

2001 Mars Odyssey Orbiter

GRS Intermediate Data Record Software Interface Specification (SIS)

DRAFT IN PREPARATION

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3.6 AHD	GRS Team to complete AHD detailed product specification – Done 05/04/2004
5.5 Example DND Label	GRS Team to create example label – Done 06/07/04
5.6 Example AHD Label	GRS Team to create example label – Done 06/07/04

CONTENTS

CHANGE LOG.....	II
TBD ITEMS.....	III
CONTENTS.....	IV
ACRONYMS.....	VI
1.0 INTRODUCTION.....	1
1.1. PURPOSE AND SCOPE.....	1
1.2. CONTENTS.....	1
1.3. APPLICABLE DOCUMENTS AND CONSTRAINTS.....	1
1.4. RELATIONSHIPS WITH OTHER INTERFACES.....	2
2.0 DATA PRODUCT CHARACTERISTICS AND ENVIRONMENT.....	3
2.1. INSTRUMENT OVERVIEW.....	3
2.2. DATA PRODUCT OVERVIEW.....	4
2.3. DATA PROCESSING.....	6
2.3.1. <i>Data Processing Level</i>	6
<i>Table 1. Processing Levels for Science Data Sets</i>	6
2.3.2. <i>Data Product Generation</i>	6
2.3.2.1. Gamma Processing.....	7
2.3.2.2. Neutron Processing.....	8
2.3.2.3. HEND Processing.....	12
2.3.3. <i>Data Flow</i>	14
2.3.4. <i>Labeling and Identification</i>	15
2.3.5. <i>Data Product Revisions</i>	15
2.4. STANDARDS USED IN GENERATING DATA PRODUCTS.....	16
2.4.1. <i>PDS Standards</i>	16
2.4.2. <i>Time Standards</i>	16
2.4.3. <i>Coordinate Systems</i>	16
2.4.4. <i>Data Storage Conventions</i>	16
2.5. DATA VALIDATION.....	16
3.0 DETAILED DATA PRODUCT SPECIFICATIONS.....	17
3.1. CGS.....	17
1.1.1. <i>Data Product Structure and Organization</i>	17
3.1.1. <i>Data Format Description</i>	17
3.1.2. <i>Label Description</i>	17
3.2. SGS.....	18
1.1.2. <i>Data Product Structure and Organization</i>	18
3.2.1. <i>Data Format Description</i>	18
3.2.2. <i>Label Description</i>	18
3.3. DND.....	18
1.1.3. <i>Data Product Structure and Organization</i>	18
3.3.1. <i>Data Format Description</i>	18
3.3.2. <i>Label Description</i>	19
3.4. AND.....	19
1.1.4. <i>Data Product Structure and Organization</i>	19
3.4.1. <i>Data Format Description</i>	19
3.4.2. <i>Label Description</i>	19
3.5. DHD.....	19

1.1.5. *Data Product Structure and Organization*..... 19

3.5.1. *Data Format Description* 20

3.5.2. *Label Description*..... 20

3.6. AHD 20

1.1.6. *Data Product Structure and Organization*..... 20

3.6.1. *Data Format Description*..... 20

3.6.2. *Label Description*..... 20

4.0 APPLICABLE SOFTWARE.....21

4.1. UTILITY PROGRAMS..... 21

4.2. APPLICABLE PDS SOFTWARE TOOLS 21

Table 2. GRS IDR Data Columns 22

5.0 APPENDICIES33

5.1. EXAMPLE: CGS LABEL..... 33

 5.1.1. *EXAMPLE: CGS Table Structure* 34

5.2. EXAMPLE: SGS LABEL 49

 5.2.1. *SGS Table Structure*..... 50

5.3. EXAMPLE : DND LABEL 66

 5.3.1. *DND Table Structure* 68

5.4. EXAMPLE: AND LABEL..... 88

 5.4.1. *AND Table Structure*..... 90

5.5. EXAMPLE: DHD LABEL..... 94

 5.5.1. *DHD Table Structure* 96

5.6. EXAMPLE: AHD LABEL..... 103

 5.6.1. *AHD Table Structure*..... 105

ACRONYMS

AHD	Averaged High Energy Neutron Detector Data
AND	Averaged Neutron Data
APPS	Analog Pulse Processing System
ASCII	American Standard Code for Information Interchange
CEB	Common Electronics Box
CGS	Corrected Gamma Spectra
CODMAC	Committee On Data Management And Computation
EDR	Experiment Data Record
DHD	Derived High Energy Neutron Detector Data
DND	Derived Neutron Data
GRS	Gamma Ray Spectrometer
GSH	Gamma Sensor Head
HEND	High Energy Neutron Detector
IAU	International Astronomical Union
IDR	Intermediate Data Record
ISO	International Standards Organization
LANL	Los Alamos National Laboratory
L_s	Areocentric Longitude
NASA	National Aeronautics and Space Administration
NS	Neutron Spectrometer
ODL	Object Description Language
PDS	Planetary Data System
RDR	Reduced Data Record
SIS	Software Interface Specification
SGS	Summed Gamma Spectra
TBD	To Be Determined
UTC	Universal Time Coordinated
VREF	Gamma subsystem voltage reference temperature

1.0 INTRODUCTION

1.1. Purpose and Scope

The purpose of this Data Product Software Interface Specification (SIS) is to provide users of the 2001 Mars Odyssey Gamma Ray Spectrometer (GRS) Intermediate Data Records (IDR) with a detailed description of the products and how they were generated, including data sources and destinations. The IDR products contain calibrated, common gain and offset spectra from the GRS Gamma Sensor Head (GSH), spatially and temporally binned gamma spectra, data derived from the raw neutron spectrometer (NS) data, spatially and temporally binned neutron spectrometer data, data derived from the raw High Energy Neutron Detector (HEND) data, and spatially and temporally binned HEND data. This SIS is intended to provide enough information to enable users to read and understand the data products. The users for whom this SIS is intended are the scientists who will analyze the data.

1.2. Contents

This Data Product SIS describes how the GRS IDR data products are formatted, labeled, and uniquely identified. The document discusses standards used in generating the products and the software that may be used to access them. The data product structures and organization are described in sufficient detail to enable a user to read the products. Finally, examples of each of the product labels are provided.

1.3. Applicable Documents and Constraints

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

1. Mars Exploration Program Data Management Plan, R. E. Arvidson, S. Slavney, and S. Nelson, Rev. 3, Mar. 20, 2002.
2. 2001 Mars Odyssey Orbiter Archive Generation, Validation and Transfer Plan, R. E. Arvidson, JPL D-20679, Rev. 0, May 21, 2001.

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

3. Planetary Data System Data Preparation Workbook, Version 3.1, JPL D-7669, Part 1, February 1, 1995.
4. Planetary Data System Data Standards Reference, Version 3.5, JPL D-7669, Part 2, October 15, 2002.
5. Planetary Science Data Dictionary Document, JPL D-7116, Rev. E, August 28, 2002.

The reader is referred to the following documents for additional information:

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- Longmire, M. L. Litvak, and A. K. Ton'chev, The Mars Odyssey Gamma-Ray Spectrometer Instrument Suite, *Space Science Rev.*, 110, 37-83, 2004.
7. Seidelmann, P. K., V. K. Abalakin, M. Bursa, M. E. Davies, C. de Bergh, J. H. Lieske, J. Oberst, J. L. Simon, E. M. Standish, P. Stooke, and P. C. Thomas, Report of the IAU/IAG working group on cartographic coordinates and rotational elements of the planets and satellites: 2000, *Celestial Mechanics and Dynamical Astronomy*, 82, 83-111, 2002.
 8. Kerry, K. E., R. L. Marcialis, D. Hamara, and C. Fellows, 2001 Mars Odyssey GRS Calibration Report, Version 3.0, October 1, 2002.
 9. Crombie, M. K., D. K. Hamara, and K. Harshman, 2001 Mars Odyssey Gamma-ray Spectrometer Gamma Data Processing, Version 3.1, October 1, 2003.
 10. McArthur, G., K. Harshman, and C. Shinohara, 2001 Mars Odyssey Gamma Ray Spectrometer NASA Level 0 Software Interface Specification, Draft, December 12, 2002.
 11. Prettyman, T. H., W. C. Feldman, M. T. Mellon, G. W. McKinney, W. V. Boynton, S. Karunatillake, D. J. Lawrence, S. Maurice, A. E. Metzger, J. R. Murphy, S. W. Squyres, R. D. Starr, R. L. Tokar, and the 2001 Mars Odyssey Gamma Ray Spectrometer Science Team, Composition and Structure of the Martian Surface in the High Southern Latitudes from Neutron Spectroscopy, *Journal of Geophysical Research*, 109, doi:10.1029/2003JE002139, 2004, in press.
 12. Feldman, W. C., T. H. Prettyman, R. L. Tokar, W. V. Boynton, R. C. Byrd, K. R. Fuller, O. Gasnault, J. L. Longmire, R. H. Olsher, S. A. Storms, and G. W. Thornton, Fast neutron counting rate spectrum aboard Mars Odyssey during cruise, *Journal of Geophysical Research - Space Physics*, 107(#A6), 1083-1083, 2002.
 13. GRS TEAM, Time Conversion Tables, Version 1.0, October 1, 2003.
 14. Mitrofanov, I.G., M. L. Litvak, and A. K. Ton'chev, 2001 Mars Odyssey Gamma-ray Spectrometer High Energy Neutron Detector Data Processing, Version 1, October 1, 2003.
 15. Prettyman, T.H., D. Delapp, W.C. Feldman, and S. Maurice, 2001 Mars Odyssey Gamma-ray Spectrometer Neutron Spectrometer Data Processing, Version 1, April 4, 2004.

1.4. Relationships with Other Interfaces

The GRS IDR data products are dependant upon the GRS EDR data products as describe in [10]. Changes to the Corrected Gamma Spectra (CGS) will affect the Summed Gamma Spectra (SGS), as the corrected spectra are summed and binned to create the summed gamma product. Changes to the Derived Neutron Data (DND) will affect the Averaged Neutron Data (AND), as the derived neutron data are used to produce the averaged data. Changes to the Derived HEND Data (DHD) will affect the Averaged HEND Data (AHD), as the derived HEND data are used to produce the averaged data. Changes to the gamma data processing algorithms will be documented in [9], and may result in re-processing the CGS and SGS. Changes to the neutron processing algorithms will be documented in the PDS data set description catalog files that accompany product releases, and may result in re-processing the DND and AND. Changes to the

HEND data processing algorithms will be documented in [14], and may result in re-processing the DHD and AHD.

2.0 DATA PRODUCT CHARACTERISTICS AND ENVIRONMENT

2.1. Instrument Overview

The GRS instrument consists of the Gamma Sensor Head, the Los Alamos National Laboratory (LANL) Neutron Spectrometer, and the Russian Academy of Science Institute for Space Research High Energy Neutron Detector. Each detector (GSH, NS, and HEND) is interfaced with the 2001 Mars Odyssey Orbiter through a microcomputer called the Common Electronics Box (CEB). Independent parameters for each detector, such as accumulation time (a.k.a. “pixel” duration) may be changed through commands executed on the CEB. In nominal operating mode, each detector collects data for one pixel, sends the data back to the CEB, and repeats the process. In addition, the CEB collects engineering data (temperatures, voltages, currents, etc). Data is sent from the CEB through the spacecraft bus for receipt by the Deep Space Network. The GSH, NS and HEND detectors will be briefly described in the following paragraphs, for the complete detailed description of the GRS instrument suite see [6].

The major components of the GSH are the germanium detector assembly, the two-stage cooler subsystem, the door, and the Gamma Pulse Amplifier (GPA). The solid-state detector is a large single crystal of n-type ultrahigh-purity germanium (HPGe), about 6.7 cm in diameter and 6.7 cm long, with semiconductor electrodes implanted or diffused such that the crystal becomes a diode, i.e. it will pass current in only one direction. The diode is operated in the reverse-bias mode with a potential of about 3000 V and a leakage current of less than 1 nA. The detector must be operated cold, less than about 140 K, to maintain high resolution and a low leakage current. When a gamma-ray photon interacts with the detector, hole-electron pairs are created that are quickly swept to the appropriate electrodes. This small charge is collected by a sensitive preamplifier, which produces a pulse whose height (voltage) is proportional to the energy deposited in the crystal. This pulse is then shaped and amplified and passed to a pulse-height analyzer, which counts the events in the form of a histogram sorted according to energy. The histogram collected for one ~19.7 second interval is referred to as the raw gamma spectrum.

The NS detector consists of a cubical block of boron-loaded plastic scintillator. It is segmented into four prism-shaped quadrants that are optically isolated from each other. Neutrons lose energy in the neutron detector through multiple elastic scattering collisions with the hydrogen and carbon nuclei that comprise the scintillator. Most of the energy is lost to proton recoils. As the recoil protons slow down in the scintillator, they produce multiple ion-electron pairs that eventually recombine to produce photons. Collection of these photons by photo-multiplier tubes produce pulses of charge that are then amplified and digitized by the neutron detector analog electronics to generate histograms. The signature of a thermal or epithermal neutron in the scintillator is a single pulse that has an amplitude that is characteristic of the $^{10}\text{B}(n,\alpha)^7\text{Li}$ reaction. The signature of a fast neutron that has lost all of its energy in the scintillator is a time-correlated double pulse. The amplitude of the first pulse provides a measure of the energy of the neutron and that of the second pulse is the same as that for a thermal or epithermal neutron.

During mapping the four prisms are oriented with one facing down toward Mars, one facing in the forward direction nearly along the spacecraft’s velocity vector, one facing backward nearly

antiparallel to the spacecraft's velocity vector, and one facing upward. The geometry of the NS allows measurement of the three neutron energy ranges. Separation of the thermal and epithermal components will be possible using the relative counting rates of the forward and backward-directed prisms and a Doppler-filter technique (Feldman and Drake, 1986). Such a separation is made possible by the fact that the Mars Odyssey spacecraft will travel faster (3.4 km s^{-1}) than a thermal neutron (2.2 km s^{-1}) while in mapping orbit. The forward directed prism will therefore scoop up thermal neutrons and the backward directed one will outrun them. The difference in counting rates between forward- and backward-directed prisms then yields a measure of the counting rate of thermal neutrons. A measure of epithermal neutrons is provided by the downward facing prism because it is completely shielded from the outside by sheets of cadmium and the other three prisms. Fast neutron counting rates are determined from the first four energy bins in a pulse height spectrum that are sensitive to fast neutrons.

The HEND instrument contains five detectors that provide measurements of neutrons in the energy range from 0.4 eV up to 15 MeV. HEND has three ^3He neutron proportional counters (Industrial LND 2517 counters.) Each of the three counters is coated by a Cd shield and different thicknesses of a neutron moderator. The counters record thermal neutrons in ^3He capture reactions to produce an α particle and a proton. When neutrons enter the detector volume, they lose energy in the polyethylene moderator until they reach the thermal neutron energy range and are registered by the proportional counters. The moderation efficiency of the polyethylene depends on its thickness. The LD detector with the thickest moderator layer ($\sim 30 \text{ mm}$) is most sensitive to neutrons with energies in the range 10 eV–1 MeV. The MD detector with a 14-mm-thick moderator is sensitive to neutrons in the energy range 10 eV–100 keV. The SD detector with the thinnest (3 mm) moderator is sensitive to neutrons with energies from the cadmium threshold of 0.4 eV to 1 keV. The combined response of the three ^3He neutron proportional counters yields data for neutrons in a broad energy range from 0.4 eV to 1 MeV.

The scintillator block of the HEND neutron detector is used to detect neutrons with energies greater than 1 MeV. The high energy detector is an inner scintillator of organic stilbene (or stilbene). The inner scintillator detects high-energy neutrons by flashes of light from recoil protons knocked out of the organic crystal lattice by neutrons. In space conditions, this organic scintillator may also detect primary protons from cosmic rays. Cosmic-ray electrons and secondary electrons produced by gamma-ray photons will be detected in the stilbene. To separate proton pulses from electron pulses an electronic separation circuit was specially designed for HEND. The separation is based on the measurable difference between time profiles of scintillation light from protons and electrons. The efficiency of this separation corresponds to one false separation of a proton-based count from 2000 electron-based counts. The stilbene scintillator also contains an external scintillator with a CsI crystal for detection of charged particles and gamma-rays above 30 keV. This detector provides the digital veto signal for anti-coincidence rejection of protons, which could be detected as proton-based counts.

2.2. Data Product Overview

The final GRS calibrated map products (RDR) may not be ready for release until near the end of the mission because it will take that long to integrate enough data to properly separate the signal peaks from the background and to reduce the data to element abundance and other derived values. To satisfy the science community interest in analyzing the GRS data on a shorter timescale, the GRS Science Team will produce a series of intermediate data products.

The first of these intermediate products is the Corrected Gamma Spectra, CGS. The CGS are gamma spectra that have been corrected for gain, offset and linearity. The end result of the correction is that all the corrected spectra have a common energy scale, allowing the direct comparison of individual spectra. Each CGS product data file contains corrected spectra collected over a 2-hour time period. The 2-hour data files will be grouped by Earth days, i.e. 12 data files per day.

The second intermediate data product is the Summed Gamma Spectra, SGS. The SGS are sums of CGS binned both spatially and temporally. The spatial constraint on the SGS is a 5-degree latitude by 5-degree longitude bin. Latitudes and longitudes are calculated for each pixel based on the spacecraft position at the midpoint of the collection interval. The temporal constraint on the SGS is 15-degrees of L_S , referred to as a season. In this nomenclature Mars season 0 is the time period between $L_S = 0$ and $L_S = 15$, where $L_S = 0$ is the vernal (spring) equinox within the northern hemisphere. The SGS product data files will contain a 72-row data table of one 15-degree L_S temporal bin, with one data record for each 5x5 degree spatial bin in a 5-degree latitude band around Mars. The 36 data files that complete data coverage over the planet will be grouped in directories labeled with Mars year and L_S interval.

The third intermediate data product is the Derived Neutron Data, DND. The DND product includes a number of calculated quantities that describe the shape and location of peaks found in the NS prism histogram data. The calculated quantities are the first step in calculation of thermal, epithermal and fast neutron counting rates. Each DND product data file will contain neutron data collected over one Earth day, approximately 4300 data records.

The fourth intermediate data product is the Averaged Neutron Data, AND. The AND are averages of DND that have been binned both spatially and temporally. The spatial constraint on the AND is a 5-degree latitude by 5-degree longitude bin. Latitudes and longitudes are calculated for each pixel based on the spacecraft position at the midpoint of the collection interval. The temporal constraint on the AND is 15-degrees of L_S . AND product data files will contain a table of one 15-degree of L_S temporal bin, with a record for each spatial bin. The AND data files will be grouped by Mars year and L_S .

The fifth intermediate data product is the Derived HEND Data, DHD. The DHD product contains the count rate and background count rate derived from the raw data for each of the five detectors in the HEND instrument. Each DHD product data file will contain neutron data collected over one Earth day, approximately 4300 data records.

The sixth intermediate data product is the Averaged HEND Data, AHD. The AHD are averages of DHD count rate data, and epithermal and fast neutron fluxes that have been binned both spatially and temporally. The spatial constraint on the AND is a 5-degree latitude by 5-degree longitude bin. Latitudes and longitudes are calculated for each pixel based on the spacecraft position at the midpoint of the collection interval. The temporal constraint on the AHD is 15-degrees of L_S . AHD product data files will contain a table of one 15-degree of L_S temporal bin, with a record for each spatial bin. The AHD data files will be grouped by Mars year and L_S .

2.3. Data Processing

2.3.1. Data Processing Level

This SIS uses the Committee On Data Management And Computation (CODMAC) data level numbering system to describe the processing level of the GRS IDR data products. GRS CGS IDR products are considered a CODMAC “Level 4” or “Resampled”. GRS SGS IDR data products are considered a CODMAC "Level 5" or "Derived". GRS DND IDR data products are considered a CODMAC “Level 4” or “Resampled”, and GRS AND IDR data products are considered a CODMAC "Level 5" or "Derived". Refer to Table 1 for a breakdown of the CODMAC and NASA data processing levels.

Table 1. Processing Levels for Science Data Sets

NASA	CODMAC	Description
Packet data	Raw - Level 1	Telemetry data stream as received at the ground station, with science and engineering data embedded.
Level-0	Edited - Level 2	Instrument science data (e.g., raw voltages, counts) at full resolution, time ordered, with duplicates and transmission errors removed.
Level 1-A	Calibrated - Level 3	Level 0 data that have been located in space and may have been transformed (e.g., calibrated, rearranged) in a reversible manner and packaged with needed ancillary and auxiliary data (e.g., radiances with the calibration equations applied).
Level 1-B	Resampled - Level 4	Irreversibly transformed (e.g., resampled, remapped, calibrated) values of the instrument measurements (e.g., radiances, magnetic field strength).
Level 1-C	Derived - Level 5	Level 1A or 1B data that have been resampled and mapped onto uniform space-time grids. The data are calibrated (i.e., radiometrically corrected) and may have additional corrections applied (e.g., terrain correction).
Level 2	Derived - Level 5	Geophysical parameters, generally derived from Level 1 data, and located in space and time commensurate with instrument location, pointing, and sampling.
Level 3	Derived - Level 5	Geophysical parameters mapped onto uniform space-time grids.

2.3.2. Data Product Generation

The raw GRS telemetry data is stored in a database by the GRS team at the University of Arizona (UA). Initial processing of all the data to include timing and spatial information is done at UA. Intermediate processing of the GSH (gamma) data is also done at UA. A full description of this processing can be found in [9]. Intermediate processing of the NS (neutron) data is done at Los Alamos National Laboratory. A full description of this processing can be found in [11]. Intermediate processing of the HEND data is done at the Russian Academy of Science Institute for Space Research. A full description of this processing can be found in [14]. The following

sections summarize the intermediate processing for each of the three instruments included in the GRS instrument suite.

2.3.2.1. Gamma Processing

The products of the gamma data reduction algorithms are a time-series data set, (CGS) corrected for gain, offset, and Integral Non-linearity (INL, the deviation of the energy to channel transfer function from a straight line) and a table of temporally and spatially binned sums (SGS) of the corrected gamma spectra, that can be used for scientific analysis. An overview of these algorithms is provided here. See [9] for details of the gamma data reduction process and [6] for details of the GSH design and operation.

The gamma portion of the data processing includes gain, offset, and Integral Non-linearity (INL, the deviation of the energy to channel transfer function from a straight line) corrections on the raw gamma spectra. Gamma data exhibit gain, offset and INL shape drifts with temperature. These drifts are due to different subsystems located in different parts of the instrument. The four major components whose temperatures contribute to these errors are the detector, the 170K board, the gamma preamplifier, and the analog pulse processing system (APPS) 2 board. Each of these components were individually characterized prior to launch and are documented in [8].

