJECT = COLUMN

OBJECT = COLUMN
COLUMN_NUMBER = 24
NAME = SHEN_BCGD
DATA_TYPE = IEEE_REAL
BYTES = 64
START_BYTE = 110
ITEMS = 16
ITEM_BYTES = 4
UNIT = COUNTS
DESCRIPTION = "Background counts for all channels of neutron channel of Inner Scintillator (counts). The Channels contain data as follows:
Channel 0 - sum of channels 0 through 5,
Channel 1 - sum of channel 6,
Channel 2 - sum of channel 7,
Channel 3 - sum of channel 8,
Channel 4 - sum of channel 9,
Channel 5 - sum of channel 10,
Channel 6 - sum of channel 11,
Channel 7 - sum of channel 12,
Channel 8 - sum of channel 13,
Channel 9 - sum of channel 14,
Channel 10 - sum of channel 15,
Channel 11 - sum of channel 6 through 8,
Channel 12 - sum of channel 9 through 12,
Channel 13 - sum of channel 13 through 14,
Channel 14 - sum of channel 6 through 14,
Channel 15 - sum of channel 0 through 16"
END_OBJECT = COLUMN

OBJECT = COLUMN
COLUMN_NUMBER = 25
NAME = SHEN_COUNTS
DATA_TYPE = IEEE_REAL
BYTES = 64
START_BYTE = 174
ITEMS = 16
ITEM_BYTES = 4
UNIT = COUNTS
DESCRIPTION = "Counts gathered in all channels of neutron channel of Inner Scintillator during frame interval. The Channels contain data as follows:
Channel 0 - sum of channels 0 through 5,
Channel 1 - sum of channel 6,
Channel 2 - sum of channel 7,
Channel 3 - sum of channel 8,
Channel 4 - sum of channel 9,
Channel 5 - sum of channel 10,
Channel 6 - sum of channel 11,
Channel 7 - sum of channel 12,
Channel 8 - sum of channel 13,"
Channel 9 - sum of channel 14,
Channel 10 - sum of channel 15,
Channel 11 - sum of channel 6 through 8,
Channel 12 - sum of channel 9 through 12,
Channel 13 - sum of channel 13 through 14,
Channel 14 - sum of channel 6 through 14,
Channel 15 - sum of channel 0 through 16
A negative in any channel indicates it should not be used.

5.6 EXAMPLE – Extended Derived LEND Data Label

PDS VERSION ID = PDS3
LABEL REVISION NOTE = "2016-06-15, LEND Team, initial release;"

/*** FILE FORMAT ***/
FILE RECORDS = 86400
RECORD_TYPE = FIXED_LENGTH
RECORD_BYTES = 71

/*** GENERAL DATA DESCRIPTION PARAMETERS ***/
PRODUCT_ID = "LEND_RDR_DLX_20090704_DAT"
PRODUCT_VERSION_ID = "1.0"
PRODUCT_TYPE = "LEND_RDR_DLX"
SOFTWARE NAME = "GEN_LEND_RDR"
SOFTWARE VERSION ID = "1.0.0"
INSTRUMENT HOST NAME = "LUNAR RECONNAISSANCE ORBITER"
INSTRUMENT NAME = "LUNAR EXPLORATION NEUTRON DETECTOR"
INSTRUMENT ID = "LEND"
DATA SET ID = "LRO-L-LEND-4/5-RDR-V1.0"
MISSION_PHASE_NAME = "COMMISSIONING"
TARGET_NAME = "MOON"
START_TIME = 2009-07-04T00:00:00
STOP_TIME = 2009-07-04T23:59:59
SPACECRAFT_CLOCK_START_COUNT = "268358399"
SPACECRAFT_CLOCK_STOP_COUNT = "268444798"
^TABLE = "LEND_RDR_DLX_20090704.DAT"

OBJECT
COLUMNS = 12
INTERCHANGE_FORMAT = BINARY
ROW_BYTES = 71
ROWS = 86400
DESCRIPTION = "This table contains a calculated sum of neutron counts for the four CSETN detectors and uncertainties for neutron counting data for each of the nine neutron sensors aboard the Lunar Reconnaissance Orbiter (LRO) Lunar Exploration Neutron Detector (LEND).

Detailed descriptions for the parameters defined below are contained in the 'LRO_LEND_RDR_SIS' document.

The complete column definitions are contained in an external file found in the LABEL directory of the archive volume."

