NASA Planetary Data System
Microwave Subnode of the Geosciences Node

Software Interface Specification

PDS-GEO-SCVDRCD

Magellan Surface Characteristics Vector Data Record on Compact Disk Read-Only Memory

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Version 1.0
January 1, 1995

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PREFACE

DOCUMENT CHANGE LOG			
REVISION NUMBER	REVISION DATE	SECTION AFFECTED	REMARKS
1.0	01/01/95	All	New document

ITEMS TO BE DETERMINED			
REVISION NUMBER	SECTION AFFECTED	ITEM DESCRIPTION	RESOLUTION
none			

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ACRONYMS AND ABBREVIATIONS

ALT-EDR	Altimetry Experiment Data Record (tape)
ANF	Altimetry Inversion File of the SCVDR
ANSI	American National Standards Institute
ARCDR	Altimetry and Radiometry Composite Data Record
ASCII	American Standard Code for Information Interchange
BPI	Bits Per Inch
C-BIDR	Compressed Basic Image Data Record (tape)
CCSDS	Consultative Committee for Space Data Systems
CCT	Computer Compatible Tape
CD-WO	Compact Disk - Write Once
CD	Compact Disk
dB	Decibel
DMAT	Data Management and Archive Team
DOS	Disk Operating System
EDF	Emissivity Data File of the SCVDR
EDR	Experiment Data Record
EOF	End of File
F-BIDR	Full Resolution Basic Image Data Record (tape)
GMF	G-Matrix File of the SCVDR
IAU	International Astronomical Union
IEEE	Institute of Electrical and Electronic Engineering
ISO	International Standards Organization
J2000	IAU Official Time Epoch
JPL	Jet Propulsion Laboratory
K	Degrees Kelvin
km	Kilometers
LSB	Least Significant Byte
MB	Megabytes
MGN	Magellan (formerly Venus Radar Mapper)
MIT	Massachusetts Institute of Technology
MSB	Most Significant Byte
NAIF	Navigation and Ancillary Information Facility
NASA	National Aeronautics and Space Administration
NFF	Altimetry Inversion Fit File of the SCVDR
NSI	NASA Science Internet
NSSDC	National Space Science Data Center
ODL	Object Definition Language (PDS)
OHF	Orbit Header File of the SCVDR
OIF	Oblique Sinusoidal Equal Area Image Data File of the SCVDR
PDS	Planetary Data System
PSG	Project Science Group
ROM	Read-Only Memory
SAB	SAR/Altimeter Burst
SAR	Synthetic Aperture Radar
SCET	Spacecraft Event Time (TDB or UTC)
SCLK	Spacecraft Clock (time)
SCVDR	Surface Characteristics Vector Data Record

SFDU	Standard Formatted Data Unit
SFOC	Space Flight Operations Center (JPL)
SIF	Sinusoidal Equal Area Image Data File of the SCVDR
SIS	Software Interface Specification
SPARC	Sun Scalable Processor Architecture
SU	Stanford University
tar	(UNIX) tape archiver utility
TBD	To Be Determined
TDB	Baricentric Dynamical (Ephemeris) Time
UNIX	operating system
UTL	Universal Resource Locator (World Wide Web)
UTC	Coordinated Universal Time
VBF85	Venus Body Fixed Coordinates, adopted by the IAU in 1985
VBF	Venus Body-Fixed coordinate system
VME	Venus Mean Equator coordinate system
VRM	Venus Radar Mapper (now Magellan)
VTF	Volume Trailer File of the SCVDR

CHAPTER 1

OVERVIEW

This Software Interface Specification (SIS) describes the format and content of the Magellan Surface Characteristics Vector Data Record on Compact-Disk Read-Only Memory Product (SCVDRCD). This product is the permanent archive version of the Surface Characteristics Vector Data Record (SCVDR) product that was written to 8mm computer tape during the radar mapping phase of the Magellan mission. The SCVDRCD combines the data files from the SCVDR tapes with PDS labels, catalog files, and tables.

The SCVDRCD is a deliverable product to the Planetary Data System (PDS) and to the National Space Science Data Center (NSSDC). The formats of all files in the SCVDRCD are based on PDS standards (Version 3).

1.1. Scope

The specifications in this document apply to all volumes containing SCVDRCD data produced at MIT. This document provides a detailed description of the SCVDRCD interface.

1.2. Applicable Documents

(1) ISO 9660-1988. Information Processing - Volume and File Structure on CD-ROM for Information Exchange, April 15, 1988.

(2) Planetary Data System Standards Reference, JPL D-7669, version 3.1, August 3, 1994

(3) Planetary Science Data Dictionary, JPL D-7116, Rev. C, November 20, 1992

(4) Planetary Data System, Data Preparation Workbook, JPL Publication D-7669, Part 1, Version 3.0, April 21, 1993.

(5) Simpson, R.A., M.J. Maurer, and E. Holmann, Stanford Magellan Data Processing System, (in preparation).

(6) SU-MGN-SCVDR. Surface Characteristics Vector Data Record Software Interface Specification, Simpson, R.A., Twicken, J.D., and Maurer, M.J., Center for Radar Astronomy, Stanford University, v 1.0, October 1, 1992. Copies of this document exist in the DOCUMENT directory of all SCVDRCD volumes; in ASCII text as SCVDR.ASC and in PostScript as SCVDR.PS.

1.3. System Siting

1.3.1. Interface Location and Medium

SCVDRCD volumes are created at MIT using hardware belonging to the Microwave Subnode of the PDS Geosciences Node, with a Young Minds CD-Studio compact disk authoring subsystem. All volumes intended for delivery to PDS shall be on CD-WO media.

1.3.2. Data Sources and Destinations

Each SCVDRCD volume is a collection of products representing, derived from, or needed to analyze a range of orbits of Magellan surface characteristics vector data. These data were derived from Magellan ALT-EDR, C-BIDR, and F-BIDR products by the Surface Property Data Processing Team at Stanford University [5], and were published on SCVDR product tapes [6]. The SCVDR files have been sorted by ascending orbit number, replaced files have been omitted, and the remainder written to CD-WO by ascending volume number. The number of orbits on each SCVDRCD disk is therefore variable.

One copy of each CD-WO archive volume is delivered using the most appropriate means to the National Space Science Data Center (NSSDC), a second copy is sent to Stanford University Center for Radar Astronomy, and a

third copy is retained at the MIT Microwave Subnode of the Planetary Data System (PDS).

1.3.3. Generation Method and Frequency

Each SCVDRCD volume is produced in several stages. First, the SCVDR data files are copied from 8mm archive tape into magnetic disk using the UNIX "tar" program. Then a PDS detached label is created for each data file using the UNIX perl script "write_cbidr_cd". Next, the CD-WO is pre-mastered using the Young Minds "makedisc" command. Finally, the CD-Studio hardware is commanded to write one or more CD-WO disks.

1.4. Assumptions and Constraints

1.4.1. Usage Constraints

Access to the SCVDRCD volumes will be determined by the Planetary Data System (PDS) and by the National Space Science Data Center (NSSDC).

1.4.2. Documentation Conventions

1.4.2.1. Data Format Descriptions

Data are stored in fields of 8-, 16-, and 32-bit signed and unsigned integers, 32-bit and 64-bit floats, and as character strings. Integers are stored in most-significant-byte (MSB) format [2]; the first byte contains the most significant bits, while the last contains the least significant bits. Refer to the applicable documents for details.

Floats use IEEE-754 format and are are stored in MSB order (i.e., the most significant mantissa bytes precede the less significant bytes.)

If a field is described as containing "n" bytes of ASCII character string data, this implies that the leftmost (lowest numbered) byte contains the first character, the next lowest byte contains the next character, and so forth. Character strings are written to CD-WO with lower numbered bytes preceding higher numbered bytes.

1.4.2.2. Limits of This Document

This document applies only to SCVDRCD volumes.

1.4.2.3. Typographic Conventions

This document has been formatted in Adobe PostScript level 1 for printing on compatible printers. It may also be previewed on bit-mapped terminals by PostScript display software that recognizes the following structured comments: %%EndProlog, %%Page:, and %%Trailer.

To make Section 5 of this document more readable, the following combinations of fonts and typefaces are used for special purposes:

Boldface for symbolic names of SFDU components, e.g. length field.

`Typewriter` for label keywords and all other ASCII character string values (for example, `` `CCSD1Z000001´ ``, always enclosed in quotation marks), decimal values (for example, `1990`, with no quotes), and hexadecimal values (for example, `0xff`, with leading `0x`).

1.4.3. Time Standards

Within SCVDRCD label files, times are expressed as a string of 19 or 23 ASCII characters

YYYY-MM-DDThh:mm:ss[.fff]

where "-", "T", ":", and "." are fixed delimiters; "YYYY" is the year "19nn" or "20nn"; "MM" is a two-digit month of year; "DD" is a two-digit day of month; "T" separates the date and time segments of the string; "hh" is hour of day; "mm" is the minutes of hour (00-59); "ss" is the seconds of minute (00-59); and ".fff" gives the fractional seconds. The data type "TIME" is assigned to this format.

When only the date is required the 10-character string

YYYY-MM-DD

may be substituted. The data type "DATE" is assigned to this format.

CHAPTER 2

INTERFACE CHARACTERISTICS

2.1. Hardware Characteristics and Limitations

2.1.1. Special Equipment and Device Interfaces

SCVDRCD volumes conform to ISO 9660 standards for CD-ROM [1]. Users of the volumes must have access to systems which can read these media.

2.1.2. Special Set-Up Requirements

None.

2.2. Volume and Size

Each SCVDRCD volume contains a set of data and ancillary files representing one or more Magellan orbits. The maximum size of SCVDRCD data files will be approximately 600 Mbytes. SCVDRCD disks may be slightly larger than this due to the additional PDS index table and label files.

2.3. Labeling and Identification

2.3.1. External Labels

Each SCVDRCD volume bears a label using the following format:

ACRONYM.SEQUENCE;VERSION

where

ACRONYM	=	SCVDRCD
SEQUENCE	=	a three digit number indicating the order in which the CD-WO volumes were produced.
VERSION	=	A single digit determining version number of the CD-WO volume. "1" is the original version.

For example, SCVDRCD.004;2 is the second version of the fourth SCVDRCD volume.

2.3.2. Internal Labels

The contents of each SCVDRCD volume will be labeled in accordance with PDS standards. Labeling is described further in subsequent sections.

2.3.3. Interface Medium Characteristics

Each SCVDRCD volume conforms to ISO 9660 standards [1]. The quantity of data stored is no more than 650 MB per disk.