In order to correct the gamma spectra to a common energy scale a spectrum shifting process is used. The temperatures of the subsystems, the gain setting of the APPS board, and a factor based on previous experience to are used to shift each individual spectrum to a desired gain (usually 0.625keV/channel) and offset (usually 0). The spectrum shifting process also corrects for the non-linearities in the APPS electronics, calculates the number of counts $> 10\text{MeV}$, and the proton fluence, producing corrected spectra which are suitable for comparison to each other. The spectrum shifting algorithm makes the gain, offset and INL corrections in one pass through the data in order to limit the amount on noise introduced into the corrected spectra.

Adjustments for gain shifts due to the detector and 170K board temperatures are linear with temperature and energy. As there is no temperature sensor directly on the 170K card, the temperature must be modeled from the outer stage temperature. In order to properly shift the gain, the gain as a function of all the corrections must be known. The first known contribution to the gain is the setting of the variable gain stage in the APPS (shaping amp gain) that is set to a value closest to our desired gain of 0.625keV/channel. The temperature independent portion of the gain is obtained from a table (Gain Offset List tabulated in [9]) that stores the corrected gain in channels/keV for the chosen APPS gain setting and the normalization temperatures of the detector and the 170K board. The normalization temperatures are chosen as the temperatures closest to average operating conditions. A final gain ratio is then calculated, and used as one term in the spectrum shifting algorithm.

The offset errors are primarily due to the GPA. The GPA has a very small gain variation ($-1.8\text{ppm}/^\circ\text{C}$) but a considerable offset variation with temperature. This offset was characterized both in the lab in pre-launch calibration and again during cruise, and is exponential over the GPA operating range. From the fit of this data a set of coefficients have been obtained and are used to calculate this offset as a function of GPA temperature. Since this offset occurs before the variable gain stage in the APPS, these coefficients will change with the shaping amp gain setting. Using the GPA temperature and the GPA coefficients (tabulated in [9]) an offset term is calculated, and is used as a term in the spectrum shifting algorithm.

INL corrections are necessary to correct for fluctuations in the APPS board electronics due to temperature. The APPS board electronics are monitored by the gamma subsystem voltage reference temperature reading (Gamma_VREF_Temp). During calibrations (see [8]) a 13th order polynomial was fit to an INL curve generated for each gamma pixel, and therefore every available VREF temperature, along a chosen temperature ramp. An 11x13 matrix was created such that for any given VREF temperature, the exact values of the 13 coefficients associated with the INL polynomial at that temperature were known. Once the equation of a specific INL polynomial was known, then the channel offset for each of 32 calibration peaks were calculated, and the original gamma spectrum adjusted to remove the APPS-related INL. The INL coefficient matrix makes it possible to correct for the APPS-related INL of any gamma pixel, given that the VREF temperature at that pixel is known. The INL coefficient matrix and the VREF temperature are used to calculate the INL term used in the spectrum shifting algorithm.

Once the three correction terms are calculated, the spectrum shifting algorithm is used to create a number of temporary spectra. These spectra are summed together to create a single temporary spectrum. This spectrum is examined to determine how close the previous correction came to yielding the desired gain (0.625keV/channel) and offset (0). If the desired gain and offset are achieved, then the all the spectra are corrected with the original terms. If the summed temporary spectrum deviates from the desired gain and offset, then the original terms are modified by the amount of deviation and the all spectra are re-corrected. This process iterates until the desired gain and offset are achieved. Updates to the correction algorithm will require re-processing of the raw gamma data. It is our intention to re-processes the data if necessary.

Summed gamma spectra are produced from the corrected gamma spectra. A summing algorithm is used to bin and combine corrected spectra both spatially and temporally. The spatial constraint is variable, but will be set at 5-degrees latitude by 5-degrees longitude bins for the SGS PDS records. In order to be grouped within a particular 5-degree bin, the latitude and longitude at the middle of the pixel (collection interval) must be greater than or equal to the lower limit and less than the upper limit. The temporal constraint on the SGS product is variable, but will be constrained for the PDS to be 15-degrees of Mars L_S . The 15-degree periods are called seasons, which are numbered 0 through 23. Seasons can vary in time from about 24 to 33 Earth days. A table of the correlation between Earth days, Mars days and L_S can be found in [13].

CGS that fall within a spatial and temporal bin are summed by adding the counts in each corresponding channel together to form a single spectrum for that bin. Engineering data associated with each corrected spectrum is also included with the summed spectra in the form of a minimum value, a maximum value and a standard deviation.

2.3.2.2. Neutron Processing

The products of the neutron data reduction algorithms are a time-series data set (DND), corrected for variations in the instrument response and the cosmic ray background, that can be used to produce thermal, epithermal, and fast neutron global maps of Mars. Tables of temporally and spatially averaged counting rates (AND) are also provided. The AND data set consists of maps of thermal, epithermal, and fast neutron counting rates averaged over 15° L_S intervals. The maps are 5° cylindrical projections. In addition to the counting rates, maps of the number of measurements binned in each pixel and the standard deviation of the pixel counting rates are provided.

A summary of these algorithms adapted from Appendix A of [11] is provided here. See [15] for details of the neutron data reduction process. See [12] and [6] for details of the neutron spectrometer design and operation.

The neutron spectrometer consists of a block of boron-loaded plastic that is diagonally segmented into four optically decoupled prisms that are viewed by separate photomultiplier tubes. During mapping, two of the prisms are aligned along the axis of motion of the spacecraft: Prism 2 (P2) faces in the forward direction and Prism 4 (P4) faces opposite to the direction of motion. The remaining two prisms are oriented along the nadir axis: Prism 1 (P1) faces downward towards Mars and Prism 3 (P3) faces upwards towards the spacecraft. P1 is covered with cadmium foil, which absorbs neutrons below roughly 0.5 eV. Consequently, P1 is sensitive to epithermal neutrons.

In order to consider data for inclusion in intermediate processing (i.e. the DND time series) we required that the instrument be aligned along the bore-site vector of spacecraft motion and nadir orientation. This eliminated times such as when the spacecraft was in safe mode for which P1 was not pointed in the nadir direction. We also required that the data in the 5×19.75 s background buffer be contiguous. This avoided the introduction of errors in the counting data when orbital data were missing. Finally, we did not process data for time intervals in which the overload monitor of the neutron spectrometer exceeded 7000 counts per second, which corresponded to solar-energetic particle events.

2.3.2.2.1. Fast Neutron Counting Data

Fast neutrons are identified by the detection of a characteristic double pulse, known as a Category-2 event. The light output caused by proton recoils produced by the prompt interaction of a fast neutron and the hydrogen in the plastic provides a measure of the energy of the incident neutron. A second pulse of light corresponding to the absorption of the neutron at low energy by ^{10}B follows a delay in which the neutron is slowing down in the plastic, but does not produce light. This double-pulse signature occurs for neutrons above approximately 700 keV.

Time-correlated double pulses can also occur when cosmic rays interact with the plastic scintillators and can distort the shape of the fast-neutron spectrum if they are not eliminated. These types of events produce a background that can affect our assessment of surface composition. They are caused when an energetic particle deposits energy in the plastic, causing a large pulse of light. The associated photomultiplier tube can emit a characteristic “after pulse” caused by the production of secondary electrons through the impact of ions on the photocathode, dynodes, or the residual gas in the tubes. The drift of ions occurs on the time scale of the neutron die-away time. So, time discrimination is ineffective in suppressing these events. However, the second pulse is usually well below the pulse height of the $^{10}\text{B}(n,\alpha)$ peak, and setting a lower level threshold is sufficient to eliminate after-pulsing.

For fast neutrons, two low-level data products are provided: Event-mode data (edr events_array) for which the magnitude of the first pulse, time to the second pulse, and magnitude of the second pulse of a selected number of events (84 per 19.75 s acquisition period) is recorded; and histogram data (edr cat2 early and late histograms) for which first pulses with magnitudes above a preset, fixed threshold are binned into histograms for early and late time windows. The late time interval (nominally chosen to be between 20 and 25 μs) was selected so that it is well beyond the die-away time of neutrons in the spectrometer and thus contains accidental events

only. The early time interval (nominally chosen to be between 0.4 and 5.4 μs) was selected so that it is sensitive to neutrons slowing down in the spectrometer. Subtraction of the late from early time histograms yields a pulse-height spectrum that is sensitive to the energy spectrum of fast neutrons. The event-mode data are useful for counting system diagnostics. The histogram data have better counting precision and are therefore preferred for the development of fast-neutron maps.

The time dependence of the gain of each prism was monitored using the centroid of the 93 keV electron equivalent peak in the second-pulse spectrum that results from the $^{10}\text{B}(n,\alpha)^7\text{Li}^*$ reaction. The second-pulse spectrum was constructed from event mode data accumulated over coarse time intervals (720×19.75 s intervals, corresponding to 6×10^4 events). The spectrum of second interactions was selected to determine the peak location because it was found to always have a well-defined, 93 keV peak, distinct from the background. The length of the window was selected to be small relative to the time scale for drift at a particular high-voltage setting, but long enough to achieve adequate counting precision for determining the peak centroid. The spectrum of second interactions derived from the event-mode data was fit to two Gaussian functions (one for low amplitude after-pulsing that is cut off at low energies by the level discriminator, and the other for the 93 keV peak) and a constant background to model the Compton continuum.

We found that the observed peak locations ranged considerably from Channel 8 to Channel 20 during the mapping phase of the mission. The main source of variation was a gradual drift in the high-voltage power supplies. However, abrupt changes in the output of the high-voltage power supplies were also observed and commanded on several occasions. Data acquired in the vicinity of the abrupt shifts in gain were filtered from the time series.

The fast-neutron counting rate for the DND data set (CAT2_PRISM1_FAST_SUMS) was taken to be the sum of the first two channels of the histogram spectrum for P1, which is primarily sensitive to neutrons coming directly from Mars. The lower channels were selected because they give the greatest counting rates and are also least susceptible to contamination by after-pulsing. However, because considerable drift in gain occurred, the threshold selected for after-pulse suppression used to construct the histogram data was not always effective. During times of high gain, the threshold was too low and after-pulsing events contaminated the histogram spectrum. Variations caused by shifts in gain were corrected using a belly-band normalization procedure described below. Cruise data were used to determine the background of fast neutrons not originating from Mars which was subtracted prior to production of the DND time series.

2.3.2.2.2. Thermal and Epithermal Neutron Counting Data

Thermal and epithermal neutrons are detected through the $^{10}\text{B}(n,\alpha)^7\text{Li}^*$ reaction, which produces a distinct peak in the pulse-height spectrum caused by the deposition of the recoil energy of the reaction products in the scintillator. This peak corresponds to an equivalent electron energy of 93 keV. For each prism, the net counting rate for this peak was determined from the Category-1 pulse-height spectrum, a spectrum of single-interaction events that is recorded every 19.75 s (edr cat1_x_hist). During this measurement interval, the spacecraft traverses approximately one degree of arc length (roughly 60 km). Determination of peak areas for each prism (CAT1_PRISM_X_PEAK_AREA, where X = 1, 2, 3, or 4) from the Category-1 spectra involved several steps summarized here:

- 1) A correction was applied to each spectrum to remove artifacts of the differential nonlinearity of the analog to digital converter from the spectrum.
- 2) The spectra were corrected in gain so that the 93 keV peak always fell in Channel 11. Implementation of this step required knowledge of the original peak location determined from the Category-2 second interaction spectrum as described in Section 2.3.2.2.1. The gain correction enabled the same region of interest (range of energy) to be used for the peak and background for all spectra.
- 3) For each prism, selected channels surrounding the peak above and below were fitted to a power law. The power law was determined for spectra in a sliding window 5×19.75 s in length. The length of the window was selected empirically to minimize the uncertainty in the background parameters because of statistical variations in counting rate while avoiding the introduction of bias resulting from integration over surface features.
- 4) The peak areas (counts in the peaks for each prism) were determined for each 19.75 s spectrum by subtracting the background predicted by the power law from the total counts in the peak region of interest.

Details of these steps can be found in [15].

The thermal-neutron counting rate was determined by subtracting the peak area for the backward-looking prism (P4) from that of the forward-looking prism (P2). During the mapping phase, the spacecraft traveled in a circular polar orbit at an average altitude of 400 km and speed of 3380 m/s. A significant portion of the population of thermal neutrons at orbital altitudes had speeds much less than that of the spacecraft and the flux of low-energy neutrons incident on the exposed face of P2 was much higher than that of P4. If the return of neutrons from the spacecraft is neglected both prisms should receive the same contribution from epithermal neutrons. Consequently, subtraction of P4 from P2 yielded a response that was representative of the thermal-neutron population. The epithermal-neutron counting rate was taken to be the counting rate for P1, which was shielded from thermal neutrons by a Cd foil. Note that based on an analysis of cruise data, the cosmic-ray-induced background for Category-1 counting rates for P1, P2, and P4 was found to be consistent with zero.

2.3.2.2.3. Normalization of Counting Data

Neutron counting rates are sensitive to a number of factors unrelated to the surface and atmosphere of Mars. These include, for example, instrument drift and variations in the galactic cosmic-ray flux. To eliminate these variations from our data set, we developed an algorithm to adjust our time-series counting data so that counting rates at equatorial latitudes did not change with time and were equal to the average counting rates observed over a normalization interval, which was arbitrarily selected to be from $L_S = 329^\circ$ to $L_S = 131^\circ$ (data collected between approximately February 19, 2002 through February 1, 2003). The region between latitudes $\pm 30^\circ$ (the "belly band") was used for normalization. Minor variations in counting rate due to seasonal changes in atmospheric mass were initially ignored, but were later restored to the time series.

The belly-band normalization algorithm removes gain and offset variations (DND CAT1_PRISM_NORM_SLOPE, CAT1_PRISM_NORM_OFFSET) caused by a number of effects, including variations in the galactic cosmic-ray background and errors in the Category-1 background subtraction algorithm. However, the normalization algorithm also removes

variations that would otherwise be present as a result of seasonal changes in atmospheric mass at the equator. To restore the effect of atmospheric mass, we combined maps of atmospheric mass at equatorial latitudes (derived from the ARC-GCM) with expressions for counting rate as a function of atmospheric thickness [11] to determine the relative variation of belly-band-averaged neutron-counting rates as a function of time. The normalized counting rates were then multiplied by the relative variation (DND CF_ATM_EPI, CF_ATM_FAST) to restore the atmospheric effect. Use of pressures from the ARC-GCM is justified because the ARC-GCM fits the Viking 1 and 2 landing-site pressure data that are representative of equatorial to mid-latitude pressure variations and were found to be reproducible year after year. This procedure was applied to the fast and epithermal counting data that show the largest atmospheric effect. Thermal neutrons vary negligibly with atmospheric mass when the water abundance of the surface is less than about 15%, which is representative of the belly band. The fast neutrons, which have the largest variation, show a 5% peak-to-peak variation in counting rate over an entire Martian year. Therefore, the correction is relatively minor.

In addition to the belly band normalization, all counting data products in the DND were corrected for variations in spacecraft altitude to an effective altitude of 400 km. The correction algorithm assumed that the variation in count rate with altitude was proportional to the solid angle subtended by Mars at the spacecraft. The counting data were also divided by the live time (DND LIVETIME) determined for each measurement interval to yield counting rates in units of counts per second.

Averaged neutron counting rates are produced from the derived (background subtracted, normalized) neutron counting rates. A summing algorithm is used to bin and combine thermal, epithermal, and fast neutron counting data both spatially and temporally. The spatial constraint is variable, but will be set at 5-degrees latitude by 5-degrees longitude bins for the AND PDS records. In order to be grouped within a particular 5-degree bin, the latitude and longitude at the middle of the collection interval must be greater than or equal to the lower limit and less than the upper limit. The temporal constraint on the AND product is variable, but will be constrained for the PDS to be 15-degrees of Mars L_S . The 15-degree periods are called seasons, which are numbered 0 through 23. Seasons can vary in time from about 24 to 33 Earth days. A table of the correlation between Earth days, Mars days and L_S can be found in [13].

2.3.2.3. HEND Processing

The products of the HEND data reduction algorithms are a time-series data set, corrected for cosmic ray background (DHD) and a table of temporally and spatially averaged counting rates (AHD), that can be used to produce epithermal and fast neutron global maps of Mars. An overview of these algorithms is provided here. See [14] for details of the HEND data reduction process and [6] for details of the HEND design and operation.

The HEND instrument collects neutron signals in four independent detectors, based on the energy of the incoming neutron. Raw counts are reported as a spectrum for each detector for each approximately 19.7 second collection interval. The raw neutron spectra are corrected for the neutron background due to the bombardment of the spacecraft by the galactic cosmic-ray flux. The galactic cosmic-ray flux induced background was measured during the cruise phase of the mission when the spacecraft was far from both the Earth and Mars. The observed background counts multiplied by an orbital geometry term is subtracted from the raw HEND spectrum to yield background subtracted counts for each collection interval for five neutron signals, SD

(Small Detector), MD (Medium Detector), LD (Large Detector), LO (sum of channels 1 -4 in the inner scintillator) and HI (sum of channels 5-15 in the inner scintillator).

Background subtracted count values for each of the five neutron signals (SD, MD, LD, LO, HI) are temporally and spatially binned to compare seasonal changes in the neutron flux. The temporal binning is 15-degrees of L_S and the spatial binning is a grid of 5-degrees latitude by 5-degrees longitude. Membership in a temporal bin is determined by calculating the fraction of the collection interval time spent in each temporal cell. Membership in a spatial bin is determined by calculating the fraction of the collection interval length in a given spatial cell along the orbital trajectory projection on the Martian surface. The temporally and spatially binned counting rate for each of the five signals (SD, MD, LD, LO, HI) are calculated by: 1) multiplying the background subtracted counts by the collection interval fraction and summing the result for each collection interval within the 15-degree L_S interval 2) multiplying the duration (in seconds) of each collection interval by the collection interval fraction and summing the result for each collection interval within the 15-degree L_S interval 3) dividing the summed counts by the summed time to yield a count rate in units of counts per second.

HEND count rate data are normalized to account for the effects of the Cosmic Gamma-Ray (CGR) flux and solar energetic particle events on the neutron count rates. The CGR flux is not a constant value and varies with time. HEND data collected during solar energetic particle events is excluded from processing, as count rates may increase by several orders of magnitude. However, exclusion of data is based on visual inspection and correlation with other instruments. This method does not guarantee all affected data is removed from the data set. Weak traces of solar particle events may remain. The effect of the variability of the CGR flux and the remains of solar particle events may cause tens of percent variation in calculated neutron fluxes.

The temporally and spatially binned count rates are normalized to the neutron signal detected at Solis Planum to yield a relative count rate. Solis Planum is considered to be one of the driest regions of Mars so the neutron flux is therefore not affected by seasonal changes. The only variations in the observed neutron signal over this region are the variations in CGR flux and any remains of solar particle events. Normalization of the temporally and spatially binned count rates by a value derived from Solis Planum effectively removes the effects of the CGR flux and solar particle events, leaving a signal that is sensitive only to seasonal changes. The Solis Planum normalization value is defined as the average count rate of collection intervals within the spatial range 245E to 295E and 15S to 55S and within the 15-degree L_S interval of the background corrected count rate. Error fields are also present in the AHD dataset for each of the averaged normalized signals. The errors are simply based on the counting statistics for the raw HEND counts in each detector.

The conversion of normalized count rates to neutron fluxes requires knowledge of the efficiency of each of the neutron detectors. Efficiency functions, derived from model calculations and direct calibrations, describe the spatial response of each of the four HEND detectors, SD, MD, LD, and the inner stilbene scintillator, to bombardment by neutrons. A series of Monte-Carlo simulations were run to calculate the efficiency of each HEND detector. The simulations accounted for the composition and geometry of the HEND instrument. In parallel, a series of experimental calibration measurements were carried out to understand the quality of the Monte-Carlo simulations. Two types of experiments were performed. The first experiment measured the HEND response to calibrated neutron sources with known spectra and the second measured the HEND response to energetic neutron fluxes. The combined results of the numerical simulations

and the experiments yield detector specific efficiency functions. See [14] for further details.

To predict the number of neutrons in a given energy level an assumption is made about the shape of the neutron spectra. Epithermal and fast neutron spectra are assumed to be described by a power law function with the normalization parameter A and power index α . The power law function is used to describe the neutron flux in particular energy interval. Once the neutron flux and the HEND detector efficiency function are known, a modeled count rate can be calculated by multiplying the flux of neutrons [$n/(\text{cm}^2 \cdot \text{sec})$] in an energy interval by the detector specific efficiency function for any given HEND detector. The modeled count rate and the observed normalized count rate are compared using a Pearson residual minimization method. If the modeled count rate (based in part on the power law function parameters A and α) accurately approximates the observed normalized count rate, then the actual neutron flux [$n/(\text{cm}^2 \cdot \text{sec})$] at the Odyssey spacecraft is calculated for different energy ranges of epithermal and fast neutrons (100eV-10keV, 10keV-1MeV, 1MeV-2.5MeV, and 2.5MeV-10MeV) for each 5-degree by 5-degree spatial cell on the surface of Mars.

2.3.3. Data Flow

The GRS IDR data product will be made available in sequential data releases at three month intervals as specified in [2] (Table 5-1, Mars Odyssey Orbiter Archive Delivery Schedule). Releases of the IDR shall remain available for transfer from the GRS PDS web site (grspds.lpl.arizona.edu).

The CGS contain approximately 67 KiB of data per record, 24 MiB of data per data file or 275 MiB of data per day during nominal mapping. Total CGS data volume for the approximately 1000 day mission will be approximately 270 GiB.

The SGS contain approximately 9 MiB of data per table. There are 36 data tables for each 15-degree L_S interval, and approximately 36 L_S divisions during nominal mapping operations. Total SGS data volume for the SGS data product will therefore be 11.5 GiB.

The DND data product size is approximately 1 MiB per day during nominal mapping. Total DND data volume for the approximately 1000 day mission will be 1 GiB.

An individual AND data product contains approximately 150 KiB of data. There will be 24 data files per Mars year, and approximately 1.5 Mars years in the nominal mapping mission. Total AND data volume will therefore be 5 MiB.

The DHD data product size is approximately 419 KiB per day during nominal mapping. Total DHD data volume for the approximately 1000 day mission will be 409 MiB.