^STRUCTURE = "LEND_RDR_DLX.FMT"
END_OBJECT = TABLE
END

5.6.1. Example LEND_RDR_DLX.FMT

OBJECT = COLUMN
COLUMN_NUMBER = 1
NAME = LRO_TIME
DATA_TYPE = MSB_UNSIGNED_INTEGER
BYTES = 8
START_BYTE = 1
DESCRIPTION = "5 upper bytes of LRO time."
END_OBJECT = COLUMN

OBJECT = COLUMN
COLUMN_NUMBER = 2
NAME = UTC
DATA_TYPE = TIME
BYTES = 23
START_BYTE = 9
DESCRIPTION = "UTC time at the middle of the collection interval, stored as yyyy-mm-ddThh:mm:ss.sss."
END_OBJECT = COLUMN

OBJECT = COLUMN
COLUMN_NUMBER = 3
NAME = CSETN_SUM_COUNTS
DATA_TYPE = IEEE_REAL
BYTES = 4
START_BYTE = 32
UNIT = COUNTS
DESCRIPTION = "Calculated sum of corrected counts in 4 CSETN detectors.
A negative in this column indicates it should not be used."
END_OBJECT = COLUMN

OBJECT = COLUMN
COLUMN_NUMBER = 4
NAME = CSETN_SUM_SIGMA
DATA_TYPE = IEEE_REAL
BYTES = 4
START_BYTE = 36
UNIT = COUNTS
DESCRIPTION = "Sigma value of calculated sum of corrected counts in 4 CSETN detectors.
A negative in this column indicates it should not be used."
END_OBJECT = COLUMN

OBJECT = COLUMN
COLUMN_NUMBER = 5
NAME = CSETN1_SIGMA
DATA_TYPE = IEEE_REAL
BYTES = 4
START_BYTE = 40
UNIT = COUNTS
DESCRIPTION = "Sigma value of corrected counts in CSETN1 detector.
A negative in this column indicates it should not be used."
END_OBJECT = COLUMN

OBJECT = COLUMN
COLUMN_NUMBER = 6
NAME = CSETN2_SIGMA
DATA_TYPE = IEEE_REAL
BYTES = 4
START_BYTE = 44
UNIT = COUNTS
DESCRIPTION = "Sigma value of corrected counts in CSETN2 detector.
A negative in this column indicates it should not be used."
END_OBJECT = COLUMN

OBJECT = COLUMN
COLUMN_NUMBER = 7
NAME = CSETN3_SIGMA
DATA_TYPE = IEEE_REAL
BYTES = 4
START_BYTE = 48
UNIT = COUNTS
DESCRIPTION = "Sigma value of corrected counts in CSETN3 detector.
A negative in this column indicates it should not be used."
END_OBJECT = COLUMN

OBJECT = COLUMN
COLUMN_NUMBER = 8
NAME = CSETN4_SIGMA
DATA_TYPE = IEEE_REAL
BYTES = 4
START_BYTE = 52
UNIT = COUNTS
DESCRIPTION = "Sigma value of corrected counts in CSETN4 detector. A negative in this column indicates it should not be used."
END_OBJECT = COLUMN

OBJECT = COLUMN
COLUMN_NUMBER = 9
NAME = SETN_SIGMA
DATA_TYPE = IEEE_REAL
BYTES = 4
START_BYTE = 56
UNIT = COUNTS
DESCRIPTION = "Sigma value of corrected counts in SETN detector. A negative in this column indicates it should not be used."
END_OBJECT = COLUMN

OBJECT = COLUMN
COLUMN_NUMBER = 10
NAME = STN1_SIGMA
DATA_TYPE = IEEE_REAL
BYTES = 4
START_BYTE = 60
UNIT = COUNTS
DESCRIPTION = "Sigma value of corrected counts in STN1 detector. A negative in this column indicates it should not be used."
END_OBJECT = COLUMN

OBJECT = COLUMN
COLUMN_NUMBER = 11
NAME = STN2_SIGMA
DATA_TYPE = IEEE_REAL
BYTES = 4
START_BYTE = 64
UNIT = COUNTS
DESCRIPTION = "Sigma value of corrected counts in STN2 detector. A negative in this column indicates it should not be used."
END_OBJECT = COLUMN

OBJECT = COLUMN
COLUMN_NUMBER = 12
NAME = STN3_SIGMA
DATA_TYPE = IEEE_REAL
BYTES = 4
START_BYTE = 68
UNIT = COUNTS
DESCRIPTION = "Sigma value of corrected counts in STN3 detector. A negative in this column indicates it should not be used."
END_OBJECT = COLUMN
5.7 EXAMPLE – Averaged Counts LEND Data Label (South Pole, Equatorial, North Pole)

The ALD South Polar product data has been averaged spatially over a 0.5 degree by 0.5 degree grid below -80 degrees.