2.4. Backup and Duplicates

Three copies will be made of each SCVDRCD volume. One copy will be retained at the PDS Microwave Sub-node at MIT; a second will be sent to the Center for Radar Astronomy at Stanford University; the third copy will be sent to NSSDC for archival.

CHAPTER 3

STRUCTURE AND ORGANIZATION OVERVIEW

3.1. Disk Organization

Each SCVDRCD volume contains a CATALOG directory, a DOCUMENT directory, a GEOMETRY directory, an INDEX directory, a LABEL directory, a SOFTWARE directory, and one or more data directories (Figure 3-1).

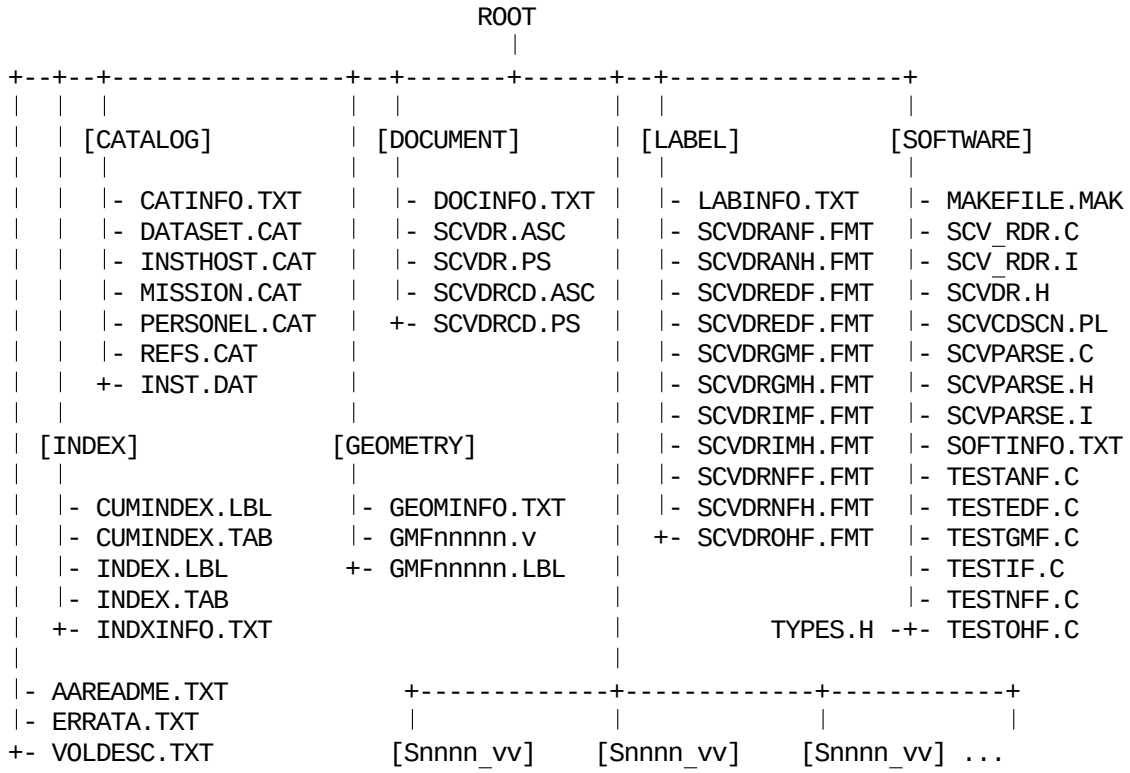

Figure 3-1. Example SCVDRCD Directory Structure

3.1.1. Root Directory

The root directory contains the following files:

AAREADME.TXT	terse description of volume contents [2].
ERRATA.TXT	cumulative list of errors on this and on previous SCVDRCD volumes.
VOLDESC.CAT	volume object definition [2].

3.1.2. CATALOG Directory

The CATALOG directory contains the following files:

CATINFO.TXT	text description of the directory contents [2].
DATASET.CAT	PDS data set template.

INST.CAT	PDS instrument template.
INSTHOST.CAT	PDS instrument host template.
MISSION.CAT	PDS mission template.
PERSONEL.CAT	PDS personnel template.
REFS.CAT	PDS reference template.

3.1.3. DOCUMENT Directory

The DOCUMENT directory contains the following files:

SCVDR.ASC	a copy of the SCVDR SIS document in ASCII characters, suitable for display or printing at 66 lines per page with up to 78 constant-width characters per line.
SCVDR.LBL	PDS label for the text of the SCVDR SIS (SCVDR.ASC) and for its PostScript version (SCVDR.PS).
SCVDR.PS	a copy of the SCVDR SIS document in PostScript format, suitable for previewing on a high-resolution graphics terminal or direct printing on a laser printer or photo-typesetter.
SCVDRCD.ASC	a copy of this SIS document in ASCII characters, suitable for display or printing at 66 lines per page with up to 78 constant-width characters per line.
SCVDRCD.LBL	PDS label for the text of this SIS (SCVDRCD.ASC) and for its PostScript version (SCVDRCD.PS).
SCVDRCD.PS	a copy of this SIS document in PostScript format, suitable for previewing on a high-resolution graphics terminal or direct printing on a laser printer or photo-typesetter.
DOCINFO.TXT	text description of the directory contents [2].

3.1.4. GEOMETRY Directory

The GEOMETRY directory contains the following files:

GEOMINFO.TXT	text description of the directory contents [2].
GMFnnnnn.LBL	PDS label for the G-matrix data file GMFnnnnn.v.
GMFnnnnn.v	A data file containing geometrical inversion matrices (G-matrices) that were used to generate one or more ANF data files on this volume. The specific ANF files are those listed in the INDEX.TAB file in the INDEX directory with a GEOMETRY_FILE_NAME column entry of this value.

3.1.5. INDEX Directory

The INDEX directory contains the following files:

CUMINDEX.LBL	PDS label for the cumulative volume index (CUMINDEX.TAB) [2].
CUMINDEX.TAB	index in tabular form for all volumes in the SCVDRCD [2].
INDEX.LBL	PDS label for the volume index (INDEX.TAB). Identifies the volume index and describes structure of the index table [2].
INDEX.TAB	volume index in tabular form [2].
INDXINFO.TXT	text description of the directory contents [2].

3.1.6. LABEL Directory

The LABEL directory contains the following files:

SCVDRANF.FMT	Description of the binary data records in the ANFnnnnn.v files.
SCVDRANH.FMT	Description of the binary header records in the ANFnnnnn.v files.
SCVDREDF.FMT	Description of the binary data records in the EDFnnnnn.v files.

SCVDREDH.FMT	Description of the binary header records in the EDFnnnnn.v files.
SCVDRGMF.FMT	Description of the binary data records in the GMFnnnnn.v files.
SCVDRGMH.FMT	Description of the binary header records in the GMFnnnnn.v files.
SCVDRIMF.FMT	Description of the binary data records in the SIFnnnnn.v and OIFnnnnn.v files.
SCVDRIMH.FMT	Description of the binary header records in the SIFnnnnn.v and OIFnnnnn.v files.
SCVDRNFF.FMT	Description of the binary data records in the NFFnnnnn.v files.
SCVDRNFH.FMT	Description of the binary header records in the NFFnnnnn.v files.
SCVDROHF.FMT	Description of the binary header records in the OHFnnnnn.v files.
LABINFO.TXT	text description of the directory contents [2].

3.1.7. SOFTWARE Directory

The SOFTWARE directory contains the following files:

MAKEFILE.MAK	Script used by the UNIX "make" command to generate executables from these source files.
SCV_RDR.C	Low level routines to read SCVDR data files into the structures defined in SCVDR.H
SCV_RDR.I	Function definition skeleton for SCV_RDR.C routines.
SCVDR.H	Definition of SCVDR data structures.
SCVDRSCN.PL	A Perl script to list contents of SCVDR data files. This file also functions as its own UNIX manual and can be printed by the UNIX commands "nroff -man scvdrscn.pl" and "troff -man scvdrscn.pl".
SCVPARSE.C	Low level routines to parse SFDU structures.
SCVPARSE.H	Definition of SFDU header structures.
SCVPARSE.I	Function definition skeleton for SCVPARSE.C routines.
SOFTINFO.TXT	text description of the directory contents [2].
TESTANF.C	A program that illustrates how to read an ANF - altimetry inversion file.
TESTEDF.C	A program that illustrates how to read an EDF - emissivity file.
TESTGMF.C	A program that illustrates how to read a GMF - G-matrix file.
TESTIF.C	A program that illustrates how to read a SIF or OIF - image data file.
TESTNFF.C	A program that illustrates how to read a NFF - inversion fit file.
TESTOHF.C	A program that illustrates how to read an OHF - orbit header file.
TYPES.H	Miscellaneous SCVDR definitions.

Note: all lines in these files have been padded on the right with blanks and terminated with an ASCII carriage return and linefeed in columns 79 and 80. It may be necessary to remove one or more of these characters in order to compile these sources on particular operating systems.

3.1.8. Data Directories

Each SCVDRCD volume contains directories for one or more orbits of altimetry, image, and emissivity data from SCVDR tapes. Data directories are named

Snnnn_vv

where "nnnn" is the orbit number, and "vv" is the version number inherited from the original SCVDR product.

3.2. Formats

SCVDRCD volumes conform to the ISO 9660 level 1 Interchange Standard CD-WO format [1], which is compatible with common computer systems including MS-DOS, Macintosh, SunOS, and VMS.

Data that comprise the SCVDRCD volumes are formatted in accordance with Planetary Data System specifications [2-4].

3.3. File Naming Conventions

In this document and on the disks themselves, file and directory names are in upper case characters. This ensures compatibility with operating systems in which these names are case insensitive (e.g., VMS and DOS) and operating systems in which names are automatically translated into one case or the other (e.g., Unix and MacOS). Within disk directories the characters ";1" are appended to all file names. VMS excepted, most operating systems will hide these suffixes from users.

3.3.1. PDS Labels

All files contained on SCVDRCD volumes are accompanied by PDS labels [2-4]. The label can either be prefixed to the associated primary file, or "detached", in which case the label becomes a file in its own right with the same name as the primary file except for the suffix ".LBL". Detached label files will be located in the same directory as the primary file.