An individual AHD data product contains approximately 247 KiB of data. There will be 96 data files per Mars year, and approximately 1.5 Mars years in the nominal mapping mission. Total AHD data volume will therefore be 34.7 MiB.

Total IDR data for the mission will be approximately 283 GiB. New versions of the IDR data will be produced if errors are found in any of the data reduction algorithms. Revisions to the IDRs can be made at any time if the impact of the error is significant.

2.3.4. Labeling and Identification

The data set IDs provided by the PDS for the GRS IDR data products are:

ODY-M-GRS-4-CGS-V1.0

ODY-M-GRS-5-SGS-V1.0

ODY-M-GRS-4-DND-V1.0

ODY-M-GRS-5-AND-V1.0

ODY-M-GRS-4-DHD-V1.0

ODY-M-GRS-5-AHD-V1.0

The version number is incremented should the IDR data product change.

There will be six file naming conventions for the GRS IDR data product. Each naming convention will be associated with a specific data product. Corrected gamma spectra follow a naming convention that begins with the acronym CGS (corrected gamma spectra) followed by an eight-digit date field in the format YYYYMMDD followed by the start hour and the end hour, e.g. CGS_20020101_00_02.DAT.

Summed gamma spectra follow a naming convention that begins with the acronym SGS (summed gamma spectra) followed by the Mars Odyssey mapping year field, followed by the starting L_S value and the ending L_S value, and finally the latitude band number, e.g. sgs_01_015_030_00.dat. The latitude band numbers begin with 00, for the 90N to 85N band and end with 35 for, the 85S to 90S band.

Derived neutron data follow a naming convention that begins with the string “dnd” followed by an eight-digit date field in the format YYYYMMDD, e.g. deriv_neutron_data_20021001.dat.

Averaged neutron data follow a naming convention that begins with the acronym AND (averaged neutron data) followed by a Mars Odyssey mapping year field, the beginning L_S value and finally the ending L_S value, e.g. AND_1_12000_12375.dat. The last two digits in the L_S fields are the fractional portion of the value.

Derived HEND data follow a naming convention that begins with the string “dhd” followed by an eight-digit date field in the format YYYYMMDD, e.g. dhd_20021001.dat.

Averaged HEND data follow a naming convention that begins with the acronym AHD (averaged HEND data) followed by a Mars Odyssey mapping year field, the beginning L_S value and finally the ending L_S value, e.g. AHD_00_330_345.dat.

All GRS IDR data products (binary .dat files) will have a detached PDS label in a separate file of the same name, extension .LBL.

2.3.5. Data Product Revisions

Individual CGS, SGS, DND, AND, DHD, and AHD 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 tables for the 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 GRS IDR data product complies with Planetary Data System standards for file formats and labels, as specified in the PDS Standards Reference [4] and the Planetary Science Data Dictionary Document [5].

2.4.2. Time Standards

The PDS labels for GRS IDR products use keywords containing a number of time values. The spacecraft clock is measured in ticks, with 256 ticks per second. Both the spacecraft receive time (`sc_rcv_time`), the time at which the spacecraft receives the data record, and the spacecraft event time (`sc_ev_time`), the time at the middle of the ~20 second collection interval, are measured in ticks. The UTC, which is the converted `sc_ev_time`, is formatted according to ISO standards [4]. CEB time, in units of milliseconds, is the number of milliseconds since the last CEB timer rollover.

2.4.3. Coordinate Systems

The cartographic coordinate system used for GRS IDR data products conforms to the IAU areocentric system with East longitudes being positive. The IAU2000 reference system [7] for Mars cartographic coordinates and rotational elements was used for computing latitude and longitude coordinates.

2.4.4. Data Storage Conventions

The GRS IDR data products are stored as fixed-length binary files, most-significant-byte-first (big-endian) format. Text files are formatted in standard ASCII text.

2.5. Data Validation

GRS IDR products will be validated by the GRS Team for science content and by the PDS for compliance with PDS archive standards [4].

3.0 DETAILED DATA PRODUCT SPECIFICATIONS

3.1. CGS

1.1.1. Data Product Structure and Organization

The CGS are gamma spectra that have been corrected for gain, offset and linearity. The result of the correction is that all the corrected spectra have a common energy scale, allowing the direct comparison of individual spectra. The CGS data product is structured as a time series, 49-column data table. See Appendix 5.1.1 for the CGS table structure.

The CGS data product is organized as a binary data file containing corrected spectra and associated data collected over a 2-hour time period, with a detached ASCII text PDS label (see Appendix 5.1) file for each binary file. The 2-hour data files are grouped by Earth day, resulting in 12 binary data file, ASCII label file pairs per data folder. Data folders are labeled by Earth date in the format YYYYMMDD. Data folders are grouped by Earth years, in folders labeled by year in the format YYYY.

3.1.1. Data Format Description

The data format for the CGS is a 49-column binary table. Columns vary in width from 2 to 65536 bytes. Column structure and start byte are described in Appendix 5.1.1. The number of rows in a data table will depend on the number of ~ 19.7 second collection intervals during the two hour time frame of the data file. We would expect ~365 records per data file, but there may be some variations due to short data gaps.

3.1.2. Label Description

The CGS data product has detached PDS labels stored as ASCII text. A PDS label is object-oriented and describes the objects in the data file. The PDS label contains keywords for product identification and for data object definitions. The label also contains descriptive information needed to interpret or process the data objects in the file.

PDS labels are written in Object Description Language (ODL) [4]. PDS label statements have the form of "keyword = value". Each label statement is terminated with a carriage return character (ASCII 13) and a line feed character (ASCII 10) sequence to allow the label to be read by many operating systems. Pointer statements with the following format are used to indicate the location of data objects:

^object = location

where the carat character (^, also called a pointer) is followed by the name of the specific data object. The location is the name of the file that contains the data object.

3.2. SGS

1.1.2. Data Product Structure and Organization

The SGS are temporally and spatially binned corrected gamma spectra. The SGS data product is structured as a 54-column data table, with 72 data records corresponding to one 5-degree latitude by 5-degree longitude spatial cell in the 5-degree latitude band. See Appendix 5.2.1 for the SGS table structure.

The SGS data product is organized as a binary data file containing the summed data values with a detached ASCII text PDS label (see Appendix 5.2) file for each binary file. The binary files are organized as one data file for each 5-degree latitude band on the planet, and are grouped in data folders by Mars Odyssey mapping year and 15-degrees of L_S .

3.2.1. Data Format Description

The data format for the SGS is a 54-column binary table. Columns vary in width from 1 to 131072 bytes. Column structure and start byte for each column are described in Appendix 5.2.1. There are 72 rows (data records) in each table. A single data record corresponds to a 5x5 degree latitude longitude spatial cell. The binary data files will be grouped by L_S intervals, with a folder for each 15-degree time interval, e.g. yr_01_ls_015-030. The L_S folders will contain 36 data files, one file for each 5-degree latitude band around the planet. The latitude bands will be numbered 00 to 35, with band 00 centered on 87.5N, and 35 centered on - 87.5S.

3.2.2. Label Description

The SGS data product has detached PDS labels stored as ASCII text. A PDS label is object-oriented and describes the objects in the data file. The PDS label contains keywords for product identification and for data object definitions. The label also contains descriptive information needed to interpret or process the data objects in the file.

3.3. DND

1.1.3. Data Product Structure and Organization

The DND data product is a set of derived values needed to calculate neutron counting rates. The DND data product is structured as a time series, 53-column data table. See Appendix 5.3.1 for the DND table structure.

The DND data product is organized as a binary data file containing the derived data values with a detached ASCII text PDS label (see Appendix 5.3) file for each binary file. The binary files are organized as one data file each Earth day. Data folders are labeled by Earth date in the format YYYYMMDD. Data folders are grouped by Earth years, in folders labeled by year in the format YYYY.

3.3.1. Data Format Description

The data format for the DND is a 53-column binary table. Columns vary in width from 1 to 23 bytes. Column structure and start byte are described in Appendix 5.3.1. The number of rows in a

data table will depend on the number of ~ 19.7 second collection intervals during the 24-hour time frame of the data file. We would expect ~ 4300 records per data file, but there may be some variations due to short data gaps.

3.3.2. Label Description

The DND data product has detached PDS labels stored as ASCII text. A PDS label is object-oriented and describes the objects in the data file. The PDS label contains keywords for product identification and for data object definitions. The label also contains descriptive information needed to interpret or process the data objects in the file.

3.4. AND

1.1.4. Data Product Structure and Organization

The AND data are the temporally and spatially binned neutron counting rates that can be used to create global maps. The AND data product is structured as an 11-column data table, with 2592 data records corresponding to one of the 5-degree latitude by 5-degree longitude spatial cell. See Appendix 5.4.1 for the AND table structure.

The AND data product is organized as a binary data file containing the averaged data values with a detached ASCII text PDS label (see Appendix 5.4) file for each binary file. The binary files are organized as one data file for each 15-degrees of L_S . Data folders are labeled by Mars Odyssey mapping year

3.4.1. Data Format Description

The data format for the AND is an 11-column binary table. Columns vary in width from 4 to 8 bytes. Column structure and start byte are described in Appendix 5.4.1. There are 2592 rows in each data table, corresponding to the 2592 5x5 degree latitude longitude spatial cells on the surface of the planet.

3.4.2. Label Description

The AND data product has detached PDS labels stored as ASCII text. A PDS label is object-oriented and describes the objects in the data file. The PDS label contains keywords for product identification and for data object definitions. The label also contains descriptive information needed to interpret or process the data objects in the file.

3.5. DHD

1.1.5. Data Product Structure and Organization

The DHD data product is a set of background subtracted count values needed to calculate neutron counting rates. The DHD data product is structured as a time series, 22-column data table. See Appendix 5.5.1 for the DHD table structure.

The DHD data product is organized as a binary data file containing the derived data values with a detached ASCII text PDS label (see Appendix 5.5) file for each binary file. The binary files are organized as one data file each Earth day. Data folders are labeled by Earth date in the format YYYYMMDD. Data folders are grouped by Earth years, in folders labeled by year in the format YYYY.

3.5.1. Data Format Description

The data format for the DHD is a 22-column binary table. Columns vary in width from 1 to 23 bytes. Column structure and start byte are described in Appendix 5.5.1. The number of rows in a data table will depend on the number of ~ 19.7 second collection intervals during the 24-hour time frame of the data file. We would expect ~4300 records per data file, but there may be some variations due to short data gaps.

3.5.2. Label Description

The DHD data product has detached PDS labels stored as ASCII text. A PDS label is object-oriented and describes the objects in the data file. The PDS label contains keywords for product identification and for data object definitions. The label also contains descriptive information needed to interpret or process the data objects in the file.

3.6. AHD

1.1.6. Data Product Structure and Organization

The AHD data are the temporally and spatially binned neutron counting rates and fluxes that can be used to create global maps. The AHD data product is structured as a 24-column data table, with 2592 data records corresponding to one of the 5-degree latitude by 5-degree longitude spatial cell. See Appendix 5.6.1 for the AND table structure.

The AHD data product is organized as a binary data file containing the averaged data values with a detached ASCII text PDS label (see Appendix 5.6) file for each binary file. The binary files are organized as one data file for each 15-degree of L_S . Data folders are labeled by Mars Odyssey mapping year

3.6.1. Data Format Description

The data format for the AHD is a 24-column binary table. Columns vary in width from 4 to 23 bytes. Column structure and start byte are described in Appendix 5.6.1. There are 2592 rows in each data table, corresponding to the 2592 5x5 degree latitude longitude spatial cells on the surface of the planet.

3.6.2. Label Description

The AHD data product has detached PDS labels stored as ASCII text. A PDS label is object-oriented and describes the objects in the data file. The PDS label contains keywords for product identification and for data object definitions. The label also contains descriptive information needed to interpret or process the data objects in the file.

4.0 APPLICABLE SOFTWARE

4.1. Utility Programs

A library of source code to parse the IDR data product files will be included in the IDR release software directory. This library allows a programmer to build applications that display or manipulate the GRS IDR data. This source is written in the Java language, and requires version 1.3 of the Java Runtime Environment (JRE) or Java Software Development Kit (SDK).

4.2. Applicable PDS Software Tools

PDS-labeled images and tables can be displayed with the program NASAView, developed by the PDS. There are versions of NASAView that run on SUN/SOLARIS, WINDOWS, LINUX operating systems. NASAView can be obtained from the PDS web site at <http://pdsproto.jpl.nasa.gov/Distribution/license.html>.

Table 2. GRS IDR Data Columns

This table lists the columns in all GRS IDR 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.

Column Name	Data Type	Length	Description	Appears In
ALPHA	IEEE_REAL	4 BYTES	Power index of the power law function used to describe the neutron spectra.	AHD
ALTITUDE	IEEE_REAL	4 BYTES	Areocentric altitude of the sub-spacecraft point in Mars-fixed rotating frame at the middle of the collection interval.	DND
APPS_GAIN_DHK	MSB_UNSIGNED_INTEGER	2 BYTES	APPS shaping amp gain setting from gamma digital housekeeping.	CGS
APPS_GAIN_DHK_DEFAULT	MSB_UNSIGNED_INTEGER	2 BYTES	APPS_GAIN_DHK default value	SGS
APPS_GAIN_DHK_MAX	MSB_UNSIGNED_INTEGER	2 BYTES	APPS_GAIN_DHK maximum value	SGS
APPS_GAIN_DHK_MIN	MSB_UNSIGNED_INTEGER	2 BYTES	APPS_GAIN_DHK minimum value	SGS
AREOCENTRIC_EAST_LONGITUDE	IEEE_REAL	4 BYTES	Sub spacecraft longitude in Mars fixed coordinates at the middle of the collection interval. Longitude increases towards the East.	DND AND SGS DHD AHD
AREOCENTRIC_LATITUDE	IEEE_REAL	8 BYTES	Sub spacecraft latitude in Mars fixed coordinates at the middle of the collection interval.	CGS DND AND SGS DHD AHD
AREOCENTRIC_LONGITUDE	IEEE_REAL	8 BYTES	Sub spacecraft longitude in Mars fixed coordinates at the middle of the collection interval. Longitude increases towards the East.	CGS
B170K_TEMP	IEEE_REAL	4 BYTES	Temperature used to normalize the 170K card gain.	CGS
B170K_TEMP_COEFFICIENT	IEEE_REAL	4 BYTES	Temperature coefficient of gain for the 170K card (parts-per-million/degree C).	CGS
B170K_TEMP_MAX	IEEE_REAL	4 BYTES	Maximum B170K_TEMP value.	SGS
B170K_TEMP_MEAN	IEEE_REAL	4 BYTES	Mean B170K_TEMP value.	SGS

Column Name	Data Type	Length	Description	Appears In
B170K_TEMP_MIN	IEEE_REAL	4 BYTES	Minimum B170K_TEMP value.	SGS
B170K_TEMP_STD	IEEE_REAL	4 BYTES	Standard deviation of the B170K_TEMP values.	SGS
BAD_CODE	MSB_UNSIGNED_INTEGER	4 BYTES	If non-zero, the data has been flagged bad. Definitions in BAD_CODE.TXT	CGS SGS
CAT1_PRISM1_ERROR	IEEE_REAL	4 BYTES	Category 1 Prism 1 peak area 1-sigma statistical error in counts/second.	DND
CAT1_PRISM1_NORM_OFFSET	IEEE_REAL	4 BYTES	The offset parameter for the bellyband normalization for the CAT1_PRISM1_PEAK_AREA.	DND
CAT1_PRISM1_NORM_SLOPE	IEEE_REAL	4 BYTES	The slope parameter for the bellyband normalization for the CAT1_PRISM1_PEAK_AREA.	DND
CAT1_PRISM1_PEAK_AREA	IEEE_REAL	4 BYTES	Category 1 Prism 1 peak area.	DND
CAT1_PRISM2_ERROR	IEEE_REAL	4 BYTES	Category 1 Prism 2 peak area 1-sigma statistical error in counts/second.	DND
CAT1_PRISM2_PEAK_AREA	IEEE_REAL	4 BYTES	Category 1 Prism 2 peak area.	DND
CAT1_PRISM3_ERROR	IEEE_REAL	4 BYTES	Category 1 Prism 3 peak area 1-sigma statistical error in counts/second.	DND
CAT1_PRISM3_PEAK_AREA	IEEE_REAL	4 BYTES	Category 1 Prism 3 peak area.	DND
CAT1_PRISM4_ERROR	IEEE_REAL	4 BYTES	Category 1 Prism 4 peak area 1-sigma statistical error in counts/second.	DND
CAT1_PRISM4_PEAK_AREA	IEEE_REAL	4 BYTES	Category 1 Prism 4 peak area.	DND
CAT2_PRISM1_ERROR	IEEE_REAL	4 BYTES	The Category 2 Prism 1 fast sum 1-sigma statistical error.	DND
CAT2_PRISM1_FAST_SUM	IEEE_REAL	4 BYTES	Category 2 Prism 1 fast neutron sum.	DND
CAT2_PRISM1_NORM_OFFSET	IEEE_REAL	4 BYTES	The offset parameter for the bellyband normalization for the CAT2_PRISM1_PEAK_AREA.	DND
CAT2_PRISM1_NORM_OFFSET	IEEE_REAL	4 BYTES	The offset parameter for the bellyband normalization for the CAT2_PRISM1_PEAK_AREA.	DND
CAT2_PRISM1_NORM_SLOPE	IEEE_REAL	4 BYTES	The slope parameter for the bellyband normalization for the CAT2_PRISM1_PEAK_AREA.	DND
CAT2_PRISM1_NORM_SLOPE	IEEE_REAL	4 BYTES	The slope parameter for the bellyband normalization for the CAT2_PRISM1_PEAK_AREA.	DND
CAT3_PRISM1_NORM_OFFSET	IEEE_REAL	4 BYTES	The offset parameter for the bellyband normalization for the CAT3_PRISM1_PEAK_AREA.	DND

Column Name	Data Type	Length	Description	Appears In
CAT3_PRISM1_NORM_SLOPE	IEEE_REAL	4 BYTES	The slope parameter for the bellyband normalization for the CAT3_PRISM1_PEAK_AREA.	DND
CAT4_PRISM1_NORM_OFFSET	IEEE_REAL	4 BYTES	The offset parameter for the bellyband normalization for the CAT4_PRISM1_PEAK_AREA.	DND
CAT4_PRISM1_NORM_SLOPE	IEEE_REAL	4 BYTES	The slope parameter for the bellyband normalization for the CAT4_PRISM1_PEAK_AREA.	DND
CEB_TIME	MSB_UNSIGNED_INTEGER	8 BYTES	Clock count from the GRS Common Electronics Box at the beginning of the collection interval.	CGS DND
CEPI	IEEE_REAL	4 BYTES	Averaged epithermal neutron counting rate in counts per second over the 5x5 degree latitude longitude map bin and 15-degrees L-sub-S.	AND
CF_ATM_EPI	IEEE_REAL	4 BYTES	Correction factor for atmospheric mass for epithermal neutrons.	DND
CF_ATM_FAST	IEEE_REAL	4 BYTES	Correction factor for atmospheric mass for fast neutrons.	DND
CFAST	IEEE_REAL	4 BYTES	Averaged fast neutron counting rate in counts per second over the 5x5 degree latitude longitude map bin and 15-degrees L-sub-S.	AND
CLOCK_TIME	IEEE_REAL	8 BYTES	The sum of the PIXEL_DURATIONS in milliseconds.	SGS
CORRECTED_SPECTRUM	IEEE_REAL	65536 BYTES	Gamma spectrum, corrected counts for each channel.	CGS
CTHERM	IEEE_REAL	4 BYTES	Averaged thermal neutron counting rate in counts per second over the 5x5 degree latitude longitude map bin and 15-degrees L-sub-S.	AND
DAY_INDEX	MSB_UNSIGNED_INTEGER	2 BYTES	Day of Martian year.	CGS DND
DEADTIME_PERCENT	IEEE_REAL	4 BYTES	Deadtime / duration.	DND
DELTA_ANGLE	IEEE_REAL	8 BYTES	Difference between instrument +y direction and true north at the middle of the collection interval.	CGS
DIRECTION	CHARACTER	1 BYTE	Direction of spacecraft travel N or S.	DND
EPITHERMAL_FLUX1	IEEE_REAL	4 BYTES	Orbital epithermal neutron flux in energy range 100 eV to 10 KeV (n/cm ² /sec)	AHD
EPITHERMAL_FLUX2	IEEE_REAL	4 BYTES	Orbital epithermal neutron flux in energy range 10 KeV to 1 MeV (n/cm ² /sec)	AHD
EXPOSURE	IEEE_REAL	4 BYTES	Exposure time of a given map pixel (cell) in seconds	AHD

Column Name	Data Type	Length	Description	Appears In
FAST_FLUX1	IEEE_REAL	4 BYTES	Orbital epithermal neutron flux in energy range 1 MeV to 2.5 MeV (n/cm ² /sec)	AHD
FAST_FLUX2	IEEE_REAL	4 BYTES	Orbital epithermal neutron flux in energy range 2.5 MeV to 10 MeV (n/cm ² /sec)	AHD
FIRST_CHANNEL	MSB_UNSIGNED_INTEGER	2 BYTES	First valid channel in the spectrum.	CGS
FIRST_CHANNEL_MAX	MSB_UNSIGNED_INTEGER	2 BYTES	The maximum first channel value in all the collection intervals summed.	SGS
FIRST_FULL_CHANNEL	MSB_UNSIGNED_INTEGER	2 BYTES	First channel with real counts.	CGS
GAIN	IEEE_REAL	4 BYTES	Target gain after correction, as determined by, as determined by instrument settings and spectral analysis. Units are KeV/channel.	CGS
GAIN_CORRECTION	IEEE_REAL	4 BYTES	After summing the corrected spectra, we may find that due to aging, drift, etc. we did not correct to the target gain. This field is then set to the ratio of the actual to the target gain, and the spectrum is recorrected with this factor included.	CGS
GAIN_MEAN	IEEE_REAL	4 BYTES	The GAIN mean	SGS
GAMMA SPECTRUM	IEEE_REAL	131072 BYTES	16384 channel summed gamma spectrum, float value for each channel	SGS
GAMMA_VREF_TEMP	IEEE_REAL	4 BYTES	V-reference temperature smoothed, and interpolated to the center of the collection interval.	CGS
GAMMA_VREF_TEMP_MAX	IEEE_REAL	4 BYTES	Maximum GAMMA_VREF_TEMP value.	SGS
GAMMA_VREF_TEMP_MEAN	IEEE_REAL	4 BYTES	Mean GAMMA_VREF_TEMP value.	SGS
GAMMA_VREF_TEMP_MIN	IEEE_REAL	4 BYTES	Minimum GAMMA_VREF_TEMP value.	SGS
GAMMA_VREF_TEMP_STD	IEEE_REAL	4 BYTES	Standard deviation of the GAMMA_VREF_TEMP values.	SGS
GPA_COEFFICIENTS	IEEE_REAL	24 BYTES	Temperature coefficients for the GPA.	CGS
GPA_TEMP	IEEE_REAL	4 BYTES	Gamma Pulse Analyzer temperature, smoothed, and interpolated to the center of the collection interval.	CGS
GPA_TEMP_MAX	IEEE_REAL	4 BYTES	Maximum GPA_TEMP value.	SGS
GPA_TEMP_MEAN	IEEE_REAL	4 BYTES	Mean GPA_TEMP value.	SGS
GPA_TEMP_MIN	IEEE_REAL	4 BYTES	Minimum GPA_TEMP value.	SGS
GPA_TEMP_STD	IEEE_REAL	4 BYTES	Standard deviation of the GPA_TEMP values.	SGS