The ALD South Polar product data is presented in a table corresponding to the 0.5 degree by 0.5 degree grid. There are 20 latitude bands and 720 longitude bands below -80, thus 14400 grid cells. Each cell corresponds to one row in the table. The first 720 rows in the table are the data for the 0.5 degree latitude band centered at -89.75 degrees south latitude, the second 720 rows are the data for the band centered at -89.25 degrees south latitude, and so on. Within each band, longitude increases eastward from the cell centered at 0.25 degrees east longitude to the cell centered at 359.75 degrees east longitude.

Averaged LEND Data products are composed of averaged normalized Counting rates and the associated timing, spatial and engineering information. The ALDs consists of the cumulative background subtracted and normalized counts of neutrons at the nine LEND
The ALD Equatorial Polar product data has been averaged spatially over a 1.0 degree by 1.0 degree grid above -80 and below 80 degrees.

The ALD Equatorial Polar product data is presented in a table corresponding to the 1.0 degree by 1.0 degree grid. There are 160 latitude bands and 360 longitude bands below 80 and above -80, thus 57600 grid cells. Each cell corresponds to one row in the table. The first 360 rows in the table are the data for the 1.0 degree latitude band centered at 79.5 degrees north latitude, the second 720 rows are the data for the band centered at 78.5 degrees north latitude, and so on. Within each band, longitude increases eastward from the cell centered at 0.50 degrees east longitude to the cell centered at 359.50 degrees east longitude.
Averaged LEND Data products are composed of averaged normalized counting rates and the associated timing, spatial and engineering information. The ALDs consist of the cumulative background subtracted and normalized counts of neutrons at the nine LEND detectors averaged over the above defined.

```
^STRUCTURE                  = "LEND_RDR_ALD_FMT"
END_OBJECT                     = TABLE
END

PDS_VERSION_ID                 = "PDS3"
LABEL_REVISION_NOTE            = "2010-02-04, LEND Team, initial release;"

/*** FILE FORMAT ***/
FILE_RECORDS                   = 14400
RECORD_TYPE                    = FIXED_LENGTH
RECORD_BYTES                   = 310

/*** GENERAL DATA DESCRIPTION PARAMETERS ***/
PRODUCT_ID                     = "LEND_RDR_ALDN_20090914_DAT"
PRODUCT_VERSION_ID             = "1.0"
PRODUCT_CREATION_TIME          = 2011-03-23T13:12:29
PRODUCT_TYPE                   = "LEND_RDR_ALD"
SOFTWARE_NAME                  = "GEN_LEND_RDR"
SOFTWARE_VERSION_ID            = "1.0.0"
INSTRUMENT_HOST_NAME           = "Lunar Reconnaissance Orbiter"
INSTRUMENT_NAME                = "Lunar Exploration Neutron Detector"
INSTRUMENT_ID                  = "LEND"
DATA_SET_ID                    = "LRO-L-LEND-4/5-RDR-V1.0"
MISSION_PHASE_NAME             = "COMMISSIONING"
TARGET_NAME                    = "MOON"
START_TIME                     = 2009-09-14T00:00:00
STOP_TIME                      = 2010-09-14T00:00:00

^TABLE                         = "LEND_RDR_ALDN_20090914.DAT"
OBJECT                         = TABLE
COLUMNS                     = 23
INTERCHANGE_FORMAT          = BINARY
ROW_BYTES                   = 310
ROWS                        = 14400
DESCRIPTION                 = "

The ALD North Polar product data has been averaged spatially over a 0.5 degree by 0.5 degree grid above 80 degrees.

The ALD North Polar product data is presented in a table corresponding to the 0.5 degree by 0.5 degree grid. There are 20 latitude bands and 720 longitude bands above 80, thus 14400 grid cells. Each cell corresponds to one row in the table. The first 720 rows in the table are the data for the 0.5 degree latitude band centered at 89.75 degrees north latitude, the second 720 rows are the data for the band centered at 89.25 degrees north latitude, and so on. Within each band, longitude increases..."
eastward from the cell centered at 0.25 degrees east longitude
to the cell centered at 359.75 degrees east longitude.

Averaged LEND Data products are composed of averaged normalized
Counting rates and the associated timing, spatial and engineering
information. The ALDs consist of the cumulative background
subtracted and normalized counts of neutrons at the nine LEND
detectors averaged over the above defined.