PDS labels, whether prefixed to or detached from their primary file, provide descriptive information about the associated file. The PDS label is an object-oriented structure consisting of sets of "keyword=value" declarations. The object to which the label refers (e.g. HEADER, TABLE, etc.) is denoted by a statement of the form:

ˆobject = location

in which the carat character (ˆ, also called a pointer in this context) indicates where to find the object. In a prefixed label, the location is an integer representing the starting record or byte number of the object, where the counting starts from record or byte number 1. In a detached label, the location denotes the name of the file containing the object, along with the starting record or byte number if there is more than one object. For example:

ˆTABLE_HEADER = ("ANF00376.1",21)
ˆTABLE = ("ANF00376.1",1025 <BYTES>)

indicates that the TABLE object begins at byte 1025 of the file ANF00376.1, in the same directory as the detached label file. Below is a list of the possible formats for the ˆobject definition.

ˆobject = n
ˆobject = n<BYTES>
ˆobject = "filename.ext"
ˆobject = ("filename.ext",n)
ˆobject = ("filename.ext",n<BYTES>)

where

n	is the starting record or byte number of the object, counting from the beginning of the file (record 1 or byte 1),
<BYTES>	indicates that the number given is in units of bytes; default is RECORDS,
filename	is the (up to) 8 character, alphanumeric upper-case file name,
ext	is the 3 character upper-case file extension.

All lines in detached label files are 80 bytes long, padded on the right with blanks to a length of 78 bytes, and ending with a carriage return character (ASCII 13) followed by a line feed character (ASCII 10) in the last byte. The first two lines are an exception: the first contains a 40-byte SFDU aggregate label, followed by a carriage return and a line feed. The second contains 36 space characters (ASCII 32) followed by a carriage return and a line feed. The first PAIR of lines is therefore 80 bytes long, and all remaining lines are offset from the start of the label by a multiple of 80 bytes.

3.3.2. Document files

Document files (.TXT suffix) may exist in the root, CATALOG, DOCUMENT, GEOMETRY, INDEX, LABEL, and SOFTWARE directories. These are ASCII files with embedded PDS labels which employ the TEXT object. All records in document files are 80-bytes in length, with a carriage return character (ASCII 13) in the next-to-last byte and a line feed character (ASCII 10) in the last byte. The first two lines are an exception: the first

contains a 40-byte SFDU aggregate label, followed by a carriage return and a line feed. The second contains 36 space characters (ASCII 32) followed by a carriage return and a line feed. The first PAIR of lines is therefore 80 bytes long, and all remaining lines are offset from the start of the file by a multiple of 80 bytes.

3.3.3. Tabular Files

Tabular files (.TAB suffix) exist in the INDEX directory (where they are ASCII files formatted for direct reading into many database management systems).

ASCII tabular files consist of data "fields" separated by commas. Character fields are also enclosed in double quotation marks (") and are padded with spaces to keep quotation marks in the same columns of successive records. Character fields are left justified, and numeric fields are right justified. The "start byte" and "bytes" values listed in the labels do not include the commas between fields or the quotation marks surrounding character fields. The records in tabular files have fixed length. Where necessary, a space character (ASCII 32) is appended to the record to make it of even length, and the last two bytes of each record contain the ASCII carriage return and line feed characters. This allows a table to be treated as a fixed length record file on computers that support this file type and as a text file with embedded line delimiters on those that do not.

All tabular files are accompanied by descriptive, detached PDS labels. The PDS label has the same name as the data file it describes, except for the extension .LBL. For example, the file INDEX.TAB is accompanied by the detached label file INDEX.LBL in the same INDEX directory.

3.3.4. Catalog files

Catalog files (suffix .CAT) exist in the root and in the CATALOG directory. They are formatted in an object-oriented structure consisting of sets of "keyword=value" declarations.

VOLDESC.CAT in the root provides an overview of the contents of the volume in the form of a completed PDS template.

The files in the CATALOG directory provides a top-level understanding of the mission, instrument and data set. They are presented in the form of completed PDS templates [4]. See section 4.2 for further details.

3.3.5. Data files

Data files (numeric suffix) exist in the per-orbit data directories and in the GEOMETRY directory. They are described in detail in section 4.3, below, and in the series of applicable documents listed in section 1.2, above. They have been copied directly from SCVDR product tapes without reformatting, except that ASCII carat characters (ASCII 94) have been appended where necessary to set their length to a multiple of 32500 bytes.

Within the files, the data fields are written without regard for the 32,500-byte record boundaries, i.e. they are written as a data stream. All data files copied from the SCVDR tapes contain SFDU labels, and varying length data record aggregates are themselves delimited by R-type SFDU marker labels [4]. The data files are as follows:

ANFnnnnn.v	Altimetry Inversion File
EDFnnnnn.v	Emissivity Data File
GMFnnnnn.v	Geometry Matrix (G-Matrix) File
NFFnnnnn.v	Altimetry Inversion Fit File
OHFnnnnn.v	Orbit Header File
OIFnnnnn.v	Oblique Sinusoidal Image File
SIFnnnnn.v	Sinusoidal Image File

All data files are accompanied by detached PDS label files, whose first 8 characters are identical to the data files they represent, and whose last 3 characters are LBL.

CHAPTER 4

DETAILED INTERFACE SPECIFICATIONS

4.1. Root Files

4.1.1. AAREADME.TXT File

The AAREADME.TXT file contains terse volume content and format information. The file has an attached PDS label of the form shown in Figure 4-1. This is an ASCII file with 80-byte records. Each line is terminated with a carriage-return (ASCII 13) line-feed (ASCII 10) pair. The first two lines are an exception: the first contains a 40-byte SFDU aggregate label, followed by a carriage return and a line feed. The second contains 36 space characters (ASCII 32) followed by a carriage return and a line feed. The first PAIR of lines is therefore 80 bytes long, and all remaining lines are offset from the start of the file by a multiple of 80 bytes.

```
CCSD3ZF0000100000001NJPL3IF0PDSX00000001

PDS_VERSION_ID                  = PDS3
RECORD_TYPE                     = STREAM
SPACECRAFT_NAME                 = MAGELLAN
TARGET_NAME                     = VENUS
OBJECT                          = TEXT
  PUBLICATION_DATE              = 1995-01-01
  NOTE                          = "MAGELLAN SCVDR ARCHIVE CD-WO"
END_OBJECT                      = TEXT
```

Figure 4-1. Example Label for *.TXT Files

Labeling requirements applicable to Figure 4-1 are described in [2]; keywords are defined in [3]. For this application, the only keywords that change are

PUBLICATION_DATE — the date in YYYY-MM-DD format on which the file was created or last modified (see Section 1.5.3).

NOTE — a brief description of the file, including a title if available.

4.1.2. ERRATA.TXT File

The ERRATA.TXT file contains general information about errors on this, and previous, volumes of the SCVDRCD product. This is an ASCII file with 80 byte records. Each line is terminated with a carriage-return (ASCII 13) line-feed (ASCII 10) pair. The first two lines are an exception: the first contains a 40-byte SFDU aggregate label, followed by a carriage return and a line feed. The second contains 36 space characters (ASCII 32) followed by a carriage return and a line feed. The first PAIR of lines is therefore 80 bytes long, and all remaining lines are offset from the start of the file by a multiple of 80 bytes.

4.1.3. VOLDESC.CAT File

VOLDESC.CAT contains a description of the contents of this volume in a PDS format readable by both humans and computers. This is an ASCII file with 80 byte records. Each line is terminated with a carriage-return (ASCII 13) line-feed (ASCII 10) pair. The first two lines are an exception: the first contains a 40-byte SFDU aggregate label, followed by a carriage return and a line feed. The second contains 36 space characters (ASCII 32) followed by a carriage return and a line feed. The first PAIR of lines is therefore 80 bytes long, and all remaining lines are offset from the start of the file by a multiple of 80 bytes. Figure 4-2 shows a sample

VOLDESC.CAT file for the first SCVDRCD volume.

```
CCSD3ZF0000100000001NJPL3IF0PDSX00000001

PDS_VERSION_ID              = PDS3
OBJECT                      = VOLUME
 VOLUME_SERIES_NAME         = "MISSION TO VENUS"
 VOLUME_SET_NAME            = "MAGELLAN RADAR DATA PRODUCT"
 VOLUME_SET_ID              = "USA_NASA_PDS_MG_2101"
 VOLUMES                    = UNK
 VOLUME_NAME                = "MAGELLAN SURFACE CHARACTERISTICS VECTOR
                               DATA RECORD"
 VOLUME_ID                  = "MG_2101"
 VOLUME_VERSION_ID          = "VERSION 1"
 PUBLICATION_DATE           = 1995-01-01
 DATA_SET_ID                = "MGN-V-RDRS-5-SCVDR-V1.0"
 VOLUME_FORMAT              = "ISO-9660"
 MEDIUM_TYPE                = "CD-WO"
 DESCRIPTION                = "This volume contains Magellan SCVDR
   (Surface Characteristics Vector Data Record) products. It also contains
   documentation files that describe the SCVDRs."
 MISSION_NAME               = "MAGELLAN"
 SPACECRAFT_NAME            = "MAGELLAN"
 SPACECRAFT_ID              = MGN
 OBJECT                     = DATA_PRODUCER
  INSTITUTION_NAME          = "STANFORD UNIVERSITY"
  FACILITY_NAME             = "CENTER FOR RADAR ASTRONOMY"
  FULL_NAME                 = "DR. G. LEONARD TYLER"
  ADDRESS_TEXT              = "STARLAB
                              DURAND BLDG, ROOM 232
                              STANFORD, CALIFORNIA, 94305-4055, USA"
 END_OBJECT                 = DATA_PRODUCER
 OBJECT                     = CATALOG
  ^DATA_SET_CATALOG         = "DATASET.CAT"
  ^INSTRUMENT_CATALOG       = "INST.CAT"
  ^INSTRUMENT_HOST_CATALOG  = "INSTHOST.CAT"
  ^MISSION_CATALOG          = "MISSION.CAT"
  ^PERSONNEL_CATALOG        = "PERSONEL.CAT"
  ^REFERENCE_CATALOG        = "REFS.CAT"
 END_OBJECT                 = CATALOG
END_OBJECT                  = VOLUME
END
```

Figure 4-2. Example VOLDESC.CAT File

4.1.3.1. Keywords and Values

Keywords in Figure 4-2 are defined in [3]. They are used in this application as follows:

PDS_VERSION_ID	The version of PDS standards to which this volume adheres; set to "PDS3".
VOLUME_SERIES_NAME	The formal name that describes a broad categorization of data products. For the SCVDRCD, set to "MISSION TO VENUS"
VOLUME_SET_NAME	The formal name describing one or more volumes containing a single data set or a collection of related data sets. For the SCVDRCD, set to "MAGELLAN RADAR DATA PRODUCT"