Column Name	Data Type	Length	Description	Appears In
GRS_ORBIT_NUMBER	MSB_UNSIGNED_INTEGER	4 BYTES	Sequential counter of orbits from GRS CEB boot.	CGS DND
GRS_PIXEL_NUMBER	MSB_UNSIGNED_INTEGER	4 BYTES	Sequential counter of accumulation intervals, starts with one as grs orbit begins. Special case on reboot when the CEB is in orbit 0, pixel 0.	CGS DND
HVBS_MONITOR	IEEE_REAL	4 BYTES	High voltage bias supply value smoothed, and interpolated to the center of the collection interval.	CGS
HVBS_MONITOR_MAX	IEEE_REAL	4 BYTES	Maximum HVBS_MONITOR value.	SGS
HVBS_MONITOR_MEAN	IEEE_REAL	4 BYTES	Mean HVBS_MONITOR value.	SGS
HVBS_MONITOR_MIN	IEEE_REAL	4 BYTES	Minimum HVBS_MONITOR value.	SGS
HVBS_MONITOR_STD	IEEE_REAL	4 BYTES	Standard deviation of the HVBS_MONITOR values.	SGS
HVPS_MNTR_2	IEEE_REAL	4 BYTES	Smoothed interpolated value at mid point of the collection interval.	DND
IN_SC_HIGH_ERROR	IEEE_REAL	4 BYTES	The statistical error of the relative count rate in the high channels (5-15) of the Inner Scintillator based on instrument counting statistics.	AHD
IN_SC_HIGH_NORMALIZATION	IEEE_REAL	4 BYTES	Normalization value used to normalize map for the high channels (5-15) of the Inner Scintillator (counts/sec).	AHD
IN_SC_HIGH_RATE	IEEE_REAL	4 BYTES	The relative count rate after normalization observed in the given map pixel (cell) by the high channels (5-15) of the Inner Scintillator.	AHD
IN_SC_LOW_ERROR	IEEE_REAL	4 BYTES	The statistical error of the relative count rate in the low channels (1-4) of the Inner Scintillator based on instrument counting statistics.	AHD
IN_SC_LOW_NORMALIZATION	IEEE_REAL	4 BYTES	Normalization value used to normalize map for the low channels (1-4) of the Inner Scintillator (counts/sec).	AHD
IN_SC_LOW_RATE	IEEE_REAL	4 BYTES	The relative count rate after normalization observed in the given map pixel (cell) by the low channels (1-4) of the Inner Scintillator	AHD
INL_COEFFICIENTS	IEEE_REAL	120 BYTES	Coefficients of the polynomial used to correct the INL for this spectrum. Calculated from GAMMA_VREF_TEMP.	CGS
INSTR_BORESIGHT_MARS	IEEE_REAL	24 BYTES	Sub instrument boresight (x,y,z) in Mars fixed coordinates at the middle of the collection interval.	CGS
INTERSECTING	BOOLEAN	1 BYTE	True if intersection data was available.	CGS
IS_NORM_TEMP	IEEE_REAL	4 BYTES	Temperature used to normalize the detector gain.	CGS
IS_TEMP_A	IEEE_REAL	4 BYTES	A temperature, smoothed and interpolated to the center of the collection	CGS

Column Name	Data Type	Length	Description	Appears In
			interval.	
IS_TEMP_A_MAX	IEEE_REAL	4 BYTES	Maximum IS_TEMP_A value.	SGS
IS_TEMP_A_MEAN	IEEE_REAL	4 BYTES	Mean IS_TEMP_A value.	SGS
IS_TEMP_A_MIN	IEEE_REAL	4 BYTES	Minimum IS_TEMP_A value.	SGS
IS_TEMP_A_STD	IEEE_REAL	4 BYTES	Standard deviation of the IS_TEMP_A values.	SGS
IS_TEMP_B	IEEE_REAL	4 BYTES	Inner Stage B temperature, smoothed and interpolated to the center of the collection interval.	CGS
IS_TEMP_B_MAX	IEEE_REAL	4 BYTES	Maximum IS_TEMP_B value.	SGS
IS_TEMP_B_MEAN	IEEE_REAL	4 BYTES	Mean IS_TEMP_B value.	SGS
IS_TEMP_B_MIN	IEEE_REAL	4 BYTES	Minimum IS_TEMP_B value.	SGS
IS_TEMP_B_STD	IEEE_REAL	4 BYTES	Standard deviation of the IS_TEMP_B values.	SGS
IS_TEMP_COEFFICIENT	IEEE_REAL	4 BYTES	Temperature coefficient of gain for the detector (parts-per-million/degree C)	CGS
L1_CNTR	MSB_UNSIGNED_INTEGER	2 BYTES	Total number of gamma events within the L1 energy range.	CGS
L1_SUM	IEEE_REAL	8 BYTES	Sum of the L1_CNTR for each spectrum.	SGS
L2_CNTR	MSB_UNSIGNED_INTEGER	2 BYTES	Total number of gamma events within the L2 energy range.	CGS
L2_SUM	IEEE_REAL	8 BYTES	Sum of the L2_CNTR for each spectrum.	SGS
L3_CNTR	MSB_UNSIGNED_INTEGER	2 BYTES	Total number of gamma events within the L3 energy range.	CGS
L3_SUM	IEEE_REAL	8 BYTES	Sum of the L3_CNTR for each spectrum.	SGS
LAST_CHANNEL	MSB_UNSIGNED_INTEGER	2 BYTES	Last valid channel in the spectrum.	CGS
LAST_CHANNEL_MIN	MSB_UNSIGNED_INTEGER	2 BYTES	The minimum last channel value in all the spectra. summed.	SGS
LAST_FULL_CHANNEL	MSB_UNSIGNED_INTEGER	2 BYTES	Last channel with real counts.	CGS
LAT_01	IEEE_REAL	4 BYTES	Latitude 1 collection interval forward.	DND
LAT_4_5	IEEE_REAL	4 BYTES	Latitude 4.5 collection intervals forward.	DND
LD_ADJUSTED_COUNTS	IEEE_REAL	4 BYTES	Counts gathered in Large Detector during collection interval with background subtracted.	DHD

Column Name	Data Type	Length	Description	Appears In
LD_BACKGROUND	IEEE_REAL	4 BYTES	Background counts for the Large Detector	DHD
LD_ERROR	IEEE_REAL	4 BYTES	The statistical error of the relative count rate in the Large Detector based on instrument counting statistics.	AHD
LD_NORMALIZATION	IEEE_REAL	4 BYTES	Normalization value used to normalize map for the Large Detector (counts/sec).	AHD
LD_RATE	IEEE_REAL	4 BYTES	The relative count rate after normalization observed in the given map pixel (cell) by the Large Detector.	AHD
LD_RAW_COUNTS	IEEE_REAL	4 BYTES	Counts gathered in Large Detector during collection interval.	DHD
LIVETIME	IEEE_REAL	4 BYTES	In seconds the pixel duration minus the dead time.	DND
LLD_CNTR	MSB_UNSIGNED_INTEGER	2 BYTES	Lower level discriminator count.	CGS
LLD_SUM	IEEE_REAL	8 BYTES	Sum of the LLD_CNTR for each spectrum.	SGS
LOCAL_HOUR	MSB_UNSIGNED_INTEGER	1 BYTE	Local Sun hour at the sub-spacecraft point.	CGS DND
LOCAL_MINUTE	MSB_UNSIGNED_INTEGER	1 BYTE	Local Sun minute at the sub-spacecraft point.	CGS DND
LON_01	IEEE_REAL	4 BYTES	Longitude 1 collection interval forward.	DND
LON_4_5	IEEE_REAL	4 BYTES	Longitude 4.5 collection intervals forward.	DND
MARS_SOL	IEEE_REAL	8 BYTES	Longitude of the Sun at 0 hours UT on the date of the record. Taken from the Association of Lunar and Planetary Observers 'Ephemeris for Physical Observation of Mars'.	CGS
MARSPOS_INSTR	IEEE_REAL	4 BYTES	The (x,y,z) position of the sub-spacecraft point as seen from the spacecraft in the instrument frame at the middle of the collection interval. If no spacecraft orientation data was available from the loaded CK files for the request time, then all elements of are set to zero.	DND
MARSVEL_INSTR	IEEE_REAL	12 BYTES	The inertial spacecraft velocity direction rotated to the instrument frame at the middle of the collection interval. If no spacecraft orientation data available, then all elements set to zero.	DND
MD_ADJUSTED_COUNTS	IEEE_REAL	4 BYTES	Counts gathered in Medium Detector during collection interval with background subtracted.	DHD
MD_BACKGROUND	IEEE_REAL	4 BYTES	Background counts for the Medium Detector	DHD

Column Name	Data Type	Length	Description	Appears In
MD_ERROR	IEEE_REAL	4 BYTES	The statistical error of the relative count rate in the Medium Detector based on instrument counting statistics.	AHD
MD_NORMALIZATION	IEEE_REAL	4 BYTES	Normalization value used to normalize map for the Medium Detector (counts/sec).	AHD
MD_RATE	IEEE_REAL	4 BYTES	The relative count rate after normalization observed in the given map pixel (cell) by the Medium Detector.	AHD
MD_RAW_COUNTS	IEEE_REAL	4 BYTES	Counts gathered in Medium Detector during collection interval.	DHD
NEPI	IEEE_REAL	4 BYTES	Number of collection intervals per map bin.	AND
NEUTRON_NORMALIZATION	IEEE_REAL	4 BYTES	Power law normalization constant used to describe the neutron spectra.	AHD
NFAST	IEEE_REAL	4 BYTES	Number of collection intervals per map bin.	AND
NTHERM	IEEE_REAL	4 BYTES	Number of collection intervals per map bin.	AND
ODY_ORBIT_NUMBER	_UNSIGNED_INTEGER	4 BYTES	Orbit number common to all instruments aboard Odyssey. This orbit number is incremented by one as the spacecraft passes through the orbital descending node.	CGS DND
OFFSET	IEEE_REAL	4 BYTES	Target offset after correction, as determined by instrument settings and spectral analysis. Units are KeV.	CGS
OFFSET_CORRECTION	IEEE_REAL	4 BYTES	Set to the ratio of the actual to the target offset.	CGS
OFFSET_MEAN	IEEE_REAL	4 BYTES	The OFFSET mean	SGS
OS_TEMP_A	IEEE_REAL	4 BYTES	Outer Stage A temperature, smoothed and interpolated to the center of the collection interval.	CGS
OS_TEMP_A_MAX	IEEE_REAL	4 BYTES	Maximum OS_TEMP_A value.	SGS
OS_TEMP_A_MEAN	IEEE_REAL	4 BYTES	Mean OS_TEMP_A value.	SGS
OS_TEMP_A_MIN	IEEE_REAL	4 BYTES	Minimum OS_TEMP_A value.	SGS
OS_TEMP_A_STD	IEEE_REAL	4 BYTES	Standard deviation of the OS_TEMP_A values.	SGS
OS_TEMP_B	IEEE_REAL	4 BYTES	Outer Stage B temperature smoothed and interpolated to the center of the collection interval.	CGS
OS_TEMP_B_MAX	IEEE_REAL	4 BYTES	Maximum OS_TEMP_B value.	SGS
OS_TEMP_B_MEAN	IEEE_REAL	4 BYTES	Mean OS_TEMP_B value.	SGS

Column Name	Data Type	Length	Description	Appears In
OS_TEMP_B_MIN	IEEE_REAL	4 BYTES	Minimum OS_TEMP_B value.	SGS
OS_TEMP_B_STD	IEEE_REAL	4 BYTES	Standard deviation of the OS_TEMP_B values.	SGS
OVERLOAD_RATE	IEEE_REAL	4 BYTES	An estimate of the flux of charged particles that deposit energies greater than about 2.6 MeV.	DND
PHA_CNTR	MSB_UNSIGNED_INTEGER	4 BYTES	Pulse Height Analyzer counter.	CGS
PHA_SUM	IEEE_REAL	8 BYTES	Sum of the PHA_CNTR for each spectrum.	SGS
PHA_TIMER	MSB_UNSIGNED_INTEGER	8 BYTES	Pulse Height Analyzer timer.	CGS
PIXEL_DURATION	MSB_UNSIGNED_INTEGER	2 BYTES	Length of the collection period in milliseconds.	CGS DND DHD
POINTING	BOOLEAN	1 BYTE	True if pointing data was available.	CGS
POWER_LEVEL	MSB_UNSIGNED_INTEGER	2 BYTES	The power level of the power supply in use during the collection interval, 1 being the highest power and 7 being the lowest.	DND
POWER_SUPPLY	MSB_UNSIGNED_INTEGER	2 BYTES	Which power supply is being used, 1 or 2.	DND
RECORD_COUNT	IEEE_REAL	8 BYTES	The count of spectra that have been summed.	SGS
SC_EV_TIME	MSB_UNSIGNED_INTEGER	8 BYTES	Spacecraft time at the middle of the collection interval, in ticks.	CGS
SC_HIGH_ADJUSTED_COUNTS	IEEE_REAL	4 BYTES	Counts gathered in high channels (5-15) of the Inner Scintillator during collection interval with background subtracted.	DHD
SC_HIGH_BACKGROUND	IEEE_REAL	4 BYTES	Background counts for high channels (5-15) of the Inner Scintillator	DHD
SC_HIGH_RAW_COUNTS	IEEE_REAL	4 BYTES	Counts gathered in high channels (5-15) of the Inner Scintillator during collection interval.	DHD
SC_LOW_ADJUSTED_COUNTS	IEEE_REAL	4 BYTES	Counts gathered in low channels (1-4) of the Inner Scintillator during collection interval with background subtracted.	DHD
SC_LOW_BACKGROUND	IEEE_REAL	4 BYTES	Background counts for low channels (1-4) of the Inner Scintillator	DHD
SC_LOW_RAW_COUNTS	IEEE_REAL	4 BYTES	Counts gathered in low channels (1-4) of the Inner Scintillator during collection interval.	DHD
SC_RECV_TIME	MSB_UNSIGNED_INTEGER	8 BYTES	The time the raw spectrum packet was received by the spacecraft, in ticks (256 per second).	CGS DND DHD
SC_START_TIME	MSB_UNSIGNED_INTEGER	8 BYTES	SC_RECV_TIME at the start of the sum, in ticks.	SGS

Column Name	Data Type	Length	Description	Appears In
SC_STOP_TIME	MSB_UNSIGNED_INTEGER	8 BYTES	SC_RECV_TIME at the end of the sum, in ticks.	SGS
SCALT	IEEE_REAL	8 BYTES	Areocentric altitude of the sub-spacecraft point in Mars-fixed rotating frame at the middle of the collection interval.	CGS
SCPOS_INERT	IEEE_REAL	4 BYTES	The geometric position (x,y,z) of the spacecraft with respect to Mars in the 'MARSIAU' inertial frame at the input epoch 'et' at the middle of the collection interval.	DND
SCVEL_INERT	IEEE_REAL	4 BYTES	The geometric velocity (x,y,z) of the spacecraft with respect to Mars in the 'MARSIAU' inertial frame at the input epoch 'et' at the middle of the collection interval.	DND
SD_ADJUSTED_COUNTS	IEEE_REAL	4 BYTES	Counts gathered in Small Detector during collection interval with background subtracted.	DHD
SD_BACKGROUND	IEEE_REAL	4 BYTES	Background counts for the Small Detector	DHD
SD_ERROR	IEEE_REAL	4 BYTES	The statistical error of the relative count rate in the Small Detector based on instrument counting statistics.	AHD
SD_NORMALIZATION	IEEE_REAL	4 BYTES	Normalization value used to normalize map for the Small Detector (counts/sec).	AHD
SD_RATE	IEEE_REAL	4 BYTES	The relative count rate after normalization observed in the given map pixel (cell) by the Small Detector.	AHD
SD_RAW_COUNTS	IEEE_REAL	4 BYTES	Counts gathered in Small Detector during collection interval.	DHD
SEPI	IEEE_REAL	4 BYTES	Standard deviation in the epithermal count rate in counts per second.	AND
SFAST	IEEE_REAL	4 BYTES	Standard deviation in the fast count rate in counts per second.	AND
STHERM	IEEE_REAL	4 BYTES	Standard deviation in the thermal count rate in counts per second.	AND
SUB_SCPOS_MARS	IEEE_REAL	24 BYTES	Sub spacecraft vector (x,y,z) in Mars fixed coordinates at the middle of the collection interval.	CGS
SUN_ACTIVITY	BOOLEAN	1 BYTE	1= Active sun during collection interval, 0= Sun not active during collection interval.	DHD
SWAP_FLAG	MSB_UNSIGNED_INTEGER	2 BYTES	The state of the swap flag.	DND
THERMAL_COUNT_RATE	IEEE_REAL	4 BYTES	The thermal neutron counting rate normalized by the ratio of the thermal counting rate averaged over all transits between +30 and -30 degrees latitude measured within +0.5 and -0.5 data of the current data point.	DND

Column Name	Data Type	Length	Description	Appears In
THERMAL_ERROR	IEEE_REAL	4 BYTES	The 1-sigma statistical error of the thermal count rate.	DND
ULD_CNTR	MSB_UNSIGNED_INTEGER	2 BYTES	Upper level discriminator count.	CGS
ULD_SUM	IEEE_REAL	8 BYTES	Sum of the ULD_CNTR for each collection interval.	SGS
UTC	CHARACTER	23 BYTES	SC_EV_TIME converted to UTC, stored as yyyy-mm-ddThh:mm:ss.sss.	CGS DND DHD
UTC_START_TIME	CHARACTER	23 BYTES	UTC start time of the sum.	SGS
UTC_STOP_TIME	CHARACTER	23 BYTES	UTC end time of the sum	SGS

5.0 APPENDICIES

5.1. EXAMPLE: CGS Label

PDS_VERSION_ID = PDS3

/* FILE CHARACTERISTICS */

RECORD_TYPE = FIXED_LENGTH

RECORD_BYTES = 65929

FILE_RECORDS = 365

/* POINTERS TO DATA OBJECTS */

^TIME_SERIES = "CGS_20021001_00_02.DAT"

/* IDENTIFICATION DATA ELEMENTS */

DATA_SET_NAME = "ODY MARS GAMMA RAY SPECTROMETER 4 CGS V1.0"

DATA_SET_ID = "ODY-M-GRS-4-CGS-V1.0"

PRODUCT_ID = "CGS_20021001_00_02"

PRODUCT_TYPE = "CORRECTED_GAMMA_SPECTRA"

PRODUCT_VERSION_ID = "1.0"

RELEASE_ID = "0004"

/* DESCRIPTIVE DATA ELEMENTS */

INSTRUMENT_HOST_NAME = "2001 MARS ODYSSEY"

INSTRUMENT_NAME = "GAMMA RAY SPECTROMETER"

SPACECRAFT_ID = ODY

TARGET_NAME = MARS

MISSION_PHASE_NAME = MAPPING

START_TIME = 2002-10-01T00:00:07.413

STOP_TIME = 2002-10-01T01:59:59.662

SPACECRAFT_CLOCK_START_COUNT = 183781809949

SPACECRAFT_CLOCK_STOP_COUNT = 183783651168

PRODUCT_CREATION_TIME = 2003-06-13T18:06:23.790

/* DATA OBJECT DEFINITION */

OBJECT = TIME_SERIES

INTERCHANGE_FORMAT = BINARY

ROWS = 365

ROW_BYTES = 65929

```
SAMPLING_PARAMETER_NAME = TIME
SAMPLING_PARAMETER_UNIT = TICKS
SAMPLING_PARAMETER_INTERVAL = "N/A"
```

```
/* The complete column definitions are contained in an external file */
/* found in the LABEL directory of the archive disk. */
```

```
COLUMNS = 49
^STRUCTURE = "CORR_GAMMA_SPECTRA_COLS.FMT"
```

```
/* DESCRIPTIVE data elements */
DESCRIPTION = "
This is the corrected gamma ray spectra with associated data."
```

```
END_OBJECT = TIME_SERIES
```

```
END
```

5.1.1. EXAMPLE: CGS Table Structure

```
OBJECT = COLUMN
COLUMN_NUMBER = 1
NAME = SC_RECV_TIME
DATA_TYPE = MSB_UNSIGNED_INTEGER
BYTES = 8
START_BYTE = 1
DESCRIPTION = "
The time the raw spectrum packet was received by the spacecraft, in
ticks (256 per second).
"
```

```
END_OBJECT = COLUMN
```

```
OBJECT = COLUMN
COLUMN_NUMBER = 2
NAME = SC_EV_TIME
DATA_TYPE = MSB_UNSIGNED_INTEGER
BYTES = 8
START_BYTE = 9
DESCRIPTION = "
Spacecraft time at the middle of the pixel, in ticks.
"
```

END_OBJECT = COLUMN

OBJECT = COLUMN

COLUMN_NUMBER = 3

NAME = CEB_TIME

DATA_TYPE = MSB_UNSIGNED_INTEGER

BYTES = 8

START_BYTE = 17

UNIT = MILLISECOND

DESCRIPTION = "

Clock count from the GRS Common Electronics Box at the beginning of the pixel.

"

END_OBJECT = COLUMN

OBJECT = COLUMN

COLUMN_NUMBER = 4

NAME = UTC

DATA_TYPE = CHARACTER

BYTES = 23

START_BYTE = 25

DESCRIPTION = "

SC_EV_TIME converted to UTC, stored as yyyy-mm-ddThh:mm:ss.sss.

"

END_OBJECT = COLUMN

OBJECT = COLUMN

COLUMN_NUMBER = 5

NAME = PIXEL_DURATION

DATA_TYPE = MSB_UNSIGNED_INTEGER

BYTES = 2

START_BYTE = 48

UNIT = MILLISECOND

DESCRIPTION = "

Length of the collection period in milliseconds.