```
^STRUCTURE                  = "LEND_RDR_ALD.FMT"
END_OBJECT                     = TABLE
END
```

5.7.1. Example LEND_RDR_ALD.FMT

```
OBJECT = COLUMN
    COLUMN_NUMBER = 1
    NAME = START_UTC_TIME
    DATA_TYPE = CHARACTER
    BYTES = 23
    START_BYTE = 1
    DESCRIPTION = "UTC time at the start of the averaged frames,
                   stored as yyyy-mm-ddThh:mm:ss.sss."
END_OBJECT = COLUMN

OBJECT = COLUMN
    COLUMN_NUMBER = 2
    NAME = STOP_UTC_TIME
    DATA_TYPE = CHARACTER
    BYTES = 23
    START_BYTE = 24
    DESCRIPTION = "UTC time at the end of the averaged frames,
                   stored as yyyy-mm-ddThh:mm:ss.sss."
END_OBJECT = COLUMN

OBJECT = COLUMN
    COLUMN_NUMBER = 3
    NAME = LUNARCENTRIC_LATITUDE
    DATA_TYPE = IEEE_REAL
    BYTES = 4
    START_BYTE = 47
    UNIT = DEGREE
    DESCRIPTION = "Latitude in LUNAR fixed coordinates at the
                   center of the given map element."
END_OBJECT = COLUMN