VOLUME_SET_ID	Identification of a data volume or a set of archive data volumes. For the SCVDRCD, set to "USA_NASA_JPL_ACRONYM_SEQUENCE" where ACRONYM and SEQUENCE are defined in Section 2.3.1. See also VOLUME_ID, below.
VOLUMES	The number of physical volumes in a volume set. Volume sets of SCVDRCD data will generally be single volumes, so this value will be set to "1".
VOLUME_NAME	The formal name of the individual SCVDRCD volume; a more specific identification than VOLUME_SET_NAME. For the SCVDRCD, set to "MAGELLAN SURFACE CHARACTERISTICS VECTOR DATA RECORD".
VOLUME_ID	A unique identifier for the volume. Usually the last two components of the VOLUME_SET_ID (see also Section 2.3.1). For the SCVDRCD, set to "MG_21nn".
VOLUME_VERSION_ID	The version of the data volume, starting with "1" for original versions and incrementing by 1 for each subsequent version.
PUBLICATION_DATE	The date in YYYY-MM-DD format on which the volume was published or released (see Section 1.4.3).
DATA_SET_ID	A unique alphanumeric identifier for the data set. For the SCVDRCD, set to "MGN-V-RDRS-5-SCVDR-V1.0"
VOLUME_FORMAT	The logical format used in writing the SCVDRCD volume. Set to "ISO-9660".
MEDIUM_TYPE	The physical storage medium for the SCVDRCD volume. Set to "CD-WO".
DESCRIPTION	A brief text description of the contents of the SCVDRCD volume.
MISSION_NAME	The planetary mission or project under which the data were acquired. A single mission may be associated with one or more spacecraft. For the SCVDRCD, set to "MAGELLAN"
SPACECRAFT_NAME	The full name of the spacecraft with which these data are associated. For the SCVDRCD, set to "MAGELLAN"
SPACECRAFT_ID	A mnemonic uniquely associated with SPACECRAFT_NAME. For the SCVDRCD, set to "MGN"
INSTITUTION_NAME	The name of the institution under which this SCVDRCD volume was produced. Set to "STANFORD UNIVERSITY".
FACILITY_NAME	The name of the department, laboratory, or subsystem under which this SCVDRCD volume was produced. Set to "CENTER FOR RADAR ASTRONOMY".
FULL_NAME	The name of the individual or organization responsible for producing this SCVDRCD volume. For the SCVDRCD, set to "DR. G. LEONARD TYLER".
ADDRESS_TEXT	Mailing address for the individual or organization responsible for producing this SCVDRCD volume. For the SCVDRCD, set to "STARLAB, DURAND BLDG, ROOM 232, STANFORD, CALIFORNIA, 94305-4055, USA".
^DATA_SET_CATALOG	File name in the CATALOG directory under which the PDS data set template is stored. Set to "DATASET.CAT".
^INSTRUMENT_CATALOG	File name in the CATALOG directory under which the PDS instrument template is stored. Set to "INST.CAT".

^INSTRUMENT_HOST_CATALOG	File name in the CATALOG directory under which the PDS instrument host template is stored. Set to "INSTHOST.CAT".
^MISSION_CATALOG	File name in the CATALOG directory under which the PDS mission template is stored. Set to "MISSION.CAT".
^PERSONNEL_CATALOG	File name in the CATALOG directory under which the PDS personnel template is stored. Set to "PERSONEL.CAT".
^REFERENCE_CATALOG	File name in the CATALOG directory under which the PDS reference template is stored. Set to "REFS.CAT".

4.2. Static Directories

Static directories are those which do not change (or change very little) from one volume to another. They appear on all volumes.

4.2.1. CATALOG Directory

The CATALOG directory contains files used in cataloging the data, including files which provide a detailed description of this volume.

4.2.1.1. CATINFO.TXT File

The CATINFO.TXT file contains a description of the contents of the CATALOG directory. The file has an attached PDS label of the form shown in Figure 4-1. This is an ASCII file with 80-byte records. Each line is terminated with a carriage-return (ASCII 13) line-feed (ASCII 10) pair. The first two lines are an exception: the first contains a 40-byte SFDU aggregate label, followed by a carriage return and a line feed. The second contains 36 space characters (ASCII 32) followed by a carriage return and a line feed. The first PAIR of lines is therefore 80 bytes long, and all remaining lines are offset from the start of the file by a multiple of 80 bytes.

4.2.1.2. DATASET.CAT File

The DATASET.CAT file contains PDS catalog information about the data set on this archive volume. This is an ASCII file with 80-byte records. Each line is terminated with a carriage-return (ASCII 13) line-feed (ASCII 10) pair. The first two lines are an exception: the first contains a 40-byte SFDU aggregate label, followed by a carriage return and a line feed. The second contains 36 space characters (ASCII 32) followed by a carriage return and a line feed. The first PAIR of lines is therefore 80 bytes long, and all remaining lines are offset from the start of the file by a multiple of 80 bytes.

4.2.1.3. INST.CAT File

The INST.CAT file contains PDS catalog information about the Magellan radar sensor. This is an ASCII file with 80-byte records. Each line is terminated with a carriage-return (ASCII 13) line-feed (ASCII 10) pair. The first two lines are an exception: the first contains a 40-byte SFDU aggregate label, followed by a carriage return and a line feed. The second contains 36 space characters (ASCII 32) followed by a carriage return and a line feed. The first PAIR of lines is therefore 80 bytes long, and all remaining lines are offset from the start of the file by a multiple of 80 bytes.

4.2.1.4. INSTHOST.CAT File

The INSTHOST.CAT file contains PDS catalog information about the Magellan spacecraft. This is an ASCII file with 80-byte records. Each line is terminated with a carriage-return (ASCII 13) line-feed (ASCII 10) pair. The first two lines are an exception: the first contains a 40-byte SFDU aggregate label, followed by a carriage return and a line feed. The second contains 36 space characters (ASCII 32) followed by a carriage return and a line feed. The first PAIR of lines is therefore 80 bytes long, and all remaining lines are offset from the start of the file by a multiple of 80 bytes.

4.2.1.5. MISSION.CAT File

The MISSION.CAT file contains PDS catalog information about the Magellan mission. This is an ASCII file with 80-byte records. Each line is terminated with a carriage-return (ASCII 13) line-feed (ASCII 10) pair. The first two lines are an exception: the first contains a 40-byte SFDU aggregate label, followed by a carriage return and a line feed. The second contains 36 space characters (ASCII 32) followed by a carriage return and a line feed. The first PAIR of lines is therefore 80 bytes long, and all remaining lines are offset from the start of the file by a multiple of 80 bytes.

4.2.1.6. PERSONEL.CAT File

The PERSONEL.CAT file contains PDS catalog information about personnel who contributed to this data set. This is an ASCII file with 80-byte records. Each line is terminated with a carriage-return (ASCII 13) line-feed (ASCII 10) pair. The first two lines are an exception: the first contains a 40-byte SFDU aggregate label, followed by a carriage return and a line feed. The second contains 36 space characters (ASCII 32) followed by a carriage return and a line feed. The first PAIR of lines is therefore 80 bytes long, and all remaining lines are offset

4.2.1.7. REFS.CAT File

The REFS.CAT file contains PDS catalog information of references to published papers that describe this data set. This is an ASCII file with 80-byte records. Each line is terminated with a carriage-return (ASCII 13) line-feed (ASCII 10) pair. The first two lines are an exception: the first contains a 40-byte SFDU aggregate label, followed by a carriage return and a line feed. The second contains 36 space characters (ASCII 32) followed by a carriage return and a line feed. The first PAIR of lines is therefore 80 bytes long, and all remaining lines are offset from the start of the file by a multiple of 80 bytes.

4.2.2. DOCUMENT Directory

The DOCUMENT directory contains files which describe the data included in the SCVDRCD volume.

4.2.2.1. DOCINFO.TXT File

The DOCINFO.TXT file contains a description of the contents of the DOCUMENT directory. The file has an attached PDS label of the form shown in Figure 4-1. This is an ASCII file with 80-byte records. Each line is terminated with a carriage-return (ASCII 13) line-feed (ASCII 10) pair. The first two lines are an exception: the first contains a 40-byte SFDU aggregate label, followed by a carriage return and a line feed. The second contains 36 space characters (ASCII 32) followed by a carriage return and a line feed. The first PAIR of lines is therefore 80 bytes long, and all remaining lines are offset from the start of the file by a multiple of 80 bytes.

4.2.2.2. SCVDR.ASC File

The SCVDR.ASC file is the Software Interface Specification for the SCVDR (the Stanford University product from which this SCVDRCD was made). This is an ASCII file with 80-byte records, suitable for display or printing at 66 lines per page with up to 78 constant-width characters per line. Each line is terminated with a carriage-return (ASCII 13) line-feed (ASCII 10) pair.

4.2.2.3. SCVDR.LBL File

SCVDR.LBL is a detached label that completely describes SCVDR.ASC and SCVDR.PS. The length of the SCVDR.LBL file is an integral multiple of 80 bytes. All records are padded to 80 bytes with ASCII blanks. Each record ends with a carriage-return (ASCII 13) line-feed (ASCII 10) pair. The first two lines are an exception: the first contains a 40-byte SFDU aggregate label, followed by a carriage return and a line feed. The second contains 36 space characters (ASCII 32) followed by a carriage return and a line feed. The first PAIR of lines is therefore 80 bytes long, and all remaining lines are offset from the start of the file by a multiple of 80 bytes.

4.2.2.4. SCVDR.PS File

The SCVDR.PS file is the Software Interface Specification for the SCVDR (the Stanford University product from which this SCVDRCD was made). This is a PostScript file with varying length records, suitable for previewing with a Display PostScript application on a high-resolution graphics terminal or direct printing on a laser printer or photo-typesetter. Each line is terminated with a carriage-return (ASCII 13) line-feed (ASCII 10) pair.

4.2.2.5. SCVDRCD.ASC File

The SCVDRCD.ASC file is the Software Interface Specification for the SCVDRCD (this document). This is an ASCII file with 80-byte records, suitable for display or printing at 66 lines per page with up to 78 constant-width characters per line. Each line is terminated with a carriage-return (ASCII 13) line-feed (ASCII 10) pair.

4.2.2.6. SCVDRCD.LBL File

SCVDRCD.LBL is a detached label that completely describes SCVDRCD.ASC and SCVDRCD.PS. The length of the SCVDRCD.LBL file is an integral multiple of 80 bytes. All records are padded to 80 bytes with ASCII blanks. Each record ends with a carriage-return (ASCII 13) line-feed (ASCII 10) pair. The first two lines are an exception: the first contains a 40-byte SFDU aggregate label, followed by a carriage return and a line feed. The second contains 36 space characters (ASCII 32) followed by a carriage return and a line feed. The first PAIR of lines is therefore 80 bytes long, and all remaining lines are offset from the start of the file by a multiple of 80 bytes.