"

END_OBJECT = COLUMN

OBJECT = COLUMN

COLUMN_NUMBER = 6

NAME = GRS_PIXEL_NUMBER

```
DATA_TYPE = MSB_UNSIGNED_INTEGER
BYTES = 4
START_BYTE = 50
INVALID_CONSTANT = 0
DESCRIPTION = "
Sequential counter of accumulation intervals, starts with one as grs
orbit begins. Special case on reboot when the CEB is in orbit 0,
pixel 0.
"
END_OBJECT = COLUMN

OBJECT = COLUMN
COLUMN_NUMBER = 7
NAME = GRS_ORBIT_NUMBER
DATA_TYPE = MSB_UNSIGNED_INTEGER
BYTES = 4
START_BYTE = 54
INVALID_CONSTANT = 0
DESCRIPTION = "
Sequential counter of orbits from GRS CEB boot.
"
END_OBJECT = COLUMN

OBJECT = COLUMN
COLUMN_NUMBER = 8
NAME = ODY_ORBIT_NUMBER
DATA_TYPE = MSB_UNSIGNED_INTEGER
BYTES = 4
START_BYTE = 58
INVALID_CONSTANT = 0
DESCRIPTION = "
Orbit number common to all instruments aboard Odyssey. This orbit
number is incremented by one as the spacecraft passes through the
orbital descending node.
"
END_OBJECT = COLUMN

OBJECT = COLUMN
COLUMN_NUMBER = 9
NAME = AREOCENTRIC_LATITUDE
DATA_TYPE = IEEE_REAL
```

BYTES = 8
START_BYTE = 62
UNIT = DEGREE
DESCRIPTION = "
Sub spacecraft latitude in Mars fixed coordinates at the middle of the
pixel.
"
END_OBJECT = COLUMN

OBJECT = COLUMN
COLUMN_NUMBER = 10
NAME = AREOCENTRIC_LONGITUDE
DATA_TYPE = IEEE_REAL
BYTES = 8
START_BYTE = 70
UNIT = DEGREE
DESCRIPTION = "
Sub spacecraft longitude in Mars fixed coordinates at the middle of the
pixel. Longitude increases towards the East.
"
END_OBJECT = COLUMN

OBJECT = COLUMN
COLUMN_NUMBER = 11
NAME = INSTR_BORESIGHT_MARS
DATA_TYPE = IEEE_REAL
BYTES = 24
START_BYTE = 78
UNIT = KILOMETER
ITEMS = 3
ITEM_BYTES = 8
DESCRIPTION = "
Sub instrument boresight (x,y,z) in Mars fixed coordinates at the
middle of the pixel.
"
END_OBJECT = COLUMN

OBJECT = COLUMN
COLUMN_NUMBER = 12
NAME = SUB_SCPOS_MARS
DATA_TYPE = IEEE_REAL

BYTES = 24
START_BYTE = 102
UNIT = KILOMETER
ITEMS = 3
ITEM_BYTES = 8
DESCRIPTION = "
Sub spacecraft vector (x,y,z) in Mars fixed coordinates at the middle
of the pixel.
"

END_OBJECT = COLUMN

OBJECT = COLUMN
COLUMN_NUMBER = 13
NAME = SCALT
DATA_TYPE = IEEE_REAL
BYTES = 8
START_BYTE = 126
UNIT = KILOMETER
DESCRIPTION = "
Areocentric altitude of the sub-spacecraft point in Mars-fixed rotating
frame at the middle of the pixel.
"

END_OBJECT = COLUMN

OBJECT = COLUMN
COLUMN_NUMBER = 14
NAME = DELTA_ANGLE
DATA_TYPE = IEEE_REAL
BYTES = 8
START_BYTE = 134
UNIT = DEGREE
DESCRIPTION = "
Difference between instrument +y direction and true north at the middle
of the pixel.
"

END_OBJECT = COLUMN

OBJECT = COLUMN
COLUMN_NUMBER = 15
NAME = MARS_SOL
DATA_TYPE = IEEE_REAL

```
BYTES = 8
START_BYTE = 142
DESCRIPTION = "
Longitude of the Sun at 0 hours UT on the date of the record. Taken
from the Association of Lunar and Planetary Observers 'Ephemeris for
Physical Observation of Mars'.
"
END_OBJECT = COLUMN
```

```
OBJECT = COLUMN
COLUMN_NUMBER = 16
NAME = DAY_INDEX
DATA_TYPE = MSB_UNSIGNED_INTEGER
BYTES = 2
START_BYTE = 150
DESCRIPTION = "
Day of Martian year.
"
END_OBJECT = COLUMN
```

```
OBJECT = COLUMN
COLUMN_NUMBER = 17
NAME = LOCAL_HOUR
DATA_TYPE = MSB_UNSIGNED_INTEGER
BYTES = 1
START_BYTE = 152
DESCRIPTION = "
Local Sun hour at the sub-spacecraft point.
"
END_OBJECT = COLUMN
```

```
OBJECT = COLUMN
COLUMN_NUMBER = 18
NAME = LOCAL_MINUTE
DATA_TYPE = MSB_UNSIGNED_INTEGER
BYTES = 1
START_BYTE = 153
DESCRIPTION = "
Local Sun minute at the sub-spacecraft point.
"
END_OBJECT = COLUMN
```

```
OBJECT = COLUMN
COLUMN_NUMBER = 19
NAME = IS_TEMP_A
DATA_TYPE = IEEE_REAL
BYTES = 4
START_BYTE = 154
UNIT = CELSIUS
DESCRIPTION = "
Inner Stage A temperature, smoothed and interpolated to the center of
the pixel.
"
END_OBJECT = COLUMN
```

```
OBJECT = COLUMN
COLUMN_NUMBER = 20
NAME = IS_TEMP_B
DATA_TYPE = IEEE_REAL
BYTES = 4
START_BYTE = 158
UNIT = CELSIUS
DESCRIPTION = "
Inner Stage B temperature, smoothed and interpolated to the center of
the pixel.
"
END_OBJECT = COLUMN
```

```
OBJECT = COLUMN
COLUMN_NUMBER = 21
NAME = OS_TEMP_A
DATA_TYPE = IEEE_REAL
BYTES = 4
START_BYTE = 162
UNIT = CELSIUS
DESCRIPTION = "
Outer Stage A temperature, smoothed and interpolated to the center of
the pixel.
"
END_OBJECT = COLUMN
```

```
OBJECT = COLUMN
```

```
COLUMN_NUMBER = 22
NAME = OS_TEMP_B
DATA_TYPE = IEEE_REAL
BYTES = 4
START_BYTE = 166
UNIT = CELSIUS
DESCRIPTION = "
Outer Stage B temperature, smoothed and interpolated to the center of
the pixel.
"
END_OBJECT = COLUMN
```

```
OBJECT = COLUMN
COLUMN_NUMBER = 23
NAME = B170K_TEMP
DATA_TYPE = IEEE_REAL
BYTES = 4
START_BYTE = 170
UNIT = CELSIUS
DESCRIPTION = "
The 170K card temperature, smoothed and interpolated for the middle of
the pixel.
"
END_OBJECT = COLUMN
```

```
OBJECT = COLUMN
COLUMN_NUMBER = 24
NAME = B170K_NORM_TEMP
DATA_TYPE = IEEE_REAL
BYTES = 4
START_BYTE = 174
UNIT = CELSIUS
DESCRIPTION = "
Temperature used to normalize the 170K card gain.
"
END_OBJECT = COLUMN
```

```
OBJECT = COLUMN
COLUMN_NUMBER = 25
NAME = IS_NORM_TEMP
DATA_TYPE = IEEE_REAL
```

```
BYTES = 4
START_BYTE = 178
UNIT = CELSIUS
DESCRIPTION = "
Temperature used to normalize the detector gain.
"
END_OBJECT = COLUMN

OBJECT = COLUMN
COLUMN_NUMBER = 26
NAME = GPA_TEMP
DATA_TYPE = IEEE_REAL
BYTES = 4
START_BYTE = 182
UNIT = CELSIUS
DESCRIPTION = "
Gamma Pulse Analyzer temperature, smoothed, and interpolated to the
center of the pixel.
"
END_OBJECT = COLUMN

OBJECT = COLUMN
COLUMN_NUMBER = 27
NAME = GAMMA_VREF_TEMP
DATA_TYPE = IEEE_REAL
BYTES = 4
START_BYTE = 186
UNIT = CELSIUS
DESCRIPTION = "
V-reference temperature smoothed, and interpolated to the center of the
pixel.
"
END_OBJECT = COLUMN

OBJECT = COLUMN
COLUMN_NUMBER = 28
NAME = HVBS_MONITOR
DATA_TYPE = IEEE_REAL
BYTES = 4
START_BYTE = 190
UNIT = VOLT
```

DESCRIPTION = "
High voltage bias supply value smoothed, and interpolated to the center
of the pixel.
"

END_OBJECT = COLUMN

OBJECT = COLUMN
COLUMN_NUMBER = 29
NAME = IS_TEMP_COEFFICIENT
DATA_TYPE = IEEE_REAL
BYTES = 4
START_BYTE = 194
DESCRIPTION = "
Temperature coefficient of gain for the detector
(parts-per-million/degree C)
"

END_OBJECT = COLUMN

OBJECT = COLUMN
COLUMN_NUMBER = 30
NAME = B170K_TEMP_COEFFICIENT
DATA_TYPE = IEEE_REAL
BYTES = 4
START_BYTE = 198
DESCRIPTION = "
Temperature coefficient of gain for the 170K card
(parts-per-million/degree C).
"

END_OBJECT = COLUMN

OBJECT = COLUMN
COLUMN_NUMBER = 31
NAME = APPS_GAIN_DHK
DATA_TYPE = MSB_UNSIGNED_INTEGER
BYTES = 2
START_BYTE = 202
DESCRIPTION = "
APPS shaping amp gain setting from gamma digital housekeeping.
"

END_OBJECT = COLUMN

OBJECT = COLUMN
COLUMN_NUMBER = 32
NAME = LLD_CNTR
DATA_TYPE = MSB_UNSIGNED_INTEGER
BYTES = 2
START_BYTE = 204
DESCRIPTION = "
Lower level discriminator count.
"

END_OBJECT = COLUMN

OBJECT = COLUMN
COLUMN_NUMBER = 33
NAME = ULD_CNTR
DATA_TYPE = MSB_UNSIGNED_INTEGER
BYTES = 2
START_BYTE = 206
DESCRIPTION = "
Upper level discriminator count.
"

END_OBJECT = COLUMN

OBJECT = COLUMN
COLUMN_NUMBER = 34
NAME = L1_CNTR
DATA_TYPE = MSB_UNSIGNED_INTEGER
BYTES = 2
START_BYTE = 208
DESCRIPTION = "
Total number of gamma events within the L1 energy range.
"

END_OBJECT = COLUMN

OBJECT = COLUMN
COLUMN_NUMBER = 35
NAME = L2_CNTR
DATA_TYPE = MSB_UNSIGNED_INTEGER
BYTES = 2
START_BYTE = 210
DESCRIPTION = "
Total number of gamma events within the L2 energy range.

```
"
END_OBJECT = COLUMN

OBJECT = COLUMN
COLUMN_NUMBER = 36
NAME = L3_CNTR
DATA_TYPE = MSB_UNSIGNED_INTEGER
BYTES = 2
START_BYTE = 212
DESCRIPTION = "
Total number of gamma events within the L3 energy range.
"
END_OBJECT = COLUMN

OBJECT = COLUMN
COLUMN_NUMBER = 37
NAME = PHA_CNTR
DATA_TYPE = MSB_UNSIGNED_INTEGER
BYTES = 4
START_BYTE = 214
DESCRIPTION = "
Pulse Height Analyzer counter.
"
END_OBJECT = COLUMN

OBJECT = COLUMN
COLUMN_NUMBER = 38
NAME = PHA_TIMER
DATA_TYPE = MSB_UNSIGNED_INTEGER
BYTES = 8
START_BYTE = 218
DESCRIPTION = "
Pulse Height Analyzer timer.
"
END_OBJECT = COLUMN

OBJECT = COLUMN
COLUMN_NUMBER = 39
NAME = FIRST_CHANNEL
DATA_TYPE = MSB_UNSIGNED_INTEGER
BYTES = 2
```

```
START_BYTE = 226
DESCRIPTION = "
First valid channel in the spectrum.
"
END_OBJECT = COLUMN

OBJECT = COLUMN
COLUMN_NUMBER = 40
NAME = LAST_CHANNEL
DATA_TYPE = MSB_UNSIGNED_INTEGER
BYTES = 2
START_BYTE = 228
DESCRIPTION = "
Last valid channel in the spectrum.
"
END_OBJECT = COLUMN

OBJECT = COLUMN
COLUMN_NUMBER = 41
NAME = FIRST_FULL_CHANNEL
DATA_TYPE = MSB_UNSIGNED_INTEGER
BYTES = 2
START_BYTE = 230
DESCRIPTION = "
First channel with real counts.
"
END_OBJECT = COLUMN

OBJECT = COLUMN
COLUMN_NUMBER = 42
NAME = LAST_FULL_CHANNEL
DATA_TYPE = MSB_UNSIGNED_INTEGER
BYTES = 2
START_BYTE = 232
DESCRIPTION = "
Last channel with real counts.
"
END_OBJECT = COLUMN

OBJECT = COLUMN
COLUMN_NUMBER = 43
```

NAME = GAIN

DATA_TYPE = IEEE_REAL

BYTES = 4

START_BYTE = 234

DESCRIPTION = "

Target gain after correction, as determined by, as determined by instrument settings and spectral analysis. Units are KeV/channel.

"

END_OBJECT = COLUMN

OBJECT = COLUMN

COLUMN_NUMBER = 44

NAME = OFFSET

DATA_TYPE = IEEE_REAL

BYTES = 4

START_BYTE = 238

DESCRIPTION = "

Target offset after correction, as determined by instrument settings and spectral analysis. Units are KeV.

"

END_OBJECT = COLUMN

OBJECT = COLUMN

COLUMN_NUMBER = 45

NAME = GAIN_CORRECTION

DATA_TYPE = IEEE_REAL

BYTES = 4

START_BYTE = 242

DESCRIPTION = "

After summing the corrected spectra, we may find that due to aging, drift, etc. we did not correct to the target gain. This field is then set to the ratio of the actual to the target gain, and the spectrum is recorrected with this factor included.

"

END_OBJECT = COLUMN

OBJECT = COLUMN

COLUMN_NUMBER = 46

NAME = OFFSET_CORRECTION

DATA_TYPE = IEEE_REAL

BYTES = 4

```
START_BYTE = 246
DESCRIPTION = "
Set to the ratio of the actual to the target offset.
"
END_OBJECT = COLUMN

OBJECT = COLUMN
COLUMN_NUMBER = 47
NAME = GPA_COEFFICIENTS
DATA_TYPE = IEEE_REAL
BYTES = 24
START_BYTE = 250
ITEMS = 3
ITEM_BYTES = 8
DESCRIPTION = "
Temperature coefficients for the GPA.
"
END_OBJECT = COLUMN

OBJECT = COLUMN
COLUMN_NUMBER = 48
NAME = INL_COEFFICIENTS
DATA_TYPE = IEEE_REAL
BYTES = 120
START_BYTE = 274
ITEMS = 15
ITEM_BYTES = 8
DESCRIPTION = "
Coefficients of the polynomial used to correct the INL for this
spectrum. Calculated from GAMMA_VREF_TEMP.
"
END_OBJECT = COLUMN

OBJECT = COLUMN
COLUMN_NUMBER = 49
NAME = CORRECTED_SPECTRUM
DATA_TYPE = IEEE_REAL
BYTES = 65536
START_BYTE = 394
ITEMS = 16384
ITEM_BYTES = 4
```

```
DESCRIPTION = "  
Gamma spectrum, corrected counts for each channel.  
"  
END_OBJECT = COLUMN
```

5.2. EXAMPLE: SGS Label

```
PDS_VERSION_ID          = PDS3  
  
/* FILE CHARACTERISTICS */  
RECORD_TYPE             = FIXED_LENGTH  
RECORD_BYTES            = 131356  
FILE_RECORDS            = 72  
  
/* POINTERS TO DATA OBJECTS */  
^TABLE                  = "SGS_1_10500_12000_00.DAT"  
  
/* IDENTIFICATION DATA ELEMENTS */  
DATA_SET_NAME           = "ODY MARS GAMMA RAY SPECTROMETER 5 SGS V1.0"  
DATA_SET_ID             = "ODY-M-GRS-5-SGS-V1.0"  
PRODUCT_ID              = "SUMMED_GAMMA_SPECTRA_1_10500_12000_00"  
PRODUCT_TYPE            = "SUMMED_GAMMA_SPECTRA"  
PRODUCT_VERSION_ID     = "1.0"  
RELEASE_ID              = "0000"  
  
/* DESCRIPTIVE DATA ELEMENTS */  
INSTRUMENT_HOST_NAME    = "2001 MARS ODYSSEY"  
INSTRUMENT_NAME         = "GAMMA RAY SPECTROMETER"  
SPACECRAFT_ID           = ODY  
TARGET_NAME             = MARS  
MISSION_PHASE_NAME      = MAPPING  
START_TIME              = 2002-12-07T08:38:21.142  
STOP_TIME               = 2003-01-08T22:58:23.239  
START_SOLAR_LONGITUDE   = 105  
STOP_SOLAR_LONGITUDE    = 120  
SPACECRAFT_CLOCK_START_COUNT = 185271705291  
SPACECRAFT_CLOCK_STOP_COUNT = 185992705411  
PRODUCT_CREATION_TIME   = 2003-09-18T22:45:18.815  
  
/* DATA OBJECT DEFINITION */
```

OBJECT = TABLE

INTERCHANGE_FORMAT = BINARY

ROWS = 72

ROW_BYTES = 131356

/* The complete column definitions are contained in an external file */

/* found in the LABEL directory of the archive disk. */

COLUMNS = 54

^STRUCTURE = "SUMMED_GAMMA_SPECTRA_COLS.FMT"

/* DESCRIPTIVE data elements */

DESCRIPTION = "

The SGS product contains sums of corrected gamma spectra with ancillary data. The data has been summed spatially over a 5 degree by 5 degree grid and temporally over intervals of 15 degrees of solar longitude.

The SGS product data is presented in a tables corresponding to the 36 latitude bands of the 5x5 degree grid.

This file is for the band centered at 87.5 degrees latitude.

Within each band, longitude increases eastward from the cell centered at 2.5 degrees east longitude to the cell centered at 357.5 degrees east longitude.

"

END_OBJECT = TABLE

END

5.2.1. SGS Table Structure

OBJECT = COLUMN

COLUMN_NUMBER = 1

NAME = AREOCENTRIC_LATITUDE

DATA_TYPE = IEEE_REAL

```
BYTES = 4
START_BYTE = 1
DESCRIPTION = "
Centerpoint areocentric latitude.
"
END_OBJECT = COLUMN
```

```
OBJECT = COLUMN
COLUMN_NUMBER = 2
NAME = AREOCENTRIC_EAST_LONGITUDE
DATA_TYPE = IEEE_REAL
BYTES = 4
START_BYTE = 5
DESCRIPTION = "
Centerpoint areocentric east longitude.
"
END_OBJECT = COLUMN
```

```
OBJECT = COLUMN
COLUMN_NUMBER = 3
NAME = UTC_START_TIME
DATA_TYPE = CHARACTER
BYTES = 23
START_BYTE = 9
DESCRIPTION = "
UTC time of first spectrum in sum.
"
END_OBJECT = COLUMN
```

```
OBJECT = COLUMN
COLUMN_NUMBER = 4
NAME = UTC_STOP_TIME
DATA_TYPE = CHARACTER
BYTES = 23
START_BYTE = 32
DESCRIPTION = "
UTC time of last spectrum in sum.
"
END_OBJECT = COLUMN
```

```
OBJECT = COLUMN
```

```
COLUMN_NUMBER = 5
NAME = SC_START_TIME
DATA_TYPE = IEEE_REAL
BYTES = 8
START_BYTE = 55
DESCRIPTION = "
Time of first spectrum in sum, in units of spacecraft clock ticks (256
per second).
```

```
"
```

```
END_OBJECT = COLUMN
```

```
OBJECT = COLUMN
COLUMN_NUMBER = 6
NAME = SC_STOP_TIME
DATA_TYPE = IEEE_REAL
BYTES = 8
START_BYTE = 63
DESCRIPTION = "
Time of last spectrum in sum, in units of spacecraft clock ticks (256
per second).
```

```
"
```

```
END_OBJECT = COLUMN
```

```
OBJECT = COLUMN
COLUMN_NUMBER = 7
NAME = CLOCK_TIME
DATA_TYPE = IEEE_REAL
BYTES = 8
START_BYTE = 71
UNIT = MILLISECOND
DESCRIPTION = "
Sum of pixel durations.
```

```
"
```

```
END_OBJECT = COLUMN
```

```
OBJECT = COLUMN
COLUMN_NUMBER = 8
NAME = RECORD_COUNT
DATA_TYPE = IEEE_REAL
BYTES = 8
START_BYTE = 79
```

```
DESCRIPTION = "  
Count of spectra being summed.  
"  
END_OBJECT = COLUMN  
  
OBJECT = COLUMN  
COLUMN_NUMBER = 9  
NAME = BAD_CODE  
DATA_TYPE = MSB_UNSIGNED_INTEGER  
BYTES = 4  
START_BYTE = 87  
DESCRIPTION = "  
Non-zero if any spectra had bad_code set.  
"  
END_OBJECT = COLUMN  
  
OBJECT = COLUMN  
COLUMN_NUMBER = 10  
NAME = LLD_SUM  
DATA_TYPE = IEEE_REAL  
BYTES = 8  
START_BYTE = 91  
DESCRIPTION = "  
Lower level discriminator count sum.  
"  
END_OBJECT = COLUMN  
  
OBJECT = COLUMN  
COLUMN_NUMBER = 11  
NAME = ULD_SUM  
DATA_TYPE = IEEE_REAL  
BYTES = 8  
START_BYTE = 99  
DESCRIPTION = "  
Upper level discriminator count sum.  
"  
END_OBJECT = COLUMN  
  
OBJECT = COLUMN  
COLUMN_NUMBER = 12  
NAME = L1_SUM
```

```
DATA_TYPE = IEEE_REAL
BYTES = 8
START_BYTE = 107
DESCRIPTION = "
Sum of counts within the L1 energy range.
"
END_OBJECT = COLUMN
```

```
OBJECT = COLUMN
COLUMN_NUMBER = 13
NAME = L2_SUM
DATA_TYPE = IEEE_REAL
BYTES = 8
START_BYTE = 115
DESCRIPTION = "
Sum of counts within the L2 energy range.
"
END_OBJECT = COLUMN
```

```
OBJECT = COLUMN
COLUMN_NUMBER = 14
NAME = L3_SUM
DATA_TYPE = IEEE_REAL
BYTES = 8
START_BYTE = 123
DESCRIPTION = "
Sum of counts within the L3 energy range.
"
END_OBJECT = COLUMN
```

```
OBJECT = COLUMN
COLUMN_NUMBER = 15
NAME = PHA_SUM
DATA_TYPE = IEEE_REAL
BYTES = 8
START_BYTE = 131
DESCRIPTION = "
Sum of Pulse Height Analyzer counter.
"
END_OBJECT = COLUMN
```