OBJECT = COLUMN
    COLUMN_NUMBER = 4
    NAME = LUNARCENTRIC EAST_LONGITUDE
    DATA_TYPE = IEEE_REAL
    BYTES = 4
    START_BYTE = 51
    UNIT = DEGREE
```
DESCRIPTION = "Longitude in Lunar fixed coordinates at the center of the given map element."

END_OBJECT = COLUMN

OBJECT = COLUMN
COLUMN_NUMBER = 5
NAME = SPARE
DATA_TYPE = IEEE_REAL
BYTES = 4
START_BYTE = 55
UNIT = SECOND
DESCRIPTION = "SPARE FIELD"
END_OBJECT = COLUMN

OBJECT = COLUMN
COLUMN_NUMBER = 6
NAME = STN1_EXPOSURE
DATA_TYPE = IEEE_REAL
BYTES = 4
START_BYTE = 59
UNIT = "COUNTS/SECOND"
DESCRIPTION = "Exposure time for given map element for given detector, sec"
END_OBJECT = COLUMN

OBJECT = COLUMN
COLUMN_NUMBER = 7
NAME = STN1_RATE
DATA_TYPE = IEEE_REAL
BYTES = 4
START_BYTE = 63
DESCRIPTION = "The relative count rate which is accumulated in given map element by STN1 detector."
END_OBJECT = COLUMN

OBJECT = COLUMN
COLUMN_NUMBER = 8
NAME = STN1_ERR
DATA_TYPE = IEEE_REAL
BYTES = 4
START_BYTE = 67
DESCRIPTION = "The statistical error of relative count rate in STN1 detector."
END_OBJECT = COLUMN

OBJECT = COLUMN
COLUMN_NUMBER = 9
NAME = SETN_EXPOSURE
DATA_TYPE = IEEE_REAL
BYTES = 4
START_BYTE = 71
UNIT = "COUNTS/SECOND"
DESCRIPTION = "Exposure time for given map element for given detector, sec"
END_OBJECT = COLUMN

OBJECT = COLUMN
<table>
<thead>
<tr>
<th>COLUMN_NUMBER</th>
<th>10</th>
<th>NAME</th>
<th>SETN_RATE</th>
<th>DATA_TYPE</th>
<th>IEEE_REAL</th>
<th>BYTES</th>
<th>4</th>
<th>START_BYTE</th>
<th>75</th>
<th>DESCRIPTION</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>&quot;The relative count rate which is accumulated in given map element by SETN detector.&quot;</td>
</tr>
<tr>
<td>END_OBJECT</td>
<td>COLUMN</td>
<td></td>
<td></td>
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<td></td>
</tr>
<tr>
<td>OBJECT</td>
<td>COLUMN</td>
<td>COLUMN_NUMBER</td>
<td>11</td>
<td>NAME</td>
<td>SETN_ERR</td>
<td>DATA_TYPE</td>
<td>IEEE_REAL</td>
<td>BYTES</td>
<td>4</td>
<td>START_BYTE</td>
</tr>
<tr>
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<td></td>
<td></td>
<td></td>
<td></td>
<td>&quot;The statistical error of relative count rate in SETN detector.&quot;</td>
</tr>
<tr>
<td>END_OBJECT</td>
<td>COLUMN</td>
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<td></td>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>OBJECT</td>
<td>COLUMN</td>
<td>COLUMN_NUMBER</td>
<td>12</td>
<td>NAME</td>
<td>STN2_EXPOSURE</td>
<td>DATA_TYPE</td>
<td>IEEE_REAL</td>
<td>BYTES</td>
<td>4</td>
<td>START_BYTE</td>
</tr>
<tr>
<td></td>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>END_OBJECT</td>
<td>COLUMN</td>
<td></td>
<td></td>
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<td></td>
<td></td>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>OBJECT</td>
<td>COLUMN</td>
<td>COLUMN_NUMBER</td>
<td>13</td>
<td>NAME</td>
<td>STN2_RATE</td>
<td>DATA_TYPE</td>
<td>IEEE_REAL</td>
<td>BYTES</td>
<td>4</td>
<td>START_BYTE</td>
</tr>
<tr>
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<td></td>
<td></td>
<td></td>
<td></td>
<td>&quot;The relative count rate which is accumulated in given map element by STN2 detector.&quot;</td>
</tr>
<tr>
<td>END_OBJECT</td>
<td>COLUMN</td>
<td></td>
<td></td>
<td></td>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>OBJECT</td>
<td>COLUMN</td>
<td>COLUMN_NUMBER</td>
<td>14</td>
<td>NAME</td>
<td>STN2_ERR</td>
<td>DATA_TYPE</td>
<td>IEEE_REAL</td>
<td>BYTES</td>
<td>4</td>
<td>START_BYTE</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>&quot;The statistical error of relative count rate in STN2 detector.&quot;</td>
</tr>
<tr>
<td>END_OBJECT</td>
<td>COLUMN</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>OBJECT</td>
<td>COLUMN</td>
<td>COLUMN_NUMBER</td>
<td>15</td>
<td>NAME</td>
<td>STN3_EXPOSURE</td>
<td>DATA_TYPE</td>
<td>IEEE_REAL</td>
<td>BYTES</td>
<td>4</td>
<td>START_BYTE</td>
</tr>
<tr>
<td></td>
<td></td>
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<td></td>
<td></td>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Column Number</td>
<td>Name</td>
<td>Data Type</td>
<td>Bytes</td>
<td>Start Byte</td>
<td>Description</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
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<td>-----------------------------------------------------------------------------</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>16</td>
<td>STN3_RATE</td>
<td>IEEE_REAL</td>
<td>4</td>
<td>99</td>
<td>&quot;The relative count rate which is accumulated in given map element by STN3 detector.&quot;</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>17</td>
<td>STN3_ERR</td>
<td>IEEE_REAL</td>
<td>4</td>
<td>103</td>
<td>&quot;The statistical error of relative count rate in STN3 detector.&quot;</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>18</td>
<td>CSETN_EXPOSURE</td>
<td>IEEE_REAL</td>
<td>4</td>
<td>107</td>