4.2.2.7. SCVDRCD.PS File

The SCVDRCD.PS file is the Software Interface Specification for the SCVDRCD (this document). This is a PostScript file with varying length records, suitable for previewing with a Display PostScript application on a high-resolution graphics terminal or direct printing on a laser printer or photo-typesetter. Each line is terminated with a carriage-return (ASCII 13) line-feed (ASCII 10) pair.

4.2.3. INDEX Directory

4.2.3.1. CUMINDEX.LBL File

CUMINDEX.LBL is a detached label that completely describes CUMINDEX.TAB. The length of the CUMINDEX.LBL file is an integral multiple of 80 bytes. All records are padded to 80 bytes with ASCII blanks. Each record ends with a carriage-return (ASCII 13) line-feed (ASCII 10) pair. The first two lines are an exception: the first contains a 40-byte SFDU aggregate label, followed by a carriage return and a line feed. The second contains 36 space characters (ASCII 32) followed by a carriage return and a line feed. The first PAIR of lines is therefore 80 bytes long, and all remaining lines are offset from the start of the file by a multiple of 80 bytes.

CUMINDEX.LBL differs from INDEX.LBL (see Appendix A) in only three ways:

* DESCRIPTION refers to CUMINDEX.TAB rather than to INDEX.TAB
* ^TABLE points to CUMINDEX.TAB rather than to INDEX.TAB
* INDEX_TYPE = CUMULATIVE rather than SINGLE

4.2.3.2. CUMINDEX.TAB File

CUMINDEX.TAB is a table listing all SCVDRCD data files published in all volumes of the volume set to date. It is an ASCII file with fixed-length 78-byte records. Each record contains 76 data bytes followed by a carriage-return (ASCII 13) line-feed (ASCII 10) pair. The detailed format and content are described by CUMINDEX.LBL.

4.2.3.3. INDEX.LBL File

INDEX.LBL is a detached label that completely describes INDEX.TAB. The length of the INDEX.LBL file is an integral multiple of 80 bytes. All records are padded to 80 bytes with ASCII blanks. Each record ends with a carriage-return (ASCII 13) line-feed (ASCII 10) pair. The first two lines are an exception: the first contains a

40-byte SFDU aggregate label, followed by a carriage return and a line feed. The second contains 36 space characters (ASCII 32) followed by a carriage return and a line feed. The first PAIR of lines is therefore 80 bytes long, and all remaining lines are offset from the start of the file by a multiple of 80 bytes. An example label for a SCVDRCD index is shown in Appendix A. Keywords are defined in [3].

4.2.3.4. INDEX.TAB File

INDEX.TAB is a table listing all SCVDRCD data files published in this volume. It is an ASCII file with fixed-length 78-byte records. Each record contains 76 data bytes followed by a carriage-return (ASCII 13) line-feed (ASCII 10) pair. The detailed format and content are described by INDEX.LBL.

4.2.3.5. INDXINFO.TXT File

The INDXINFO.TXT file contains a description of the contents of the INDEX directory. The file has an attached PDS label of the form shown in Figure 4-1. This is an ASCII file with 80-byte records. Each line is terminated with a carriage-return (ASCII 13) line-feed (ASCII 10) pair. The first two lines are an exception: the first contains a 40-byte SFDU aggregate label, followed by a carriage return and a line feed. The second contains 36 space characters (ASCII 32) followed by a carriage return and a line feed. The first PAIR of lines is therefore 80 bytes long, and all remaining lines are offset from the start of the file by a multiple of 80 bytes.

4.2.4. LABEL Directory

4.2.4.1. LABINFO.TXT File

The LABINFO.TXT file contains a description of the contents of the LABEL directory. The file has an attached PDS label of the form shown in Figure 4-1. This is an ASCII file with 80-byte records. Each line is terminated with a carriage-return (ASCII 13) line-feed (ASCII 10) pair. The first two lines are an exception: the first contains a 40-byte SFDU aggregate label, followed by a carriage return and a line feed. The second contains 36 space characters (ASCII 32) followed by a carriage return and a line feed. The first PAIR of lines is therefore 80 bytes long, and all remaining lines are offset from the start of the file by a multiple of 80 bytes.

4.2.4.2. SCVDRANF.FMT File

This file describes the contents of the binary data records in the ANF files in the data directories [6]. This is an ASCII file with 80-byte records. Each line is terminated with a carriage-return (ASCII 13) line-feed (ASCII 10) pair. The first two lines are an exception: the first contains a 40-byte SFDU aggregate label, followed by a carriage return and a line feed. The second contains 36 space characters (ASCII 32) followed by a carriage return and a line feed. The first PAIR of lines is therefore 80 bytes long, and all remaining lines are offset from the start of the file by a multiple of 80 bytes. records. Each record is delimited by a carriage-return (ASCII 13) line-feed (ASCII 10) pair.

4.2.4.3. SCVDRANH.FMT File

This file describes the contents of the binary header record in the ANF files in the data directories [6]. This is an ASCII file with 80-byte records. Each line is terminated with a carriage-return (ASCII 13) line-feed (ASCII 10) pair. The first two lines are an exception: the first contains a 40-byte SFDU aggregate label, followed by a carriage return and a line feed. The second contains 36 space characters (ASCII 32) followed by a carriage return and a line feed. The first PAIR of lines is therefore 80 bytes long, and all remaining lines are offset from the start of the file by a multiple of 80 bytes. records. Each record is delimited by a carriage-return (ASCII 13) line-feed (ASCII 10) pair.

4.2.4.4. SCVDREDF.FMT File

This file describes the contents of the binary data records in the EDF files in the data directories [6]. This is an ASCII file with 80-byte records. Each line is terminated with a carriage-return (ASCII 13) line-feed (ASCII 10) pair. The first two lines are an exception: the first contains a 40-byte SFDU aggregate label, followed by a carriage return and a line feed. The second contains 36 space characters (ASCII 32) followed by a carriage return and a line feed. The first PAIR of lines is therefore 80 bytes long, and all remaining lines are offset from the start of the file by a multiple of 80 bytes. records. Each record is delimited by a carriage-return (ASCII 13)

line-feed (ASCII 10) pair.

4.2.4.5. SCVDREDH.FMT File

This file describes the contents of the binary header record in the EDF files in the data directories [6]. This is an ASCII file with 80-byte records. Each line is terminated with a carriage-return (ASCII 13) line-feed (ASCII 10) pair. The first two lines are an exception: the first contains a 40-byte SFDU aggregate label, followed by a carriage return and a line feed. The second contains 36 space characters (ASCII 32) followed by a carriage return and a line feed. The first PAIR of lines is therefore 80 bytes long, and all remaining lines are offset from the start of the file by a multiple of 80 bytes. records. Each record is delimited by a carriage-return (ASCII 13) line-feed (ASCII 10) pair.

4.2.4.6. SCVDRGMF.FMT File

This file describes the contents of the binary data records in the GMF files in the GEOMETRY directory [6]. This is an ASCII file with 80-byte records. Each line is terminated with a carriage-return (ASCII 13) line-feed (ASCII 10) pair. The first two lines are an exception: the first contains a 40-byte SFDU aggregate label, followed by a carriage return and a line feed. The second contains 36 space characters (ASCII 32) followed by a carriage return and a line feed. The first PAIR of lines is therefore 80 bytes long, and all remaining lines are offset from the start of the file by a multiple of 80 bytes. records. Each record is delimited by a carriage-return (ASCII 13) line-feed (ASCII 10) pair.

4.2.4.7. SCVDRGMH.FMT File

This file describes the contents of the binary header record in the GMF files in the GEOMETRY directory [6]. This is an ASCII file with 80-byte records. Each line is terminated with a carriage-return (ASCII 13) line-feed (ASCII 10) pair. The first two lines are an exception: the first contains a 40-byte SFDU aggregate label, followed by a carriage return and a line feed. The second contains 36 space characters (ASCII 32) followed by a carriage return and a line feed. The first PAIR of lines is therefore 80 bytes long, and all remaining lines are offset from the start of the file by a multiple of 80 bytes. records. Each record is delimited by a carriage-return (ASCII 13) line-feed (ASCII 10) pair.

4.2.4.8. SCVDRIMF.FMT File

This file describes the contents of the binary data records in the OIF and SIF files in the data directories [6]. This is an ASCII file with 80-byte records. Each line is terminated with a carriage-return (ASCII 13) line-feed (ASCII 10) pair. The first two lines are an exception: the first contains a 40-byte SFDU aggregate label, followed by a carriage return and a line feed. The second contains 36 space characters (ASCII 32) followed by a carriage return and a line feed. The first PAIR of lines is therefore 80 bytes long, and all remaining lines are offset from the start of the file by a multiple of 80 bytes. records. Each record is delimited by a carriage-return (ASCII 13) line-feed (ASCII 10) pair.

4.2.4.9. SCVDRIMH.FMT File

This file describes the contents of the binary header record in the OIF and SIF files in the data directories [6]. This is an ASCII file with 80-byte records. Each line is terminated with a carriage-return (ASCII 13) line-feed (ASCII 10) pair. The first two lines are an exception: the first contains a 40-byte SFDU aggregate label, followed by a carriage return and a line feed. The second contains 36 space characters (ASCII 32) followed by a carriage return and a line feed. The first PAIR of lines is therefore 80 bytes long, and all remaining lines are offset from the start of the file by a multiple of 80 bytes. records. Each record is delimited by a carriage-return (ASCII 13) line-feed (ASCII 10) pair.

4.2.4.10. SCVDRNFF.FMT File

This file describes the contents of the binary data records in the NFF files in the data directories [6]. This is an ASCII file with 80-byte records. Each line is terminated with a carriage-return (ASCII 13) line-feed (ASCII 10) pair. The first two lines are an exception: the first contains a 40-byte SFDU aggregate label, followed by a carriage return and a line feed. The second contains 36 space characters (ASCII 32) followed by a carriage return and a line feed. The first PAIR of lines is therefore 80 bytes long, and all remaining lines are offset from the

start of the file by a multiple of 80 bytes. records. Each record is delimited by a carriage-return (ASCII 13) line-feed (ASCII 10) pair.