OBJECT = COLUMN
COLUMN_NUMBER = 16
NAME = HVBS_MONITOR_MIN
DATA_TYPE = IEEE_REAL
BYTES = 4
START_BYTE = 139
UNIT = VOLT
DESCRIPTION = "
Minimum value of High Voltage Bias Supply Monitor voltage.
"

END_OBJECT = COLUMN

OBJECT = COLUMN
COLUMN_NUMBER = 17
NAME = HVBS_MONITOR_MAX
DATA_TYPE = IEEE_REAL
BYTES = 4
START_BYTE = 143
UNIT = VOLT
DESCRIPTION = "
Maximum value of High Voltage Bias Supply Monitor.
"

END_OBJECT = COLUMN

OBJECT = COLUMN
COLUMN_NUMBER = 18
NAME = HVBS_MONITOR_MEAN
DATA_TYPE = IEEE_REAL
BYTES = 4
START_BYTE = 147
UNIT = VOLT
DESCRIPTION = "
Mean value of High Voltage Bias Supply Monitor.
"

END_OBJECT = COLUMN

OBJECT = COLUMN
COLUMN_NUMBER = 19
NAME = HVBS_MONITOR_STD
DATA_TYPE = IEEE_REAL
BYTES = 4

START_BYTE = 151
UNIT = VOLT
DESCRIPTION = "
Standard Deviation of High Voltage Bias Supply Monitor.
"

END_OBJECT = COLUMN

OBJECT = COLUMN
COLUMN_NUMBER = 20
NAME = IS_TEMP_A_MIN
DATA_TYPE = IEEE_REAL
BYTES = 4
START_BYTE = 155
UNIT = CELSIUS
DESCRIPTION = "
Minimum value of Inner Stage temperature A.
"

END_OBJECT = COLUMN

OBJECT = COLUMN
COLUMN_NUMBER = 21
NAME = IS_TEMP_A_MAX
DATA_TYPE = IEEE_REAL
BYTES = 4
START_BYTE = 159
UNIT = CELSIUS
DESCRIPTION = "
Maximum value of Inner Stage temperature A.
"

END_OBJECT = COLUMN

OBJECT = COLUMN
COLUMN_NUMBER = 22
NAME = IS_TEMP_A_MEAN
DATA_TYPE = IEEE_REAL
BYTES = 4
START_BYTE = 163
UNIT = CELSIUS
DESCRIPTION = "
Mean value of Inner Stage temperature A.
"

END_OBJECT = COLUMN

OBJECT = COLUMN

COLUMN_NUMBER = 23

NAME = IS_TEMP_A_STD

DATA_TYPE = IEEE_REAL

BYTES = 4

START_BYTE = 167

UNIT = CELSIUS

DESCRIPTION = "

Standard Deviation of Inner Stage temperature A.

"

END_OBJECT = COLUMN

OBJECT = COLUMN

COLUMN_NUMBER = 24

NAME = IS_TEMP_B_MIN

DATA_TYPE = IEEE_REAL

BYTES = 4

START_BYTE = 171

UNIT = CELSIUS

DESCRIPTION = "

Minimum value of Inner Stage temperature B.

"

END_OBJECT = COLUMN

OBJECT = COLUMN

COLUMN_NUMBER = 25

NAME = IS_TEMP_B_MAX

DATA_TYPE = IEEE_REAL

BYTES = 4

START_BYTE = 175

UNIT = CELSIUS

DESCRIPTION = "

Maximum value of Inner Stage temperature B.

"

END_OBJECT = COLUMN

OBJECT = COLUMN

COLUMN_NUMBER = 26

NAME = IS_TEMP_B_MEAN

```
DATA_TYPE = IEEE_REAL
BYTES = 4
START_BYTE = 179
UNIT = CELSIUS
DESCRIPTION = "
Mean value of Inner Stage temperature B.
"
END_OBJECT = COLUMN

OBJECT = COLUMN
COLUMN_NUMBER = 27
NAME = IS_TEMP_B_STD
DATA_TYPE = IEEE_REAL
BYTES = 4
START_BYTE = 183
UNIT = CELSIUS
DESCRIPTION = "
Standard Deviation of Inner Stage temperature B.
"
END_OBJECT = COLUMN

OBJECT = COLUMN
COLUMN_NUMBER = 28
NAME = OS_TEMP_A_MIN
DATA_TYPE = IEEE_REAL
BYTES = 4
START_BYTE = 187
UNIT = CELSIUS
DESCRIPTION = "
Minimum value of Outer Stage temperature A.
"
END_OBJECT = COLUMN

OBJECT = COLUMN
COLUMN_NUMBER = 29
NAME = OS_TEMP_A_MAX
DATA_TYPE = IEEE_REAL
BYTES = 4
START_BYTE = 191
UNIT = CELSIUS
DESCRIPTION = "
```

Maximum value of Outer Stage temperature A.

"

END_OBJECT = COLUMN

OBJECT = COLUMN

COLUMN_NUMBER = 30

NAME = OS_TEMP_A_MEAN

DATA_TYPE = IEEE_REAL

BYTES = 4

START_BYTE = 195

UNIT = CELSIUS

DESCRIPTION = "

Mean value of Outer Stage temperature A.

"

END_OBJECT = COLUMN

OBJECT = COLUMN

COLUMN_NUMBER = 31

NAME = OS_TEMP_A_STD

DATA_TYPE = IEEE_REAL

BYTES = 4

START_BYTE = 199

UNIT = CELSIUS

DESCRIPTION = "

Standard Deviation of Outer Stage temperature A.

"

END_OBJECT = COLUMN

OBJECT = COLUMN

COLUMN_NUMBER = 32

NAME = OS_TEMP_B_MIN

DATA_TYPE = IEEE_REAL

BYTES = 4

START_BYTE = 203

UNIT = CELSIUS

DESCRIPTION = "

Minimum value of Outer Stage temperature B.

"

END_OBJECT = COLUMN

OBJECT = COLUMN

```
COLUMN_NUMBER = 33
NAME = OS_TEMP_B_MAX
DATA_TYPE = IEEE_REAL
BYTES = 4
START_BYTE = 207
UNIT = CELSIUS
DESCRIPTION = "
Maximum value of Outer Stage temperature B.
"
END_OBJECT = COLUMN
```

```
OBJECT = COLUMN
COLUMN_NUMBER = 34
NAME = OS_TEMP_B_MEAN
DATA_TYPE = IEEE_REAL
BYTES = 4
START_BYTE = 211
UNIT = CELSIUS
DESCRIPTION = "
Mean value of Outer Stage temperature B.
"
END_OBJECT = COLUMN
```

```
OBJECT = COLUMN
COLUMN_NUMBER = 35
NAME = OS_TEMP_B_STD
DATA_TYPE = IEEE_REAL
BYTES = 4
START_BYTE = 215
UNIT = CELSIUS
DESCRIPTION = "
Standard Deviation of Outer Stage temperature B.
"
END_OBJECT = COLUMN
```

```
OBJECT = COLUMN
COLUMN_NUMBER = 36
NAME = B170K_TEMP_MIN
DATA_TYPE = IEEE_REAL
BYTES = 4
START_BYTE = 219
```

UNIT = CELSIUS
DESCRIPTION = "
Minimum value of 170K card temperature.
"

END_OBJECT = COLUMN

OBJECT = COLUMN
COLUMN_NUMBER = 37
NAME = B170K_TEMP_MAX
DATA_TYPE = IEEE_REAL
BYTES = 4
START_BYTE = 223
UNIT = CELSIUS
DESCRIPTION = "
Maximum value of 170K card temperature.
"

END_OBJECT = COLUMN

OBJECT = COLUMN
COLUMN_NUMBER = 38
NAME = B170K_TEMP_MEAN
DATA_TYPE = IEEE_REAL
BYTES = 4
START_BYTE = 227
UNIT = CELSIUS
DESCRIPTION = "
Mean value of 170K card temperature.
"

END_OBJECT = COLUMN

OBJECT = COLUMN
COLUMN_NUMBER = 39
NAME = B170K_TEMP_STD
DATA_TYPE = IEEE_REAL
BYTES = 4
START_BYTE = 231
UNIT = CELSIUS
DESCRIPTION = "
Standard Deviation of 170K card temperature.
"

END_OBJECT = COLUMN

OBJECT = COLUMN
COLUMN_NUMBER = 40
NAME = GPA_TEMP_MIN
DATA_TYPE = IEEE_REAL
BYTES = 4
START_BYTE = 235
UNIT = CELSIUS
DESCRIPTION = "
Minimum value of Gamma Pulser Analyzer temperature.
"
END_OBJECT = COLUMN

OBJECT = COLUMN
COLUMN_NUMBER = 41
NAME = GPA_TEMP_MAX
DATA_TYPE = IEEE_REAL
BYTES = 4
START_BYTE = 239
UNIT = CELSIUS
DESCRIPTION = "
Maximum value of Gamma Pulser Analyzer temperature.
"
END_OBJECT = COLUMN

OBJECT = COLUMN
COLUMN_NUMBER = 42
NAME = GPA_TEMP_MEAN
DATA_TYPE = IEEE_REAL
BYTES = 4
START_BYTE = 243
UNIT = CELSIUS
DESCRIPTION = "
Mean value of Gamma Pulser Analyzer temperature.
"
END_OBJECT = COLUMN

OBJECT = COLUMN
COLUMN_NUMBER = 43
NAME = GPA_TEMP_STD
DATA_TYPE = IEEE_REAL

BYTES = 4
START_BYTE = 247
UNIT = CELSIUS
DESCRIPTION = "
Standard Deviation of Gamma Pulser Analyzer temperature.
"
END_OBJECT = COLUMN

OBJECT = COLUMN
COLUMN_NUMBER = 44
NAME = GAMMA_VREF_TEMP_MIN
DATA_TYPE = IEEE_REAL
BYTES = 4
START_BYTE = 251
UNIT = CELSIUS
DESCRIPTION = "
Minimum value of Gamma V Reference temperature.
"
END_OBJECT = COLUMN

OBJECT = COLUMN
COLUMN_NUMBER = 45
NAME = GAMMA_VREF_TEMP_MAX
DATA_TYPE = IEEE_REAL
BYTES = 4
START_BYTE = 255
UNIT = CELSIUS
DESCRIPTION = "
Maximum value of Gamma V Reference temperature.
"
END_OBJECT = COLUMN

OBJECT = COLUMN
COLUMN_NUMBER = 46
NAME = GAMMA_VREF_TEMP_MEAN
DATA_TYPE = IEEE_REAL
BYTES = 4
START_BYTE = 259
UNIT = CELSIUS
DESCRIPTION = "
Mean value of Gamma V Reference temperature.

```
"
END_OBJECT = COLUMN

OBJECT = COLUMN
COLUMN_NUMBER = 47
NAME = GAMMA_VREF_TEMP_STD
DATA_TYPE = IEEE_REAL
BYTES = 4
START_BYTE = 263
UNIT = CELSIUS
DESCRIPTION = "
Standard Deviation of Gamma V Reference temperature.
"
END_OBJECT = COLUMN

OBJECT = COLUMN
COLUMN_NUMBER = 48
NAME = APPS_GAIN_DHK_DEFAULT
DATA_TYPE = MSB_UNSIGNED_INTEGER
BYTES = 2
START_BYTE = 267
DESCRIPTION = "
Default value of APPS gain.
"
END_OBJECT = COLUMN

OBJECT = COLUMN
COLUMN_NUMBER = 49
NAME = APPS_GAIN_DHK_MIN
DATA_TYPE = MSB_UNSIGNED_INTEGER
BYTES = 2
START_BYTE = 269
DESCRIPTION = "
Minimum value of APPS gain.
"
END_OBJECT = COLUMN

OBJECT = COLUMN
COLUMN_NUMBER = 50
NAME = APPS_GAIN_DHK_MAX
DATA_TYPE = MSB_UNSIGNED_INTEGER
```

```
BYTES = 2
START_BYTE = 271
DESCRIPTION = "
Maximum value of APPS gain.
"
END_OBJECT = COLUMN
```

```
OBJECT = COLUMN
COLUMN_NUMBER = 51
NAME = GAIN_MEAN
DATA_TYPE = IEEE_REAL
BYTES = 4
START_BYTE = 273
DESCRIPTION = "
Mean value of gain corrections.
"
END_OBJECT = COLUMN
```

```
OBJECT = COLUMN
COLUMN_NUMBER = 52
NAME = OFFSET_MEAN
DATA_TYPE = IEEE_REAL
BYTES = 4
START_BYTE = 277
DESCRIPTION = "
Mean value of offset corrections.
"
END_OBJECT = COLUMN
```

```
OBJECT = COLUMN
COLUMN_NUMBER = 53
NAME = FIRST_CHANNEL_MAX
DATA_TYPE = MSB_UNSIGNED_INTEGER
BYTES = 2
START_BYTE = 281
DESCRIPTION = "
Maximum first valid channel in the spectrum.
"
END_OBJECT = COLUMN
```

```
OBJECT = COLUMN
```

```

COLUMN_NUMBER = 54
NAME = LAST_CHANNEL_MIN
DATA_TYPE = MSB_UNSIGNED_INTEGER
BYTES = 2
START_BYTE = 283
DESCRIPTION = "
Minimum last valid channel in the spectrum.
"
END_OBJECT = COLUMN

```

```

OBJECT = COLUMN
COLUMN_NUMBER = 55
NAME = GAMMA_SPECTRUM
DATA_TYPE = IEEE_REAL
BYTES = 131072
START_BYTE = 285
ITEMS = 16384
ITEM_BYTES = 8
DESCRIPTION = "
Corrected gamma spectrum, float value for each channel.
"
END_OBJECT = COLUMN

```

5.3. EXAMPLE : DND Label

```
PDS_VERSION_ID      = PDS3
```

```
/* FILE CHARACTERISTICS */
```

```
RECORD_TYPE         = FIXED_LENGTH
RECORD_BYTES        = 256
FILE_RECORDS        = 2879
```

```
/* POINTERS TO DATA OBJECTS */
```

```
^TIME_SERIES        = "DND_20020220.DAT"
```

```
/* IDENTIFICATION DATA ELEMENTS */
```

```
DATA_SET_NAME       = "ODY MARS GAMMA RAY SPECTROMETER 4 DND V1.0"
DATA_SET_ID         = "ODY-M-GRS-4-DND-V1.0"
PRODUCT_ID          = "DND_20020220"
PRODUCT_TYPE        = "DERIVED_NEUTRON_DATA"
PRODUCT_VERSION_ID  = "1.0"
RELEASE_ID          = "0008"
```

/* DESCRIPTIVE DATA ELEMENTS */

INSTRUMENT_HOST_NAME = "2001 MARS ODYSSEY"
 INSTRUMENT_NAME = "GAMMA RAY SPECTROMETER"
 SPACECRAFT_ID = ODY
 TARGET_NAME = MARS
 MISSION_PHASE_NAME = MAPPING
 START_TIME = 2002-02-20T00:00:01.475
 STOP_TIME = 2002-02-20T23:58:43.086
 SPACECRAFT_CLOCK_START_COUNT = 178849402044
 SPACECRAFT_CLOCK_STOP_COUNT = 178871500407
 PRODUCT_CREATION_TIME = 2004-05-14T21:20:43.409

/* DATA OBJECT DEFINITION */

OBJECT = TIME_SERIES

INTERCHANGE_FORMAT = BINARY
 ROWS = 2879
 ROW_BYTES = 256

SAMPLING_PARAMETER_NAME = TIME
 SAMPLING_PARAMETER_UNIT = TICKS
 SAMPLING_PARAMETER_INTERVAL = "N/A"

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

COLUMNS = 53
 ^STRUCTURE = "DERIV_NEUTRON_DATA_COLS.FMT"

/* DESCRIPTIVE data elements */

DESCRIPTION = "

The DND product contains normalized neutron counting rates for all four of the Neutron Spectrometer prisms, from which thermal and epithermal neutron count rates are determined.

Thermal and epithermal count rates are included in the data set.

Background-corrected and normalized fast counting data are also provided for the nadir-looking prism (Prism 1). The data is presented in a table format with one row of data for each NS collection interval within a 24 Earth hour period. The DND data can be used along with models and calibration

procedures described in the literature [Feldman et al., 2003; Prettyman et al., 2004] to study the composition and structure of the surface and atmosphere of Mars on sub-seasonal time scales.

"

END_OBJECT = TIME_SERIES

END

5.3.1. DND Table Structure

OBJECT = COLUMN

COLUMN_NUMBER = 1

NAME = SC_RECV_TIME

DATA_TYPE = MSB_UNSIGNED_INTEGER

BYTES = 8

START_BYTE = 1

DESCRIPTION = "

The time this packet was received by the spacecraft, in ticks (256 per second).

"

END_OBJECT = COLUMN

OBJECT = COLUMN

COLUMN_NUMBER = 2

NAME = CEB_TIME

DATA_TYPE = MSB_UNSIGNED_INTEGER

BYTES = 8

START_BYTE = 9

DESCRIPTION = "

Clock count from the GRS Common Electronics Box at the beginning of the pixel.

"

END_OBJECT = COLUMN

OBJECT = COLUMN

COLUMN_NUMBER = 3

NAME = UTC
DATA_TYPE = CHARACTER
BYTES = 23
START_BYTE = 17
DESCRIPTION = "
Time at the middle of the collection interval converted to UTC, stored
as yyyy-mm-ddThh:mm:ss.sss.
"
END_OBJECT = COLUMN

OBJECT = COLUMN
COLUMN_NUMBER = 4
NAME = GRS_PIXEL_NUMBER
DATA_TYPE = MSB_UNSIGNED_INTEGER
BYTES = 4
START_BYTE = 40
INVALID_CONSTANT = 0
DESCRIPTION = "
Sequential counter of accumulation intervals, starts with one as grs
orbit begins. Special case on reboot when the the CEB is in orbit 0,
pixel 0.
"
END_OBJECT = COLUMN

OBJECT = COLUMN
COLUMN_NUMBER = 5
NAME = GRS_ORBIT_NUMBER
DATA_TYPE = MSB_UNSIGNED_INTEGER
BYTES = 4
START_BYTE = 44
INVALID_CONSTANT = 0
DESCRIPTION = "
Sequential counter of orbits from GRS CEB boot.
"

END_OBJECT = COLUMN

OBJECT = COLUMN

COLUMN_NUMBER = 6

NAME = ODY_ORBIT_NUMBER

DATA_TYPE = MSB_UNSIGNED_INTEGER

BYTES = 4

START_BYTE = 48

INVALID_CONSTANT = 0

DESCRIPTION = "

Orbit number common to all instruments aboard Odyssey. This orbit number is incremented by one as the spacecraft passes through the orbital descending node.

"

END_OBJECT = COLUMN

OBJECT = COLUMN

COLUMN_NUMBER = 7

NAME = AREOCENTRIC_LATITUDE

DATA_TYPE = IEEE_REAL

BYTES = 4

START_BYTE = 52

UNIT = DEGREE

DESCRIPTION = "

Sub spacecraft latitude in Mars fixed coordinates at the middle of the collection interval.

"

END_OBJECT = COLUMN

OBJECT = COLUMN

COLUMN_NUMBER = 8

NAME = AREOCENTRIC_EAST_LONGITUDE

DATA_TYPE = IEEE_REAL

BYTES = 4

START_BYTE = 56

UNIT = DEGREE

DESCRIPTION = "

Sub spacecraft longitude in Mars fixed coordinates at the middle of the collection interval. Longitude increases towards the East.

"

END_OBJECT = COLUMN

OBJECT = COLUMN

COLUMN_NUMBER = 9

NAME = ALTITUDE

DATA_TYPE = IEEE_REAL

BYTES = 4

START_BYTE = 60

UNIT = KILOMETER

DESCRIPTION = "

Areocentric altitude of the sub-spacecraft point in Mars-fixed rotating frame at the middle of the collection interval.

"

END_OBJECT = COLUMN

OBJECT = COLUMN

COLUMN_NUMBER = 10

NAME = SCPOS_INERT

DATA_TYPE = IEEE_REAL

BYTES = 12

START_BYTE = 64

UNIT = KILOMETER

ITEMS = 3

ITEM_BYTES = 4

DESCRIPTION = "

The geometric position (x,y,z) of the spacecraft with respect to Mars in the 'MARSIAU' IAU2000 reference system inertial frame at the input epoch 'et' at the middle of the pixel.

"
END_OBJECT = COLUMN

OBJECT = COLUMN
COLUMN_NUMBER = 11
NAME = SCVEL_INERT
DATA_TYPE = IEEE_REAL
BYTES = 12
START_BYTE = 76
UNIT = "KILOMETER/SECOND"
ITEMS = 3
ITEM_BYTES = 4
DESCRIPTION = "

The geometric velocity (x,y,z) of the spacecraft with respect to Mars in the 'MARSIAU' IAU2000 reference system inertial frame at the input epoch 'et' at the middle of the pixel.