<td>&quot;Exposure time for given map element for given detector, sec&quot;</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>19</td>
<td>CSETN_RATE</td>
<td>IEEE_REAL</td>
<td>4</td>
<td>111</td>
<td>&quot;The relative count rate which is accumulated in given map element by sum of CSETN1-4 detectors.&quot;</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>20</td>
<td>CSETN_ERR</td>
<td>IEEE_REAL</td>
<td>4</td>
<td>115</td>
<td>&quot;The statistical error of relative count rate in the sum of CSETN1-4 detector.&quot;</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
NAME = SHEN_EXPOSURE
DATA_TYPE = IEEE_REAL
BYTES = 64
START_BYTE = 119
ITEMS = 16
ITEM_BYTES = 4
DESCRIPTION = "Exposure time for given map element for given channel."

END_OBJECT = COLUMN

OBJECT = COLUMN
COLUMN_NUMBER = 22
NAME = SHEN_RATE
DATA_TYPE = IEEE_REAL
BYTES = 64
START_BYTE = 183
ITEMS = 16
ITEM_BYTES = 4
DESCRIPTION = "The relative count rate which is observed in given map element by neutron channel of stilbene detector. First element is sum of count rate in channels 0 through 5. Second element is sum of count rate in channel 6. Third element is sum of count rate in channel 7. Fourth element is sum of count rate in channel 8. Fifth element is sum of count rate in channel 9. Sixth element is sum of count rate in channel 10. Seventh element is sum of count rate in channel 11. Eighth element is sum of count rate in channel 12. Ninth element is sum of count rate in channel 13. Tenth element is sum of count rate in channel 14. Eleventh element is sum of count rate in channel 15. Twelfth element is sum of count rate in channels 6, 7, 8. Thirteenth element is sum of count rate in channels 9, 10, 11, 12. Fourteenth element is sum of count rate in channels 13, 14. Fifteenth element is sum of count rate in channels 6 through 14. Sixteenth element is sum of count rate in channels 0 through 15."

END_OBJECT = COLUMN

OBJECT = COLUMN
COLUMN_NUMBER = 23
NAME = SHEN_ERR
DATA_TYPE = IEEE_REAL
BYTES = 64
START_BYTE = 247
ITEMS = 16
ITEM_BYTES = 4
DESCRIPTION = "The statistical error of relative count rate in neutron channel of stilbene detector. First element is the error in channels 0 through 5. Second element is the error in channel 6. Third element is the error in channel 7. Fourth element is the error in channel 8. Fifth element is the error in channel 9. Sixth element is the error in channel 10."
Seventh element is the error in channel 11
Eighth element is the error in channel 12
Ninth element is the error in channel 13
Tenth element is the error in channel 14
Eleventh element is the error in channel 15
Twelfth element is the error in channels 6, 7, 8
Thirteenth element is the error in channels 9, 10, 11, 12
Fourteenth element is the error in channels 13, 14
Fifteenth element is the error in channels 6 through 14
Sixteenth element is the error in channels 0 through 15

END_OBJECT = COLUMN

5.8 EXAMPLE – Averaged Fluxes LEND Data Label

PDS_VERSION_ID = "PDS3"
DD_VERSION_ID = PDSCAT1R52 (Data Dictionary Version)
LABEL_REVISION_NOTE = "2008-01-15, LEND Team, initial release:"

/*** FILE FORMAT ***/
FILE_RECORDS = 86400
RECORD_TYPE = FIXED_LENGTH
RECORD_BYTES = 82

/*** GENERAL DATA DESCRIPTION PARAMETERS ***/
PRODUCT_ID = "LEND_RDR_ALF_20090201_DAT"
PRODUCT_VERSION_ID = "1.0"
PRODUCT_TYPE = "LEND_RDR_ALF"
SOFTWARE_NAME = "GEN_LEND_RDR"
SOFTWARE_VERSION_ID = "1.0.0"
INSTRUMENT_HOST_NAME = "Lunar Reconnaissance Orbiter"
INSTRUMENT_NAME = "Lunar Exploration Neutron Detector"
INSTRUMENT_ID = "LEND"
DATA_SET_ID = "LRO-LEND-4/5-RDR-V1.0"
MISSION_PHASE_NAME = "PRIMARY MISSION"
TARGET_NAME = "MOON"
START_TIME = 2009-02-01T00:00:00
STOP_TIME = 2009-02-28T23:59:59

^TABLE = "LEND_RDR_ALF_20090201.DAT"

OBJECT = TABLE
COLUMNS = 11
INTERCHANGE_FORMAT = BINARY
ROW_BYTES = 82
ROWS = 86400
DESCRIPTION = "The ALF product data has been averaged spatially over a
0.5 degree by 0.5 degree grid above and below 80 and -80 degrees
and at a 1.0 degree by 1.0 degree grid elsewhere and temporally
over one earth year (September 15, 2009 to September 14, 2010)."
The ALF product data is presented in a table corresponding to the 0.5 degree by 0.5 degree grid. There are 200 latitude bands and 720 longitude bands above and below 80 and -80 and 360 between, thus 86400 grid cells. Each cell corresponds to one row in the table. The first 720 rows in the table are the data for the 0.5 degree latitude band centered at 89.75 degrees north latitude, the second 720 rows are the data for the band centered at 89.5 degrees north latitude, and so on. Within each band, longitude increases eastward from the cell centered at 0.5 degrees east longitude to the cell centered at 359.5 degrees east longitude.

Averaged LEND Data products are composed of averaged fluxes and the associated timing, spatial and engineering information. The ALFs consists of the orbital neutron fluxes at the nine LEND detectors averaged over the above defined.