4.2.4.11. SCVDRNFH.FMT File

This file describes the contents of the binary header record in the NFF files in the data directories [6]. This is an ASCII file with 80-byte records. Each line is terminated with a carriage-return (ASCII 13) line-feed (ASCII 10) pair. The first two lines are an exception: the first contains a 40-byte SFDU aggregate label, followed by a carriage return and a line feed. The second contains 36 space characters (ASCII 32) followed by a carriage return and a line feed. The first PAIR of lines is therefore 80 bytes long, and all remaining lines are offset from the start of the file by a multiple of 80 bytes. records. Each record is delimited by a carriage-return (ASCII 13) line-feed (ASCII 10) pair.

4.2.4.12. SCVDROHF.FMT File

This file describes the contents of the single binary data record in the OHF files in the data directories [6]. This is an ASCII file with 80-byte records. Each line is terminated with a carriage-return (ASCII 13) line-feed (ASCII 10) pair. The first two lines are an exception: the first contains a 40-byte SFDU aggregate label, followed by a carriage return and a line feed. The second contains 36 space characters (ASCII 32) followed by a carriage return and a line feed. The first PAIR of lines is therefore 80 bytes long, and all remaining lines are offset from the start of the file by a multiple of 80 bytes. records. Each record is delimited by a carriage-return (ASCII 13) line-feed (ASCII 10) pair.

4.2.5. SOFTWARE Directory

This directory contains a small number of C, C++, and Perl commands that read SCVDR data files. These commands do nothing powerful—they are intended to be employed as skeletons around which useful software can be constructed.

All lines in these files have been padded on the right with blanks and terminated with an ASCII carriage return and linefeed in columns 79 and 80. It may be necessary to copy the files to magnetic disk, removing one or more of these characters in order to compile these sources on particular operating systems. Similarly, many of the C language source and header files embed other header files using lowercase file names. On systems such as MacOS or UNIX that are case-sensitive toward file names, it may be necessary to copy the include files onto magnetic disk and rename them to lower case letters if the CD-ROM file names are represented in uppercase.

Most files in this directory do **NOT** contain PDS labels.

4.2.5.1. MAKEFILE.MAK File

This file contains a script used by the software maintenance command "make" to generate executables from the C-language source files in this directory. This is an ASCII file with 80-byte records. Each line is terminated with a carriage-return (ASCII 13) line-feed (ASCII 10) pair. The syntax is simply "make", but it may be necessary to copy the files to magnetic disk, removing one or more of these characters in order to compile these sources on particular operating systems.

4.2.5.2. SCV_RDR.C File

This file contains a set of low level C-language routines to read SCVDR data files into the structures defined in SCVDR.H. SCV_RDR.C calls the routines in SCVPARSE.C to handle PDS and CCSDS labels. This is an ASCII file with 80-byte records. Each line is terminated with a carriage-return (ASCII 13) line-feed (ASCII 10) pair.

4.2.5.3. SCV_RDR.I File

This file contains C-language function definition skeletons for SCV_RDR.C routines. It may be used with C++ and with ANSI and K&R C compilers. This is an ASCII file with 80-byte records. Each line is terminated with a carriage-return (ASCII 13) line-feed (ASCII 10) pair.

4.2.5.4. SCVDR.H File

This C language header file defines all SCVDR binary data structures. This is an ASCII file with 80-byte records. Each line is terminated with a carriage-return (ASCII 13) line-feed (ASCII 10) pair.

4.2.5.5. SCVDRSCN.PL File

This Perl script lists the contents of SCVDR data files. The file also functions as its own UNIX manual and can be printed by "nroff -man" or "troff -man". This is an ASCII file with 80-byte records. Each line is terminated with a carriage-return (ASCII 13) line-feed (ASCII 10) pair.

4.2.5.6. SCVPARSE.C File

This file contains low-level C-language routines to parse PDS and CCSDS SFDU labels. It is an ASCII file with 80-byte records. Each line is terminated with a carriage-return (ASCII 13) line-feed (ASCII 10) pair.

4.2.5.7. SCVPARSE.H File

This C language header file contains definitions of PDS and CCSDS SFDU SFDU labels. It is an ASCII file with 80-byte records. Each line is terminated with a carriage-return (ASCII 13) line-feed (ASCII 10) pair.

4.2.5.8. SCVPARSE.I File

This file contains C-language function definition skeletons for SCVPARSE.C routines. It may be used with C++ and with ANSI and K&R C compilers. This is an ASCII file with 80-byte records. Each line is terminated with a carriage-return (ASCII 13) line-feed (ASCII 10) pair.

4.2.5.9. SOFTINFO.TXT File

The SOFTINFO.TXT file contains a description of the contents of the SOFTWARE directory. The file has an attached PDS label of the form shown in Figure 4-1. This is an ASCII file with 80-byte records. Each line is terminated with a carriage-return (ASCII 13) line-feed (ASCII 10) pair. The first two lines are an exception: the first contains a 40-byte SFDU aggregate label, followed by a carriage return and a line feed. The second contains 36 space characters (ASCII 32) followed by a carriage return and a line feed. The first PAIR of lines is therefore 80 bytes long, and all remaining lines are offset from the start of the file by a multiple of 80 bytes.

4.2.5.10. TESTANF.C File

This is a C language main program that reads an ANF (altimetry inversion) file (specified as its only argument). If successful, it returns without any output. Otherwise, it writes an error message to stderr and then exits. It may be used as a skeleton for the development of more realistic applications. This is an ASCII file with 80-byte records. Each line is terminated with a carriage-return (ASCII 13) line-feed (ASCII 10) pair.

4.2.5.11. TESTEDF.C File

This is a C language main program that reads an EDF (emissivity) file (specified as its only argument). If successful, it returns without any output. Otherwise, it writes an error message to stderr and then exits. It may be used as a skeleton for the development of more realistic applications. This is an ASCII file with 80-byte records. Each line is terminated with a carriage-return (ASCII 13) line-feed (ASCII 10) pair.

4.2.5.12. TESTGMF.C File

This is a C language main program that reads a GMF (G-Matrix) file (specified as its only argument). If successful, it returns without any output. Otherwise, it writes an error message to stderr and then exits. It may be used as a skeleton for the development of more realistic applications. This is an ASCII file with 80-byte records. Each line is terminated with a carriage-return (ASCII 13) line-feed (ASCII 10) pair.

4.2.5.13. TESTIF.C File

This is a C language main program that reads a SIF (sinusoidal image data) or OIF (oblique sinusoidal image data) file (specified as its only argument). If successful, it returns without any output. Otherwise, it writes an

error message to stderr and then exits. It may be used as a skeleton for the development of more realistic applications. This is an ASCII file with 80-byte records. Each line is terminated with a carriage-return (ASCII 13) line-feed (ASCII 10) pair.

4.2.5.14. TESTNFF.C File

This is a C language main program that reads an NFF (inversion fit) file (specified as its only argument). If successful, it returns without any output. Otherwise, it writes an error message to stderr and then exits. It may be used as a skeleton for the development of more realistic applications. This is an ASCII file with 80-byte records. Each line is terminated with a carriage-return (ASCII 13) line-feed (ASCII 10) pair.

4.2.5.15. TESTOHF.C File

This is a C language main program that reads an OHF (orbit header) file (specified as its only argument). If successful, it returns without any output. Otherwise, it writes an error message to stderr and then exits. It may be used as a skeleton for the development of more realistic applications. This is an ASCII file with 80-byte records. Each line is terminated with a carriage-return (ASCII 13) line-feed (ASCII 10) pair.

4.2.5.16. TYPES.H File

This is a C-language header file containing miscellaneous SCVDR definitions. This is an ASCII file with 80-byte records. Each line is terminated with a carriage-return (ASCII 13) line-feed (ASCII 10) pair.

4.3. Data Directories

SCVDRCD volumes include directories for each orbit during which useful surface characteristics data were taken. The data inherited from the SCVDR products are recorded in 6 separate binary files:

ANF*nnnnn*.*v*	Altimetry Inversion File
EDF*nnnnn*.*v*	Emissivity Data File
NFF*nnnnn*.*v*	Altimetry Inversion Fit File
OHF*nnnnn*.*v*	Orbit Header File
OIF*nnnnn*.*v*	Oblique Sinusoidal Image File
SIF*nnnnn*.*v*	Sinusoidal Image File

Each data file is paired with a PDS detached label file with the same name; e.g. ANF00376.1 is paired with ANF00376.LBL. The label files describe the contents of the data files in the Planetary Data System's Object Descriptor Language (ODL) as described in [2]. Examples of label files and companion format files are included in Appendices A and B, respectively.

4.3.1. ANFnnnnn.v

The Altimetry Inversion File (ANF) tabulates the radar scattering cross-section for varying incidence angles at a series of footprints lying along the Magellan nadir track. It is generated from the ALT-EDR product. Its format

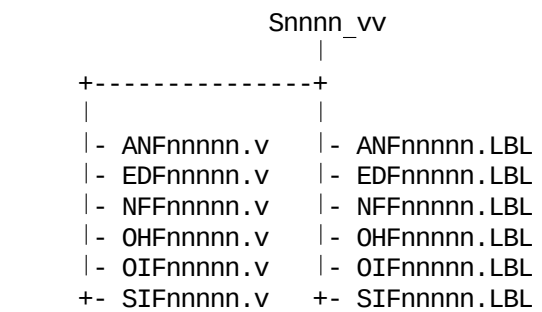

Figure 4-3. Example SCVDRCD Data Directory Structure

is defined in [6].

4.3.2. ANFnnnnn.LBL

ANFnnnnn.LBL is a detached label that describes the accompanying ANFnnnnn.v file. Its length is an integral multiple of 80 bytes. All records are padded to 80 bytes with ASCII blanks, and each record ends with a carriage-return (ASCII 13) line-feed (ASCII 10) pair. The first two lines are an exception: the first contains a 40-byte SFDU aggregate label, followed by a carriage return and a line feed. The second contains 36 space characters (ASCII 32) followed by a carriage return and a line feed. The first PAIR of lines is therefore 80 bytes long, and all remaining lines are offset from the start of the file by a multiple of 80 bytes. An example ANFnnnnn.LBL file is shown in Appendix A.

4.3.3. EDFnnnnn.v

The Emissivity Data File (EDF) tabulates the microwave emissivity of the surface footprint defined by the intersection of the Magellan High Gain Antenna with the Venus surface. It is generated from radiometer measurements contained in the Magellan SAR burst header files on ALT-EDR and C-BIDR products. Its format is defined in [6].