"
END_OBJECT = COLUMN

OBJECT = COLUMN
COLUMN_NUMBER = 12
NAME = MARSPOS_INSTR
DATA_TYPE = IEEE_REAL
BYTES = 12
START_BYTE = 88
UNIT = KILOMETER
ITEMS = 3
ITEM_BYTES = 4
DESCRIPTION = "

The (x,y,z) position of the sub-spacecraft point as seen from the spacecraft in the instrument frame at the middle of the collection interval. If no spacecraft orientation data was available from the loaded CK files for the request time, then all elements of are set to zero.

```
"
END_OBJECT = COLUMN

OBJECT = COLUMN
COLUMN_NUMBER = 13
NAME = MARSVEL_INSTR
DATA_TYPE = IEEE_REAL
BYTES = 12
START_BYTE = 100
UNIT = "KILOMETER/SECOND"
ITEMS = 3
ITEM_BYTES = 4
DESCRIPTION = "
  Contains the inertial spacecraft velocity direction (x,y,z) rotated to
  the instrument frame at the middle of the collection 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 = 14
NAME = DAY_INDEX
DATA_TYPE = MSB_UNSIGNED_INTEGER
BYTES = 2
START_BYTE = 112
DESCRIPTION = "
  Day of Martian year.
"
END_OBJECT = COLUMN

OBJECT = COLUMN
COLUMN_NUMBER = 15
NAME = LOCAL_HOUR
```

DATA_TYPE = MSB_UNSIGNED_INTEGER
BYTES = 2
START_BYTE = 114
DESCRIPTION = "
Local Sun hour at the sub-spacecraft point.
"
END_OBJECT = COLUMN

OBJECT = COLUMN
COLUMN_NUMBER = 16
NAME = LOCAL_MINUTE
DATA_TYPE = MSB_UNSIGNED_INTEGER
BYTES = 2
START_BYTE = 116
DESCRIPTION = "
Local Sun minute at the sub-spacecraft point.
"
END_OBJECT = COLUMN

OBJECT = COLUMN
COLUMN_NUMBER = 17
NAME = PIXEL_DURATION
DATA_TYPE = IEEE_REAL
BYTES = 4
START_BYTE = 118
UNIT = SECOND
DESCRIPTION = "
Length of the collection interval in seconds.
"
END_OBJECT = COLUMN

OBJECT = COLUMN
COLUMN_NUMBER = 18
NAME = POWER_SUPPLY

```
DATA_TYPE = MSB_UNSIGNED_INTEGER
BYTES = 2
START_BYTE = 122
DESCRIPTION = "
Which power supply is being used, 1 or 2.
"
END_OBJECT = COLUMN
```

```
OBJECT = COLUMN
COLUMN_NUMBER = 19
NAME = SWAP_FLAG
DATA_TYPE = MSB_UNSIGNED_INTEGER
BYTES = 2
START_BYTE = 124
DESCRIPTION = "
The state of the prompt/delayed swap flag.
"
END_OBJECT = COLUMN
```

```
OBJECT = COLUMN
COLUMN_NUMBER = 20
NAME = POWER_LEVEL
DATA_TYPE = MSB_UNSIGNED_INTEGER
BYTES = 2
START_BYTE = 126
DESCRIPTION = "
The power level of the power supply in use during the collection
interval, 1 being highest power and 7 being lowest power.
"
END_OBJECT = COLUMN
```

```
OBJECT = COLUMN
COLUMN_NUMBER = 21
NAME = DIRECTION
```

DATA_TYPE = MSB_UNSIGNED_INTEGER
BYTES = 1
START_BYTE = 128
DESCRIPTION = "
Direction of spacecraft travel N(1) or S(0).
"
END_OBJECT = COLUMN

OBJECT = COLUMN
COLUMN_NUMBER = 22
NAME = LIVETIME
DATA_TYPE = IEEE_REAL
BYTES = 4
START_BYTE = 129
UNIT = SECOND
DESCRIPTION = "
In seconds, duration - deadtime, where deadtime = dead_cnt * .000512
sec.
"
END_OBJECT = COLUMN

OBJECT = COLUMN
COLUMN_NUMBER = 23
NAME = DEADTIME_PERCENT
DATA_TYPE = IEEE_REAL
BYTES = 4
START_BYTE = 133
DESCRIPTION = "
Deadtime / duration.
"
END_OBJECT = COLUMN

OBJECT = COLUMN
COLUMN_NUMBER = 24

NAME = OVERLOAD_RATE

DATA_TYPE = IEEE_REAL

BYTES = 4

START_BYTE = 137

DESCRIPTION = "

The OVERLOAD_RATE gives an estimate of the flux of charged particles that deposit energies greater than about 2.6 MeV. The OVERLOAD_RATE is determined by dividing the EDR GCR_CNT field by 110 cm², which is the average projected area of the spectrometer, and by the collection interval duration (DND PIXEL_DURATION field). The units are centimeters squared per second. Note that the GCR_CNT field gives the number of overload events during a collection interval, corresponding to events that produce greater than 2.6 MeV equivalent light output. While these events can be caused by gamma rays and neutrons, most are associated with energetic particles. When the OVERLOAD_RATE is lowest, overload events are dominated by galactic cosmic rays, in which case the OVERLOAD_RATE gives an estimate of the galactic cosmic ray flux. The OVERLOAD_RATE is primarily used to identify periods of high count rate, which corresponding to energetic particle events. Such events are filtered from the DND data set by the processing algorithms.

"

END_OBJECT = COLUMN

OBJECT = COLUMN

COLUMN_NUMBER = 25

NAME = HVPS_MNTR_2

DATA_TYPE = IEEE_REAL

BYTES = 4

START_BYTE = 141

UNIT = VOLT

DESCRIPTION = "

The value of the High Voltage Power Supply Monitor 2 at the mid point of the collection interval that has been smoothed with a Gaussian weighted smoothing algorithm over 30 HVPS_MNTR_2 measurements and

interpolated to the time at the middle of the NS collection interval from the HVPS_MNTR_2 engineering measurement that happens just before the NS collection interval and the one just after the NS collection interval.

"

END_OBJECT = COLUMN

OBJECT = COLUMN

COLUMN_NUMBER = 26

NAME = LAT_1

DATA_TYPE = IEEE_REAL

BYTES = 4

START_BYTE = 145

UNIT = DEGREE

DESCRIPTION = "

Latitude in degrees to be associated with CAT1, Prism 1 count rate and error

"

END_OBJECT = COLUMN

OBJECT = COLUMN

COLUMN_NUMBER = 27

NAME = LON_1

DATA_TYPE = IEEE_REAL

BYTES = 4

START_BYTE = 149

UNIT = DEGREE

DESCRIPTION = "

Longitude in degrees to be associated with CAT1, Prism 1 count rate and error

"

END_OBJECT = COLUMN

OBJECT = COLUMN

COLUMN_NUMBER = 28
NAME = LAT_4_5
DATA_TYPE = IEEE_REAL
BYTES = 4
START_BYTE = 153
UNIT = DEGREE
DESCRIPTION = "
Latitude in degrees to be associated with the thermal count rate and
error
"
END_OBJECT = COLUMN

OBJECT = COLUMN
COLUMN_NUMBER = 29
NAME = LON_4_5
DATA_TYPE = IEEE_REAL
BYTES = 4
START_BYTE = 157
UNIT = DEGREE
DESCRIPTION = "
Longitude in degrees to be associated with the thermal count rate and
error
"
END_OBJECT = COLUMN

OBJECT = COLUMN
COLUMN_NUMBER = 30
NAME = CAT1_PRISM1_PEAK_AREA
DATA_TYPE = IEEE_REAL
BYTES = 4
START_BYTE = 161
DESCRIPTION = "
The counting rate given by the area in the $^{10}\text{B}(n,\alpha)^7\text{Li}$ reaction
peak above background registered by prism 1, in units of s^{-1} . The

counting rate as measured is normalized by the ratio of the average Cat1 Prism1 counting rate averaged over all transits between +30 degrees and -30 degrees latitude measured within +0.5 and -0.5 days of the current data point. This counting rate is also the epithermal neutron counting rate.

"

END_OBJECT = COLUMN

OBJECT = COLUMN

COLUMN_NUMBER = 31

NAME = CAT1_PRISM1_ERROR

DATA_TYPE = IEEE_REAL

BYTES = 4

START_BYTE = 165

DESCRIPTION = "

The 1-sigma statistical error of the CAT1_PRISM1_PEAK_AREA (counts/s).

"

END_OBJECT = COLUMN

OBJECT = COLUMN

COLUMN_NUMBER = 32

NAME = CAT1_PRISM2_PEAK_AREA

DATA_TYPE = IEEE_REAL

BYTES = 4

START_BYTE = 169

DESCRIPTION = "

The counting rate given by the area in the $^{10}\text{B}(n,\alpha)^7\text{Li}$ reaction peak above background registered by prism 2, in units of s^{-1} . The counting rate as measured is normalized by the ratio of the average Cat1 Prism2 counting rate averaged over all transits between +30 degrees and -30 degrees latitude measured within +0.5 and -0.5 days of the current data point.

"

END_OBJECT = COLUMN

```
OBJECT = COLUMN
COLUMN_NUMBER = 33
NAME = CAT1_PRISM2_ERROR
DATA_TYPE = IEEE_REAL
BYTES = 4
START_BYTE = 173
DESCRIPTION = "
The 1-sigma statistical error of the CAT1_PRISM2_PEAK_AREA (counts/s).
"
END_OBJECT = COLUMN
```

```
OBJECT = COLUMN
COLUMN_NUMBER = 34
NAME = CAT1_PRISM3_PEAK_AREA
DATA_TYPE = IEEE_REAL
BYTES = 4
START_BYTE = 177
DESCRIPTION = "
The counting rate given by the area in the  $^{10}\text{B}(n,\alpha)^7\text{Li}$  reaction
peak above background registered by prism 3, in units of  $\text{s}^{-1}$ . The
counting rate as measured is normalized by the ratio of the average
Cat1 Prism3 counting rate averaged over all transits between +30
degrees and -30 degrees latitude measured within +0.5 and -0.5 days of
the current data point.
"
END_OBJECT = COLUMN
```

```
OBJECT = COLUMN
COLUMN_NUMBER = 35
NAME = CAT1_PRISM3_ERROR
DATA_TYPE = IEEE_REAL
BYTES = 4
START_BYTE = 181
```

DESCRIPTION = "

The 1-sigma statistical error of the CAT1_PRISM3_PEAK_AREA (counts/s).

"

END_OBJECT = COLUMN

OBJECT = COLUMN

COLUMN_NUMBER = 36

NAME = CAT1_PRISM4_PEAK_AREA

DATA_TYPE = IEEE_REAL

BYTES = 4

START_BYTE = 185

DESCRIPTION = "

The counting rate given by the area in the $^{10}\text{B}(n,\alpha)^7\text{Li}$ reaction peak above background registered by prism 4, in units of s^{-1} . The counting rate as measured is normalized by the ratio of the average Cat1 Prism4 counting rate averaged over all transits between +30 degrees and -30 degrees latitude measured within +0.5 and -0.5 days of the current data point.

"

END_OBJECT = COLUMN

OBJECT = COLUMN

COLUMN_NUMBER = 37

NAME = CAT1_PRISM4_ERROR

DATA_TYPE = IEEE_REAL

BYTES = 4

START_BYTE = 189

DESCRIPTION = "

The 1-sigma statistical error of the CAT1_PRISM4_PEAK_AREA (counts/s).

"

END_OBJECT = COLUMN

OBJECT = COLUMN

COLUMN_NUMBER = 38

NAME = CAT2_PRISM1_FAST_SUM

DATA_TYPE = IEEE_REAL

BYTES = 4

START_BYTE = 193

DESCRIPTION = "

The sum of the counting rate in the lowest two channels of the
[(early-time) - (late time)] fast-neutron histograms, in units of s^{-1} .

The counting rate as measured is normalized by the ratio of the average
CAT2_PRISM1_FAST_SUM counting rate averaged over all transits between
+30 degrees and -30 degrees latitude measured within +0.5 and -0.5 days
of the current data point.

"

END_OBJECT = COLUMN

OBJECT = COLUMN

COLUMN_NUMBER = 39

NAME = CAT2_PRISM1_ERROR

DATA_TYPE = IEEE_REAL

BYTES = 4

START_BYTE = 197

DESCRIPTION = "

The 1-sigma statistical error of the CAT2_PRISM1_FAST_SUM (counts/s).

"

END_OBJECT = COLUMN

OBJECT = COLUMN

COLUMN_NUMBER = 40

NAME = THERMAL_COUNT_RATE

DATA_TYPE = IEEE_REAL

BYTES = 4

START_BYTE = 201

DESCRIPTION = "

The difference between CAT1_PRISM2_Peak_Area and CAT1_PRISM4_Peak_Area,
in units of s^{-1} . The counting rate as measured is normalized by the

ratio of the Thermal Count Rate averaged over all transits between +30 degrees and -30 degrees latitude measured within +0.5 and -0.5 days of the current data point.

"

END_OBJECT = COLUMN

OBJECT = COLUMN

COLUMN_NUMBER = 41

NAME = THERMAL_ERROR

DATA_TYPE = IEEE_REAL

BYTES = 4

START_BYTE = 205

DESCRIPTION = "

The 1-sigma statistical error of the THERMAL_COUNT_RATE (counts/s)

"

END_OBJECT = COLUMN

OBJECT = COLUMN

COLUMN_NUMBER = 42

NAME = CAT1_PRISM1_NORM_SLOPE

DATA_TYPE = IEEE_REAL

BYTES = 4

START_BYTE = 209

DESCRIPTION = "

The slope parameter for the bellyband normalization for the CAT1_PRISM1_PEAK_AREA.

"

END_OBJECT = COLUMN

OBJECT = COLUMN

COLUMN_NUMBER = 43

NAME = CAT1_PRISM1_NORM_OFFSET

DATA_TYPE = IEEE_REAL

BYTES = 4

START_BYTE = 213
DESCRIPTION = "
The offset parameter for the bellyband normalization for the
CAT1_PRISM1_PEAK_AREA.
"
END_OBJECT = COLUMN

OBJECT = COLUMN
COLUMN_NUMBER = 44
NAME = CAT1_PRISM2_NORM_SLOPE
DATA_TYPE = IEEE_REAL
BYTES = 4
START_BYTE = 217
DESCRIPTION = "
The slope parameter for the bellyband normalization for the
CAT1_PRISM2_PEAK_AREA.
"
END_OBJECT = COLUMN

OBJECT = COLUMN
COLUMN_NUMBER = 45
NAME = CAT1_PRISM2_NORM_OFFSET
DATA_TYPE = IEEE_REAL
BYTES = 4
START_BYTE = 221
DESCRIPTION = "
The offset parameter for the bellyband normalization for the
CAT1_PRISM2_PEAK_AREA.
"
END_OBJECT = COLUMN

OBJECT = COLUMN
COLUMN_NUMBER = 46
NAME = CAT1_PRISM3_NORM_SLOPE

DATA_TYPE = IEEE_REAL

BYTES = 4

START_BYTE = 225

DESCRIPTION = "

The slope parameter for the bellyband normalization for the
CAT1_PRISM3_PEAK_AREA.

"

END_OBJECT = COLUMN

OBJECT = COLUMN

COLUMN_NUMBER = 47

NAME = CAT1_PRISM3_NORM_OFFSET

DATA_TYPE = IEEE_REAL

BYTES = 4

START_BYTE = 229

DESCRIPTION = "

The offset parameter for the bellyband normalization for the
CAT1_PRISM3_PEAK_AREA.

"

END_OBJECT = COLUMN

OBJECT = COLUMN

COLUMN_NUMBER = 48

NAME = CAT1_PRISM4_NORM_SLOPE

DATA_TYPE = IEEE_REAL

BYTES = 4

START_BYTE = 233

DESCRIPTION = "

The slope parameter for the bellyband normalization for the
CAT1_PRISM4_PEAK_AREA.

"

END_OBJECT = COLUMN

OBJECT = COLUMN

COLUMN_NUMBER = 49

NAME = CAT1_PRISM4_NORM_OFFSET

DATA_TYPE = IEEE_REAL

BYTES = 4

START_BYTE = 237

DESCRIPTION = "

The offset parameter for the bellyband normalization for the
CAT1_PRISM4_PEAK_AREA.

"

END_OBJECT = COLUMN

OBJECT = COLUMN

COLUMN_NUMBER = 50

NAME = CAT2_PRISM1_NORM_SLOPE

DATA_TYPE = IEEE_REAL

BYTES = 4

START_BYTE = 241

DESCRIPTION = "

The slope parameter for the bellyband normalization for the
CAT2_PRISM1_FAST_SUM.

"

END_OBJECT = COLUMN

OBJECT = COLUMN

COLUMN_NUMBER = 51

NAME = CAT2_PRISM1_NORM_OFFSET

DATA_TYPE = IEEE_REAL

BYTES = 4

START_BYTE = 245

DESCRIPTION = "

The offset parameter for the bellyband normalization for the
CAT2_PRISM1_FAST_SUM.

"

END_OBJECT = COLUMN

```
OBJECT = COLUMN
COLUMN_NUMBER = 52
NAME = CF_ATM_EPI
DATA_TYPE = IEEE_REAL
BYTES = 4
START_BYTE = 249
DESCRIPTION = "
Correction factor for atmospheric mass for epithermal neutrons.
"
END_OBJECT = COLUMN
```

```
OBJECT = COLUMN
COLUMN_NUMBER = 53
NAME = CF_ATM_FAST
DATA_TYPE = IEEE_REAL
BYTES = 4
START_BYTE = 253
DESCRIPTION = "
Correction factor for atmospheric mass for fast neutrons.
"
END_OBJECT = COLUMN
```

5.4. EXAMPLE: AND Label

```
PDS_VERSION_ID      = PDS3

/* FILE CHARACTERISTICS */
RECORD_TYPE         = FIXED_LENGTH
RECORD_BYTES       = 44
FILE_RECORDS       = 2592

/* POINTERS TO DATA OBJECTS */
^TIME_SERIES       = "AND_01_315_330.DAT"

/* IDENTIFICATION DATA ELEMENTS */
```

```

DATA_SET_NAME      = "ODY MARS GAMMA RAY SPECTROMETER 5 AND V1.0"
DATA_SET_ID        = "ODY-M-GRS-5-AND-V1.0"
PRODUCT_ID         = "AND_01_315_330"
PRODUCT_TYPE       = "AVERAGED_NEUTRON_DATA"
PRODUCT_VERSION_ID = "1.0"
RELEASE_ID         = "0008"

```

```
/* DESCRIPTIVE DATA ELEMENTS */
```

```

INSTRUMENT_HOST_NAME = "2001 MARS ODYSSEY"
INSTRUMENT_NAME      = "GAMMA RAY SPECTROMETER"
SPACECRAFT_ID        = ODY
TARGET_NAME          = MARS
MISSION_PHASE_NAME   = MAPPING
START_TIME           = 2003-12-13T00:00:00.000
STOP_TIME            = 2004-01-09T00:00:00.000
SPACECRAFT_CLOCK_START_COUNT = 193469682859
SPACECRAFT_CLOCK_STOP_COUNT  = 194066880625
PRODUCT_CREATION_TIME   = 2005-06-12T14:05:47.309

```

```
/* DATA OBJECT DEFINITION */
```

```
OBJECT          = TABLE
```

```

INTERCHANGE_FORMAT = BINARY
ROWS               = 2592
ROW_BYTES          = 44

```

```

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

```

```

COLUMNS          = 11
^STRUCTURE        = "AVG_NEUTRON_DATA_COLS.FMT"

```

```
/* DESCRIPTIVE data elements */
```

```
DESCRIPTION      = "
```

The AND product contains average fluxes for epithermal, thermal, and fast neutrons. The data is presented in a table format for a 5 degree by 5 degree grid. There are 36 latitude bands and 72 longitude bands, thus 2592 grid cells. Each cell corresponds to one row in the table. The first 72 rows in the table are the data for the 5 degree latitude band centered at 87.5 degrees north

latitude, the second 72 rows are the data for the band centered at 82.5 degrees north latitude, and so on. Within each band, longitude increases eastward from the cell centered at 2.5 degrees east longitude to the cell centered at 357.5 degrees east longitude.

"

END_OBJECT = TABLE

END

5.4.1. AND Table Structure

OBJECT = COLUMN

COLUMN_NUMBER = 1

NAME = AREOCENTRIC_LATITUDE

DATA_TYPE = IEEE_REAL

BYTES = 4

START_BYTE = 1

UNIT = DEGREE

DESCRIPTION = "

Centerpoint areocentric latitude.

"

END_OBJECT = COLUMN

OBJECT = COLUMN

COLUMN_NUMBER = 2

NAME = AREOCENTRIC_EAST_LONGITUDE

DATA_TYPE = IEEE_REAL

BYTES = 4

START_BYTE = 5

UNIT = DEGREE

DESCRIPTION = "

Centerpoint areocentric east longitude.