```
^STRUCTURE = "LEND_RDR_AL.FMT"
END_OBJECT = TABLE
END

5.8.1. Example LEND_RDR_AL.FMT
```

```
OBJECT = COLUMN
COLUMN_NUMBER = 1
NAME = START_UTC_TIME
DATA_TYPE = CHARACTER
BYTES = 23
START_BYTE = 1
DESCRIPTION = "UTC time at the start of the averaged frames, stored as yyyy-mm-ddThh:mm:ss.sss."
END_OBJECT = COLUMN

OBJECT = COLUMN
COLUMN_NUMBER = 2
NAME = STOP_UTC_TIME
DATA_TYPE = CHARACTER
BYTES = 23
START_BYTE = 24
DESCRIPTION = "UTC time at the end of the averaged frames, stored as yyyy-mm-ddThh:mm:ss.sss."
END_OBJECT = COLUMN

OBJECT = COLUMN
COLUMN_NUMBER = 3
NAME = LUNARCENTRIC_LATITUDE
DATA_TYPE = IEEE_REAL
BYTES = 4
START_BYTE = 47
UNIT = DEGREE
DESCRIPTION = "Latitude in LUNAR fixed coordinates at the
center of the given map element."

**OBJECT** = COLUMN

<table>
<thead>
<tr>
<th>COLUMN_NUMBER</th>
<th>NAME</th>
<th>DATA_TYPE</th>
<th>BYTES</th>
<th>START_BYTE</th>
<th>DESCRIPTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>4</td>
<td>LUNARCENTIC EAST_LONGITUDE</td>
<td>IEEE_REAL</td>
<td>4</td>
<td>51</td>
<td>Longitude in Lunar fixed coordinates at the center of the given map element.</td>
</tr>
<tr>
<td>5</td>
<td>THERMAL</td>
<td>IEEE_REAL</td>
<td>4</td>
<td>55</td>
<td>Orbital thermal neutron flux in energy range [&lt; 0.4 eV] (n/cm²2sec).</td>
</tr>
<tr>
<td>6</td>
<td>EPITHERMAL_FLUX1</td>
<td>IEEE_REAL</td>
<td>4</td>
<td>59</td>
<td>Orbital epithermal neutron flux in energy range [0,4 eV - 100 eV] (n/cm²2sec).</td>
</tr>
<tr>
<td>7</td>
<td>EPITHERMAL_FLUX2</td>
<td>IEEE_REAL</td>
<td>4</td>
<td>63</td>
<td>Orbital epithermal neutron flux in energy range [0.10 keV - 10 keV] (n/cm²2sec).</td>
</tr>
<tr>
<td>8</td>
<td>EPITHERMAL_FLUX3</td>
<td>IEEE_REAL</td>
<td>4</td>
<td>67</td>
<td>Orbital epithermal neutron flux in energy range [10 keV - 1.0 MeV] (n/cm²2sec).</td>
</tr>
<tr>
<td>9</td>
<td>FAST_FLUX1</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
DATA_TYPE = IEEE_REAL
BYTES = 4
START_BYTE = 71
DESCRIPTION = "Orbital fast neutron flux in energy range
[1 MeV - 2.5 MeV] (n/cm^2sec)."
END_OBJECT = COLUMN

OBJECT = COLUMN
COLUMN_NUMBER = 10
NAME = FAST_FLUX2
DATA_TYPE = IEEE_REAL
BYTES = 4
START_BYTE = 75
DESCRIPTION = "Orbital fast neutron flux in energy range
[2.5 MeV - 7.5 MeV] (n/cm^2sec)."
END_OBJECT = COLUMN

OBJECT = COLUMN
COLUMN_NUMBER = 11
NAME = FAST_FLUX3
DATA_TYPE = IEEE_REAL
BYTES = 4
START_BYTE = 79
DESCRIPTION = "Orbital fast neutron flux in energy range
[7.5 MeV - 10 MeV] (n/cm^2sec)."
END_OBJECT = COLUMN