4.3.4. EDFnnnnn.LBL

EDFnnnnn.LBL is a detached label that describes the accompanying EDFnnnnn.v file. Its length is an integral multiple of 80 bytes. All records are padded to 80 bytes with ASCII blanks, and each record ends with a carriage-return (ASCII 13) line-feed (ASCII 10) pair. The first two lines are an exception: the first contains a 40-byte SFDU aggregate label, followed by a carriage return and a line feed. The second contains 36 space characters (ASCII 32) followed by a carriage return and a line feed. The first PAIR of lines is therefore 80 bytes long, and all remaining lines are offset from the start of the file by a multiple of 80 bytes. An example EDFnnnnn.LBL file is shown in Appendix A.

4.3.5. NFFnnnnn.v

The Altimetry Inversion Fit File (NFF) contains the results of fitting one or more scattering models to the scattering function of each footprint of the accompanying ANF file. Its format is defined in [6].

4.3.6. NFFnnnnn.LBL

NFFnnnnn.LBL is a detached label that describes the accompanying NFFnnnnn.v file. Its length is an integral multiple of 80 bytes. All records are padded to 80 bytes with ASCII blanks, and each record ends with a carriage-return (ASCII 13) line-feed (ASCII 10) pair. The first two lines are an exception: the first contains a 40-byte SFDU aggregate label, followed by a carriage return and a line feed. The second contains 36 space characters (ASCII 32) followed by a carriage return and a line feed. The first PAIR of lines is therefore 80 bytes long, and all remaining lines are offset from the start of the file by a multiple of 80 bytes. An example NFFnnnnn.LBL file is shown in Appendix A.

4.3.7. OHFnnnnn.v

The Orbit Header File (OHF) contains information about the other five data files in the same directory. Its format is defined in [6].

4.3.8. OHFnnnnn.LBL

OHFnnnnn.LBL is a detached label that describes the accompanying OHFnnnnn.v file. Its length is an integral multiple of 80 bytes. All records are padded to 80 bytes with ASCII blanks, and each record ends with a carriage-return (ASCII 13) line-feed (ASCII 10) pair. The first two lines are an exception: the first contains a 40-byte SFDU aggregate label, followed by a carriage return and a line feed. The second contains 36 space characters (ASCII 32) followed by a carriage return and a line feed. The first PAIR of lines is therefore 80 bytes long, and all remaining lines are offset from the start of the file by a multiple of 80 bytes. An example OHFnnnnn.LBL file is shown in Appendix A.

4.3.9. OIFnnnnn.v

The Oblique Sinusoidal Image File (OIF) contains the results of fitting an N-th order polynomial in incidence angle to the measurements of SAR backscatter cross-section at each line of a polar image file. It is generated from Magellan C-BIDR and F-BIDR products. Its format is defined in [6].

4.3.10. OIFnnnnn.LBL

OIFnnnnn.LBL is a detached label that describes the accompanying OIFnnnnn.v file. Its length is an integral multiple of 80 bytes. All records are padded to 80 bytes with ASCII blanks, and each record ends with a carriage-return (ASCII 13) line-feed (ASCII 10) pair. The first two lines are an exception: the first contains a 40-byte SFDU aggregate label, followed by a carriage return and a line feed. The second contains 36 space characters (ASCII 32) followed by a carriage return and a line feed. The first PAIR of lines is therefore 80 bytes long, and all remaining lines are offset from the start of the file by a multiple of 80 bytes. An example OIFnnnnn.LBL file is shown in Appendix A.

4.3.11. SIFnnnnn.v

The Sinusoidal Image File (SIF) contains the results of fitting an N-th order polynomial in incidence angle to the measurements of SAR backscatter cross-section at each line of a non-polar image file. It is generated from Magellan C-BIDR and F-BIDR products. Its format is defined in [6].

4.3.12. SIFnnnnn.LBL

SIFnnnnn.LBL is a detached label that describes the accompanying SIFnnnnn.v file. Its length is an integral multiple of 80 bytes. All records are padded to 80 bytes with ASCII blanks, and each record ends with a carriage-return (ASCII 13) line-feed (ASCII 10) pair. The first two lines are an exception: the first contains a 40-byte SFDU aggregate label, followed by a carriage return and a line feed. The second contains 36 space characters (ASCII 32) followed by a carriage return and a line feed. The first PAIR of lines is therefore 80 bytes long, and all remaining lines are offset from the start of the file by a multiple of 80 bytes. An example SIFnnnnn.LBL file is shown in Appendix A.

CHAPTER 5

SUPPORT STAFF AND COGNIZANT PERSONNEL

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APPENDIX A

EXAMPLE PDS LABELS

A.1. ANF00376.LBL Example

```
CCSD3ZF0000100000001NJPL3IF0PDSX00000001

PDS_VERSION_ID                = PDS3
DATA_SET_ID                   = 'MGN-V-RDRS-5-SCVDR-V1.0'
PRODUCT_ID                    = 'ANF00376.1'
SOURCE_PRODUCT_ID             = 'SCVDR.00376-00399;1'

/* PHYSICAL DESCRIPTION OF THE FILE
RECORD_TYPE                   = FIXED_LENGTH
RECORD_BYTES                  = 32500
FILE_RECORDS                  = 25

/* LOCATION OF OBJECTS WITHIN THE FILE
^HEADER                       = ('ANF00376.1',21<BYTES>)
^HEADER_TABLE                 = ('ANF00376.1',395<BYTES>)
^TABLE                        = ('ANF00376.1',559<BYTES>)

/* GENERAL PARAMETERS
SPACECRAFT_NAME               = 'MAGELLAN'
MISSION_PHASE_NAME            = 'MAPPING CYCLE 1'
INSTRUMENT_NAME               = 'RADAR SYSTEM'
TARGET_NAME                   = 'VENUS'
ORBIT_NUMBER                  = 376
START_TIME                    = 1990-09-15T16:22:21.074
STOP_TIME                     = 1990-09-15T16:59:27.022
PRODUCT_CREATION_TIME         = 1992-08-27T22:21:46
NOTE                          = 'ALTIMETRY_INVERSION_FILE'
DESCRIPTION                   = "The Altimetry Inversion Data File (ANF)
    contains the results of inverting the time and frequency spectra of a
    single orbit of Magellan altimetry, from the ALT-EDR product, by
    means of the accompanying Geometry Matrix File (GMF). The ANF
    contains a CCSD header, a keyword and value SFDU, a binary header
    record SFDU, and one or more binary data record SFDUs, sandwiched
    between starting and ending marker SFDUs."

/* DESCRIPTION OF OBJECTS WITHIN THE FILE
OBJECT                        = HEADER
 HEADER_TYPE                  = 'N/A'
 SFDU_FORMAT_ID               = 'NJPL1K00KL00'
 INTERCHANGE_FORMAT           = ASCII
 RECORD_TYPE                  = STREAM
 BYTES                        = 374
 RECORDS                      = 14
 DESCRIPTION                  = "SFDU keyword label (K-type)."
END_OBJECT                    = HEADER
```

```
OBJECT                         = HEADER_TABLE
 HEADER_TYPE                   = ’N/A’
 SFDU_FORMAT_ID                = ’NJPL1I000005’
 INTERCHANGE_FORMAT            = BINARY
 RECORD_TYPE                   = FIXED_LENGTH
 ROW_BYTES                     = 72
 ROWS                          = 1
 COLUMNS                       = 24
 ^STRUCTURE                    = ’SCVDRANH.FMT’
 DESCRIPTION                   = "The single binary ANF header record
    contains constants that describe the inversion process, algorithm
    IDs, and the maximum sizes of arrays in the ANF data records."
END_OBJECT                     = HEADER_TABLE

OBJECT                         = TABLE
 SFDU_FORMAT_ID                = ’NJPL1I000006’
 INTERCHANGE_FORMAT            = BINARY
 RECORD_TYPE                   = UNDEFINED
 ROW_BYTES                     = ’UNK’
 ROWS                          = 712
 COLUMNS                       = 64
 ^STRUCTURE                    = ’SCVDRANF.FMT’
 DESCRIPTION                   = "Each varying length ANF data record
    contains measurements of the surface scattering cross-section at
    various incidence angle, obtained by inverting the altimeter’s delay
    and frequency spectra using the geometry matrices in the file
    ’GMF00376.1’ located in the GEOMETRY directory of this disk."
END_OBJECT                     = TABLE

END
```

A.2. CUMINDEX.LBL Example

```
CCSD3ZF0000100000001NJPL3IF0PDSX00000001

PDS_VERSION_ID           = PDS3
RECORD_TYPE              = FIXED_LENGTH
RECORD_BYTES             = 78
FILE_RECORDS             = 13
DATA_SET_ID              = ’MGN-V-RDRS-5-SCVDR-V1.0’
^TABLE                   = "CUMINDEX.TAB"
SPACECRAFT_NAME          = MAGELLAN
INSTRUMENT_NAME          = ’RADAR SYSTEM’
TARGET_NAME              = VENUS
DESCRIPTION              = "This table locates all SCVDR products
                             on all archive volumes produced to date."

/* DESCRIPTION OF THE COLUMNS CONTAINED IN THE TABLE */

OBJECT                   = TABLE
  INTERCHANGE_FORMAT     = ASCII
  ROW_BYTES              = 76
  ROWS                   = 13
  COLUMNS                = 7

  OBJECT                 = COLUMN
```

```
  NAME                = ORBIT_NUMBER
  DESCRIPTION         = "Orbit number of the data file"
  DATA_TYPE           = 'ASCII INTEGER'
  START_BYTE          = 1
  BYTES               = 4
END_OBJECT

OBJECT                = COLUMN
  NAME                = VERSION_NUMBER
  DESCRIPTION         = "Version number of the data file"
  DATA_TYPE           = 'ASCII INTEGER'
  START_BYTE          = 6
  BYTES               = 2
END_OBJECT

OBJECT                = COLUMN
  NAME                = FILE_NAME
  DESCRIPTION         = "File name of the data file on its CD-ROM"
  DATA_TYPE           = CHARACTER
 START_BYTE           = 10
 BYTES                = 7
END_OBJECT

OBJECT                = COLUMN
  NAME                = DIRECTORY_NAME
  DESCRIPTION         = "Directory in which the data file resides
                         on its CD-ROM"
  DATA_TYPE           = CHARACTER
  START_BYTE          = 23
  BYTES               = 8
END_OBJECT

OBJECT                = COLUMN
  NAME                = ORIGINAL_PRODUCT
  DESCRIPTION         = "Unique Product ID of the original SCVDR data
                         tape assigned by the Magellan Project from
                         which this SCVDR was generated."
  DATA_TYPE           = CHARACTER
  START_BYTE          = 34
  BYTES               = 19
END_OBJECT

OBJECT                = COLUMN
  NAME                = GEOMETRY_FILE_NAME
  DESCRIPTION         = "This field is only non-blank for ANF files,
                         for which it denotes the file name of the
                         geometry matrix file (GMF) used to create this
                         product. All geometry files are located in the
                         GEOMETRY directory of the same disk as the
                         corresponding ANF file."
  DATA_TYPE           = CHARACTER
 START_BYTE           = 56
 BYTES                = 10
END_OBJECT
```

```
  OBJECT                 = COLUMN
    NAME                 = VOLUME_ID
    DESCRIPTION          = "CD-ROM volume in which the data file resides"
    DATA_TYPE            = CHARACTER
    START_BYTE           = 69
    BYTES                = 7
  END_OBJECT

END_OBJECT
END
```