"

END_OBJECT = COLUMN

OBJECT = COLUMN
COLUMN_NUMBER = 3
NAME = CTHERM
DATA_TYPE = IEEE_REAL
BYTES = 4
START_BYTE = 9
DESCRIPTION = "
Averaged Thermal neutron count rate (counts per second) over the 5x5
degree latitude longitude map bin and 15-degrees L-sub-S.
"
END_OBJECT = COLUMN

OBJECT = COLUMN
COLUMN_NUMBER = 4
NAME = NTHERM
DATA_TYPE = IEEE_REAL
BYTES = 4
START_BYTE = 13
DESCRIPTION = "
Number of collection intervals per map bin.
"
END_OBJECT = COLUMN

OBJECT = COLUMN
COLUMN_NUMBER = 5
NAME = STHERM
DATA_TYPE = IEEE_REAL
BYTES = 4
START_BYTE = 17
DESCRIPTION = "
Standard deviation in the thermal count rate (counts per second).
"
END_OBJECT = COLUMN

```
OBJECT = COLUMN
COLUMN_NUMBER = 6
NAME = CEPI
DATA_TYPE = IEEE_REAL
BYTES = 4
START_BYTE = 21
DESCRIPTION = "
Averaged Epithermal neutron count rate (counts per second) over the 5x5
degree latitude longitude map bin and 15-degrees L-sub-S.
"
END_OBJECT = COLUMN
```

```
OBJECT = COLUMN
COLUMN_NUMBER = 7
NAME = NEPI
DATA_TYPE = IEEE_REAL
BYTES = 4
START_BYTE = 25
DESCRIPTION = "
Number of collection intervals per map bin.
"
END_OBJECT = COLUMN
```

```
OBJECT = COLUMN
COLUMN_NUMBER = 8
NAME = SEPI
DATA_TYPE = IEEE_REAL
BYTES = 4
START_BYTE = 29
DESCRIPTION = "
Standard deviation in the epithermal count rate (counts per second).
"
END_OBJECT = COLUMN
```

OBJECT = COLUMN
COLUMN_NUMBER = 9
NAME = CFAST
DATA_TYPE = IEEE_REAL
BYTES = 4
START_BYTE = 33
DESCRIPTION = "
Averaged Thermal neutron count rate (counts per second) over the 5x5
degree latitude longitude map bin and 15-degrees L-sub-S.
"
END_OBJECT = COLUMN

OBJECT = COLUMN
COLUMN_NUMBER = 10
NAME = NFAST
DATA_TYPE = IEEE_REAL
BYTES = 4
START_BYTE = 37
DESCRIPTION = "
Number of collection intervals per map bin.
"
END_OBJECT = COLUMN

OBJECT = COLUMN
COLUMN_NUMBER = 11
NAME = SFAST
DATA_TYPE = IEEE_REAL
BYTES = 4
START_BYTE = 41
DESCRIPTION = "
Standard deviation in the fast count rate (counts per second).
"
END_OBJECT = COLUMN

5.5. EXAMPLE: DHD Label

DS_VERSION_ID = PDS3

/* FILE CHARACTERISTICS */

RECORD_TYPE = FIXED_LENGTH

RECORD_BYTES = 108

FILE_RECORDS = 3939

/* POINTERS TO DATA OBJECTS */

^TIME_SERIES = "DHD_20030101.DAT"

/* IDENTIFICATION DATA ELEMENTS */

DATA_SET_NAME = "ODY MARS GAMMA RAY SPECTROMETER 4 DHD V1.0"

DATA_SET_ID = "ODY-M-GRS-4-DHD-V1.0"

PRODUCT_ID = "DHD_20030101"

PRODUCT_TYPE = "DERIVED_HEND_DATA"

PRODUCT_VERSION_ID = "1.0"

RELEASE_ID = "0008"

/* DESCRIPTIVE DATA ELEMENTS */

INSTRUMENT_HOST_NAME = "2001 MARS ODYSSEY"

INSTRUMENT_NAME = "GAMMA RAY SPECTROMETER"

SPACECRAFT_ID = ODY

TARGET_NAME = MARS

MISSION_PHASE_NAME = MAPPING

START_TIME = 2003-01-01T00:00:24.502

STOP_TIME = 2003-01-01T23:59:55.850

SPACECRAFT_CLOCK_START_COUNT = 185816715317

SPACECRAFT_CLOCK_STOP_COUNT = 185838826192

PRODUCT_CREATION_TIME = 2004-04-29T21:36:55.991

/* DATA OBJECT DEFINITION */

OBJECT = TIME_SERIES

```
INTERCHANGE_FORMAT      = BINARY
ROWS                     = 3939
ROW_BYTES                = 108
```

```
SAMPLING_PARAMETER_NAME  = TIME
SAMPLING_PARAMETER_UNIT  = TICKS
SAMPLING_PARAMETER_INTERVAL = "N/A"
```

```
/* The complete column definitions are contained in an external file */
/* found in the LABEL directory of the archive disk.                */
```

```
COLUMNS                 = 22
^STRUCTURE                = "DERIV_HEND_DATA_COLS.FMT"
```

```
/* DESCRIPTIVE data elements */
```

```
DESCRIPTION              = "
```

Derived HEND data are composed of raw counts, a background component, background subtracted counts and the associated timing and spatial information. The five raw counts fields included in the DHDs consist of the cumulative counts of neutrons at the detector of interest over one collection interval. The collection interval is approximately 19.7 seconds, but may vary over the course of mapping. The five background count fields are derived from spatial data and count data collected during the cruise phase of the mission. The five background subtracted count fields are the background subtracted counts at the detector of interest over one collection interval. Timing and spatial data provided with the counts include spacecraft clock values and spacecraft geometry data. The sc_ev_time, utc time and spatial fields are all recorded at the center of the collection interval.

```
"
```

```
END_OBJECT              = TIME_SERIES
```

```
END
```

5.5.1. DHD Table Structure

OBJECT = COLUMN

COLUMN_NUMBER = 1

NAME = SC_RECV_TIME

DATA_TYPE = MSB_UNSIGNED_INTEGER

BYTES = 8

START_BYTE = 1

DESCRIPTION = "

The time this packet was received by the spacecraft, in ticks (256 per second).

"

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 pixel, stored as yyyy-mm-ddThh:mm:ss.sss.

"

END_OBJECT = COLUMN

OBJECT = COLUMN

COLUMN_NUMBER = 3

NAME = SUN_ACTIVITY

DATA_TYPE = BOOLEAN

BYTES = 1

START_BYTE = 32

DESCRIPTION = "

1(active sun during pixel interval); 0(no active sun during pixel interval)

"

END_OBJECT = COLUMN

OBJECT = COLUMN

COLUMN_NUMBER = 4

NAME = AREOCENTRIC_LATITUDE

DATA_TYPE = IEEE_REAL

BYTES = 4

START_BYTE = 33

UNIT = DEGREE

INVALID_CONSTANT = -999.0

DESCRIPTION = "

Latitude in Mars fixed coordinates at the middle of the pixel.

"

END_OBJECT = COLUMN

OBJECT = COLUMN

COLUMN_NUMBER = 5

NAME = AREOCENTRIC_EAST_LONGITUDE

DATA_TYPE = IEEE_REAL

BYTES = 4

START_BYTE = 37

UNIT = DEGREE

INVALID_CONSTANT = -999.0

DESCRIPTION = "

Longitude in Mars fixed coordinates at the middle of the pixel.

"

END_OBJECT = COLUMN

OBJECT = COLUMN

COLUMN_NUMBER = 6

NAME = LS

DATA_TYPE = IEEE_REAL

BYTES = 4

START_BYTE = 41

DESCRIPTION = "
Solar longitude (L-sub-s) at the middle of pixel.
"
END_OBJECT = COLUMN

OBJECT = COLUMN
COLUMN_NUMBER = 7
NAME = PIXEL_DURATION
DATA_TYPE = IEEE_REAL
BYTES = 4
START_BYTE = 45
UNIT = SECOND
DESCRIPTION = "
Duration of pixel in seconds.
"
END_OBJECT = COLUMN

OBJECT = COLUMN
COLUMN_NUMBER = 8
NAME = SD_BACKGROUND
DATA_TYPE = IEEE_REAL
BYTES = 4
START_BYTE = 49
DESCRIPTION = "
Background counts for the Small Detector.
"
END_OBJECT = COLUMN

OBJECT = COLUMN
COLUMN_NUMBER = 9
NAME = MD_BACKGROUND
DATA_TYPE = IEEE_REAL
BYTES = 4
START_BYTE = 53

```
DESCRIPTION = "  
Background counts for Medium Detector.  
"  
END_OBJECT = COLUMN  
  
OBJECT = COLUMN  
COLUMN_NUMBER = 10  
NAME = LD_BACKGROUND  
DATA_TYPE = IEEE_REAL  
BYTES = 4  
START_BYTE = 57  
DESCRIPTION = "  
Background counts for Large Detector.  
"  
END_OBJECT = COLUMN  
  
OBJECT = COLUMN  
COLUMN_NUMBER = 11  
NAME = SC_LOW_BACKGROUND  
DATA_TYPE = IEEE_REAL  
BYTES = 4  
START_BYTE = 61  
DESCRIPTION = "  
Background counts for low channels of Inner Scintillator.  
"  
END_OBJECT = COLUMN  
  
OBJECT = COLUMN  
COLUMN_NUMBER = 12  
NAME = SC_HIGH_BACKGROUND  
DATA_TYPE = IEEE_REAL  
BYTES = 4  
START_BYTE = 65  
DESCRIPTION = "
```

Background counts for high channels of Inner Scintillator.

"

END_OBJECT = COLUMN

OBJECT = COLUMN

COLUMN_NUMBER = 13

NAME = SD_RAW_COUNTS

DATA_TYPE = IEEE_REAL

BYTES = 4

START_BYTE = 69

DESCRIPTION = "

Counts gathered in Small Detector detector during pixel interval.

"

END_OBJECT = COLUMN

OBJECT = COLUMN

COLUMN_NUMBER = 14

NAME = MD_RAW_COUNTS

DATA_TYPE = IEEE_REAL

BYTES = 4

START_BYTE = 73

DESCRIPTION = "

Counts gathered in Medium Detector detector during pixel interval.

"

END_OBJECT = COLUMN

OBJECT = COLUMN

COLUMN_NUMBER = 15

NAME = LD_RAW_COUNTS

DATA_TYPE = IEEE_REAL

BYTES = 4

START_BYTE = 77

DESCRIPTION = "

Counts gathered in Large Detector detector during pixel interval.

```
"  
END_OBJECT = COLUMN  
  
OBJECT = COLUMN  
COLUMN_NUMBER = 16  
NAME = SC_LOW_RAW_COUNTS  
DATA_TYPE = IEEE_REAL  
BYTES = 4  
START_BYTE = 81  
DESCRIPTION = "  
Counts gathered in low channels of Inner Scintillator during pixel  
interval.  
"  
END_OBJECT = COLUMN  
  
OBJECT = COLUMN  
COLUMN_NUMBER = 17  
NAME = SC_HIGH_RAW_COUNTS  
DATA_TYPE = IEEE_REAL  
BYTES = 4  
START_BYTE = 85  
DESCRIPTION = "  
Counts gathered in high channels of Inner Scintillator during pixel  
interval.  
"  
END_OBJECT = COLUMN  
  
OBJECT = COLUMN  
COLUMN_NUMBER = 18  
NAME = SD_ADJUSTED_COUNTS  
DATA_TYPE = IEEE_REAL  
BYTES = 4  
START_BYTE = 89  
DESCRIPTION = "
```

Counts gathered in Small Detector during pixel interval with background subtracted.

"

END_OBJECT = COLUMN

OBJECT = COLUMN

COLUMN_NUMBER = 19

NAME = MD_ADJUSTED_COUNTS

DATA_TYPE = IEEE_REAL

BYTES = 4

START_BYTE = 93

DESCRIPTION = "

Counts gathered in Medium Detector during pixel interval with background subtracted.

"

END_OBJECT = COLUMN

OBJECT = COLUMN

COLUMN_NUMBER = 20

NAME = LD_ADJUSTED_COUNTS

DATA_TYPE = IEEE_REAL

BYTES = 4

START_BYTE = 97

DESCRIPTION = "

Counts gathered in Large Detector during pixel interval with background subtracted.

"

END_OBJECT = COLUMN

OBJECT = COLUMN

COLUMN_NUMBER = 21

NAME = SC_LOW_ADJUSTED_COUNTS

DATA_TYPE = IEEE_REAL

BYTES = 4

```

START_BYTE = 101
DESCRIPTION = "
Counts gathered in low channels of Inner Scintillator during pixel
interval with background subtracted.
"
END_OBJECT = COLUMN

OBJECT = COLUMN
COLUMN_NUMBER = 22
NAME = SC_HIGH_ADJUSTED_COUNTS
DATA_TYPE = IEEE_REAL
BYTES = 4
START_BYTE = 105
DESCRIPTION = "
Counts gathered in high channels of Inner Scintillator during pixel
interval with background subtracted.
"
END_OBJECT = COLUMN

```

5.6. EXAMPLE: AHD Label

```

PDS_VERSION_ID          = PDS3

/* FILE CHARACTERISTICS */
RECORD_TYPE             = FIXED_LENGTH
RECORD_BYTES            = 96
FILE_RECORDS            = 2592

/* POINTERS TO DATA OBJECTS */
^TABLE                  = "AHD_01_270_285.DAT"

/* IDENTIFICATION DATA ELEMENTS */
DATA_SET_NAME           = "ODY MARS GAMMA RAY SPECTROMETER 5 AHD V1.0"
DATA_SET_ID             = "ODY-M-GRS-5-AHD-V1.0"
PRODUCT_ID              = "AHD_01_270_285"

```

PRODUCT_TYPE = "AVERAGED_HEND_DATA"
PRODUCT_VERSION_ID = "1.0"
RELEASE_ID = "0008"

/* DESCRIPTIVE DATA ELEMENTS */

INSTRUMENT_HOST_NAME = "2001 MARS ODYSSEY"
INSTRUMENT_NAME = "GAMMA RAY SPECTROMETER"
SPACECRAFT_ID = ODY
TARGET_NAME = MARS
MISSION_PHASE_NAME = MAPPING
START_TIME = 2003-09-30T00:00:00.000
STOP_TIME = 2003-10-24T00:00:00.000
START_SOLAR_LONGITUDE = 270
STOP_SOLAR_LONGITUDE = 285
SPACECRAFT_CLOCK_START_COUNT = 191832929844
SPACECRAFT_CLOCK_STOP_COUNT = 192363766025
PRODUCT_CREATION_TIME = 2004-04-29T23:10:23.550

/* DATA OBJECT DEFINITION */

OBJECT = TABLE

INTERCHANGE_FORMAT = BINARY
ROWS = 2592
ROW_BYTES = 96

/* The complete column definitions are contained in an external file */

/* found in the LABEL directory of the archive disk. */

COLUMNS = 24
^STRUCTURE = "AVG_HEND_DATA_COLS.FMT"

/* DESCRIPTIVE data elements */

DESCRIPTION = "

The AND product data has been averaged spatially over a 5 degree by 5 degree grid and temporally over intervals of 15 degrees of solar longitude.

The AHD product data is presented in a table corresponding to the 5 degree by 5 degree grid. There are 36 latitude bands and 72 longitude bands, thus 2592 grid cells. Each cell corresponds to one row in the table. The first 72 rows in the table are the data for the 5 degree latitude band centered at 87.5 degrees north latitude, the second 72 rows are the data for the band centered at 82.5 degrees north latitude, and so on. Within each band, longitude increases eastward from the cell centered at 2.5 degrees east longitude to the cell centered at 357.5 degrees east longitude.

Averaged HEND Data products are composed of averaged normalized counting rates, orbital neutron fluxes and the associated timing, spatial and engineering information. The AHDs consists of the cumulative background subtracted and normalized counts of neutrons at the four HEND detectors averaged over the 5x5 degree latitude longitude, 15-degree Ls.

Please refer to the HEND processing document located in the document directory that accompanies this release for a full description of how HEND spectra are processed to yield averaged normalized counting rates and orbital neutron fluxes.

"

END_OBJECT = TABLE

END

5.6.1. AHD Table Structure

OBJECT = COLUMN

COLUMN_NUMBER = 1

NAME = AREOCENTRIC_LATITUDE

DATA_TYPE = IEEE_REAL
BYTES = 4
START_BYTE = 1
UNIT = DEGREE
DESCRIPTION = "
Centerpoint areocentric latitude.
"
END_OBJECT = COLUMN

OBJECT = COLUMN
COLUMN_NUMBER = 2
NAME = AREOCENTRIC_EAST_LONGITUDE
DATA_TYPE = IEEE_REAL
BYTES = 4
START_BYTE = 5
UNIT = DEGREE
DESCRIPTION = "
Centerpoint areocentric east longitude.
"
END_OBJECT = COLUMN

OBJECT = COLUMN
COLUMN_NUMBER = 3
NAME = EXPOSURE
DATA_TYPE = IEEE_REAL
BYTES = 4
START_BYTE = 9
UNIT = SECOND
DESCRIPTION = "
Exposure time of given map pixel in seconds.
"
END_OBJECT = COLUMN

OBJECT = COLUMN

COLUMN_NUMBER = 4
NAME = SD_NORMALIZATION
DATA_TYPE = IEEE_REAL
BYTES = 4
START_BYTE = 13
INVALID_CONSTANT = -999
DESCRIPTION = "
Normalization value which was used to normalize map for the Small
Detector (counts/sec).
"
END_OBJECT = COLUMN

OBJECT = COLUMN
COLUMN_NUMBER = 5
NAME = SD_RATE
DATA_TYPE = IEEE_REAL
BYTES = 4
START_BYTE = 17
INVALID_CONSTANT = -999
DESCRIPTION = "
The relative count rate (after normalization) which is observed in the
given map pixel by the Small Detector.
"
END_OBJECT = COLUMN

OBJECT = COLUMN
COLUMN_NUMBER = 6
NAME = SD_ERROR
DATA_TYPE = IEEE_REAL
BYTES = 4
START_BYTE = 21
INVALID_CONSTANT = -999
DESCRIPTION = "
The statistical error of the relative count rate in the Small Detector.

"
END_OBJECT = COLUMN

OBJECT = COLUMN
COLUMN_NUMBER = 7
NAME = MD_NORMALIZATION
DATA_TYPE = IEEE_REAL
BYTES = 4
START_BYTE = 25
INVALID_CONSTANT = -999
DESCRIPTION = "
Normalization value which was used to normalize map for the Medium
Detector (counts/sec).
"
END_OBJECT = COLUMN

OBJECT = COLUMN
COLUMN_NUMBER = 8
NAME = MD_RATE
DATA_TYPE = IEEE_REAL
BYTES = 4
START_BYTE = 29
INVALID_CONSTANT = -999
DESCRIPTION = "
The relative count rate (after normalization) which is observed in
given map pixel by the Medium Detector.
"
END_OBJECT = COLUMN

OBJECT = COLUMN
COLUMN_NUMBER = 9
NAME = MD_ERROR
DATA_TYPE = IEEE_REAL
BYTES = 4

START_BYTE = 33

INVALID_CONSTANT = -999

DESCRIPTION = "

The statistical error of relative count rate in the Medium Detector.

"

END_OBJECT = COLUMN

OBJECT = COLUMN

COLUMN_NUMBER = 10

NAME = LD_NORMALIZATION

DATA_TYPE = IEEE_REAL

BYTES = 4

START_BYTE = 37

INVALID_CONSTANT = -999

DESCRIPTION = "

Normalization value which was used to normalize map for the Large Detector (counts/sec).

"

END_OBJECT = COLUMN

OBJECT = COLUMN

COLUMN_NUMBER = 11

NAME = LD_RATE

DATA_TYPE = IEEE_REAL

BYTES = 4

START_BYTE = 41

INVALID_CONSTANT = -999

DESCRIPTION = "

The relative count rate (after normalization) which is observed in given map pixel by the Large Detector.

"

END_OBJECT = COLUMN

OBJECT = COLUMN

COLUMN_NUMBER = 12
NAME = LD_ERROR
DATA_TYPE = IEEE_REAL
BYTES = 4
START_BYTE = 45
INVALID_CONSTANT = -999
DESCRIPTION = "
The statistical error of relative count rate in the Large Detector.
"
END_OBJECT = COLUMN

OBJECT = COLUMN
COLUMN_NUMBER = 13
NAME = IN_SC_LOW_NORMALIZATION
DATA_TYPE = IEEE_REAL
BYTES = 4
START_BYTE = 49
INVALID_CONSTANT = -999
DESCRIPTION = "
Normalization value which was used to normalize map for low energy
channels in the inner scintillator (count/sec).
"
END_OBJECT = COLUMN

OBJECT = COLUMN
COLUMN_NUMBER = 14
NAME = IN_SC_LOW_RATE
DATA_TYPE = IEEE_REAL
BYTES = 4
START_BYTE = 53
INVALID_CONSTANT = -999
DESCRIPTION = "
The relative count rate (after normalization) which is observed in
given map pixel by the inner scintillator (low channels) .

```
"  
END_OBJECT = COLUMN  
  
OBJECT = COLUMN  
COLUMN_NUMBER = 15  
NAME = IN_SC_LOW_ERROR  
DATA_TYPE = IEEE_REAL  
BYTES = 4  
START_BYTE = 57  
INVALID_CONSTANT = -999  
DESCRIPTION = "  
The statistical error of relative count rate in the inner scintillator  
(low channels).  
"  
END_OBJECT = COLUMN
```

```
OBJECT = COLUMN  
COLUMN_NUMBER = 16  
NAME = IN_SC_HIGH_NORMALIZATION  
DATA_TYPE = IEEE_REAL  
BYTES = 4  
START_BYTE = 61  
INVALID_CONSTANT = -999  
DESCRIPTION = "  
Normalization value which was used to normalize map for high energy  
channels in the inner scintillator (count/sec).  
"  
END_OBJECT = COLUMN
```

```
OBJECT = COLUMN  
COLUMN_NUMBER = 17  
NAME = IN_SC_HIGH_RATE  
DATA_TYPE = IEEE_REAL  
BYTES = 4
```

START_BYTE = 65

INVALID_CONSTANT = -999

DESCRIPTION = "

The relative count rate (after normalization) which is observed in given map pixel by the inner scintillator (high channels).

"

END_OBJECT = COLUMN

OBJECT = COLUMN

COLUMN_NUMBER = 18

NAME = IN_SC_HIGH_ERROR

DATA_TYPE = IEEE_REAL

BYTES = 4

START_BYTE = 69

INVALID_CONSTANT = -999

DESCRIPTION = "

The statistical error of relative count rate in the inner scintillator (high channels).

"

END_OBJECT = COLUMN

OBJECT = COLUMN

COLUMN_NUMBER = 19

NAME = EPITHERMAL_FLUX1

DATA_TYPE = IEEE_REAL

BYTES = 4

START_BYTE = 73

INVALID_CONSTANT = -999

DESCRIPTION = "

Orbital epithermal neutron flux in energy range [100 eV-10 keV] (n/cm²/sec).

"

END_OBJECT = COLUMN

```
OBJECT = COLUMN
COLUMN_NUMBER = 20
NAME = EPITHERMAL_FLUX2
DATA_TYPE = IEEE_REAL
BYTES = 4
START_BYTE = 77
INVALID_CONSTANT = -999
DESCRIPTION = "
Orbital epithermal neutron flux in energy range [10 keV-1 MeV]
(n/cm^2/sec).
"
END_OBJECT = COLUMN
```

```
OBJECT = COLUMN
COLUMN_NUMBER = 21
NAME = FAST_FLUX1
DATA_TYPE = IEEE_REAL
BYTES = 4
START_BYTE = 81
INVALID_CONSTANT = -999
DESCRIPTION = "
Orbital fast neutron flux in energy range [1 MeV - 2.5 MeV]
(n/cm^2/sec).
"
END_OBJECT = COLUMN
```

```
OBJECT = COLUMN
COLUMN_NUMBER = 22
NAME = FAST_FLUX2
DATA_TYPE = IEEE_REAL
BYTES = 4
START_BYTE = 85
INVALID_CONSTANT = -999
DESCRIPTION = "
```

Orbital fast neutron flux in energy range [2.5 MeV - 10 MeV]
(n/cm²/sec).

"

END_OBJECT = COLUMN

OBJECT = COLUMN

COLUMN_NUMBER = 23

NAME = NEUTRON_NORMALIZATION

DATA_TYPE = IEEE_REAL

BYTES = 4

START_BYTE = 89

INVALID_CONSTANT = -999

DESCRIPTION = "

Normalization of neutron spectra.

"

END_OBJECT = COLUMN

OBJECT = COLUMN

COLUMN_NUMBER = 24

NAME = ALPHA

DATA_TYPE = IEEE_REAL

BYTES = 4

START_BYTE = 93

INVALID_CONSTANT = -999

DESCRIPTION = "

Power index of neutron spectra.

"

END_OBJECT = COLUMN