A.3. EDF00376.LBL Example

```
CCSD3ZF0000100000001NJPL3IF0PDSX00000001

PDS_VERSION_ID               = PDS3
DATA_SET_ID                  = 'MGN-V-RDRS-5-SCVDR-V1.0'
PRODUCT_ID                   = 'EDF00376.1'
SOURCE_PRODUCT_ID            = 'SCVDR.00376-00399;1'

/* PHYSICAL DESCRIPTION OF THE FILE
RECORD_TYPE                  = FIXED_LENGTH
RECORD_BYTES                 = 32500
FILE_RECORDS                 = 20

/* LOCATION OF OBJECTS WITHIN THE FILE
^HEADER                      = ('EDF00376.1',21<BYTES>)
^HEADER_TABLE                = ('EDF00376.1',395<BYTES>)
^TABLE                       = ('EDF00376.1',575<BYTES>)

/* GENERAL PARAMETERS
SPACECRAFT_NAME              = 'MAGELLAN'
MISSION_PHASE_NAME           = 'MAPPING CYCLE 1'
INSTRUMENT_NAME              = 'RADAR SYSTEM'
TARGET_NAME                  = 'VENUS'
ORBIT_NUMBER                 = 376
START_TIME                   = 1990-09-15T16:22:15.591
STOP_TIME                    = 1990-09-15T16:59:26.060
PRODUCT_CREATION_TIME        = 1992-08-27T22:21:46
NOTE                         = 'EMISSIVITY_FILE'
DESCRIPTION                  = "The Emissivity Data File (EDF) contains
    measurements of the microwave emissivity of the Venus surface,
    obtained from the radiometer mode of the Magellan radar sensor. The
    EDF contains a CCSD header, a keyword and value SFDU, a binary header
    record SFDU, and one or more binary data record SFDUs, sandwiched
    between starting and ending marker SFDUs."

/* DESCRIPTION OF OBJECTS WITHIN THE FILE
OBJECT                       = HEADER
 HEADER_TYPE                 = 'N/A'
 SFDU_FORMAT_ID              = 'NJPL1K00KL00'
 INTERCHANGE_FORMAT          = ASCII
 RECORD_TYPE                 = STREAM
 BYTES                       = 374
 RECORDS                     = 14
 DESCRIPTION                 = "SFDU keyword label (K-type)."
```

```
END_OBJECT                    = HEADER

OBJECT                        = HEADER_TABLE
 HEADER_TYPE                  = 'N/A'
 SFDU_FORMAT_ID               = 'NJPL1I000021'
 INTERCHANGE_FORMAT           = BINARY
 RECORD_TYPE                  = FIXED_LENGTH
 ROW_BYTES                    = 92
 ROWS                         = 1
 COLUMNS                      = 30
 ^STRUCTURE                   = 'SCVDREDH.FMT'
 DESCRIPTION                  = "The single binary EDF header record
    contains constants that describe the radiometry data reduction
    process, the algorithm IDs, and planetary parameters."
END_OBJECT                    = HEADER_TABLE

OBJECT                        = TABLE
 SFDU_FORMAT_ID               = 'NJPL1I000022'
 INTERCHANGE_FORMAT           = BINARY
 RECORD_TYPE                  = FIXED_LENGTH
 ROW_BYTES                    = 240
 ROWS                         = 2628
 COLUMNS                      = 42
 ^STRUCTURE                   = 'SCVDREDF.FMT'
 DESCRIPTION                  = "Each fixed length EDF data record
    contains the result of processing a pair of measurements made by the
    radiometric mode of the Magellan radar system, one in which the
    receiver was coupled to the high gain antenna, the other to a load at
    a known temperature. The difference between these values is used to
    derive the surface microwave brightness, and hence its emissivity."
END_OBJECT                    = TABLE

END
```

A.4. GMF00376.LBL Example

```
CCSD3ZF0000100000001NJPL3IF0PDSX00000001

PDS_VERSION_ID                = PDS3
DATA_SET_ID                   = 'MGN-V-RDRS-5-SCVDR-V1.0'
PRODUCT_ID                    = 'GMF00376.1'
SOURCE_PRODUCT_ID             = 'SCVDR.00376-00399;1'

/* PHYSICAL DESCRIPTION OF THE FILE
RECORD_TYPE                   = FIXED_LENGTH
RECORD_BYTES                  = 32500
FILE_RECORDS                  = 149

/* LOCATION OF OBJECTS WITHIN THE FILE
^HEADER                       = ('GMF00376.1',21<BYTES>)
^HEADER_TABLE                 = ('GMF00376.1',329<BYTES>)
^TABLE                        = ('GMF00376.1',459<BYTES>)

/* GENERAL PARAMETERS
SPACECRAFT_NAME               = 'MAGELLAN'
MISSION_PHASE_NAME            = 'MAPPING CYCLE 1'
```

```
INSTRUMENT_NAME               = 'RADAR SYSTEM'
TARGET_NAME                   = 'VENUS'
ORBIT_NUMBER                  = 376
PRODUCT_CREATION_TIME         = 1992-08-27T22:21:46
NOTE                          = 'GEOMETRY_MATRIX_FILE'
DESCRIPTION                   = "The Geometry Matrix Data File (GMF)
    contains the values of the G-matrices used to invert the delay and
    frequency spectra of the Magellan altimeter. The GMF contains a CCSD
    header, a keyword and value SFDU, a binary header record SFDU, and
    one or more binary data record SFDUs, sandwiched between starting and
    ending marker SFDUs."

/* DESCRIPTION OF OBJECTS WITHIN THE FILE
OBJECT                        = HEADER
 HEADER_TYPE                  = 'N/A'
 SFDU_FORMAT_ID               = 'NJPL1K00KL00'
 INTERCHANGE_FORMAT           = ASCII
 RECORD_TYPE                  = STREAM
 BYTES                        = 308
 RECORDS                      = 11
 DESCRIPTION                  = "SFDU keyword label (K-type)."
END_OBJECT                    = HEADER

OBJECT                        = HEADER_TABLE
 HEADER_TYPE                  = 'N/A'
 SFDU_FORMAT_ID               = 'NJPL1I000023'
 INTERCHANGE_FORMAT           = BINARY
 RECORD_TYPE                  = FIXED_LENGTH
 ROW_BYTES                    = 44
 ROWS                         = 1
 COLUMNS                      = 8
 ^STRUCTURE                   = 'SCVDRGMH.FMT'
 DESCRIPTION                  = "The single binary GMF header record
    contains the maximum sizes of arrays in the GMF data records."
END_OBJECT                    = HEADER_TABLE

OBJECT                        = TABLE
 SFDU_FORMAT_ID               = 'NJPL1I000024'
 INTERCHANGE_FORMAT           = BINARY
 RECORD_TYPE                  = UNDEFINED
 ROW_BYTES                    = 'UNK'
 ROWS                         = 168
 COLUMNS                      = 23
 ^STRUCTURE                   = 'SCVDRGMF.FMT'
 DESCRIPTION                  = "Each varying length GMF record contains
    the matrices used to invert the altimeter delay or frequency spectrum
    to yield the scattering functions in the ANF data records."
END_OBJECT                    = TABLE

END
```

A.5. INDEX.LBL Example

```
CCSD3ZF0000100000001NJPL3IF0PDSX00000001

PDS_VERSION_ID           = PDS3
RECORD_TYPE              = FIXED_LENGTH
RECORD_BYTES             = 78
FILE_RECORDS             = 13
DATA_SET_ID              = 'MGN-V-RDRS-5-SCVDR-V1.0'
^TABLE                   = "INDEX.TAB"
SPACECRAFT_NAME          = MAGELLAN
INSTRUMENT_NAME          = 'RADAR SYSTEM'
TARGET_NAME              = VENUS
DESCRIPTION              = "This table locates all SCVDR products
                            on the current volume"

/* DESCRIPTION OF THE COLUMNS CONTAINED IN THE TABLE */

OBJECT                   = TABLE
  INTERCHANGE_FORMAT     = ASCII
  ROW_BYTES              = 76
  ROWS                   = 13
  COLUMNS                = 7

  OBJECT                 = COLUMN
    NAME                 = ORBIT_NUMBER
    DESCRIPTION          = "Orbit number of the data file"
    DATA_TYPE            = 'ASCII INTEGER'
    START_BYTE           = 1
    BYTES                = 4
  END_OBJECT

  OBJECT                 = COLUMN
    NAME                 = VERSION_NUMBER
    DESCRIPTION          = "Version number of the data file"
    DATA_TYPE            = 'ASCII INTEGER'
    START_BYTE           = 6
    BYTES                = 2
  END_OBJECT

  OBJECT                 = COLUMN
    NAME                 = FILE_NAME
    DESCRIPTION          = "File name of the data file on this CD-ROM"
    DATA_TYPE            = CHARACTER
   START_BYTE            = 10
   BYTES                 = 7
  END_OBJECT

  OBJECT                 = COLUMN
    NAME                 = DIRECTORY_NAME
    DESCRIPTION          = "Directory in which the data file resides
                            on this CD-ROM"
    DATA_TYPE            = CHARACTER
    START_BYTE           = 23
    BYTES                = 8
  END_OBJECT
```

```
  OBJECT                 = COLUMN
    NAME                 = ORIGINAL_PRODUCT
    DESCRIPTION          = "Unique Product ID of the original SCVDR data
                            tape assigned by the Magellan Project from
                            which this SCVDR was generated."
    DATA_TYPE            = CHARACTER
    START_BYTE           = 34
    BYTES                = 19
  END_OBJECT

  OBJECT                 = COLUMN
    NAME                 = GEOMETRY_FILE_NAME
    DESCRIPTION          = "This field is only non-blank for ANF files,
                            for which it denotes the file name of the
                            geometry matrix file (GMF) used to create this
                            product. All geometry files are located in the
                            GEOMETRY directory of the same disk as the
                            corresponding ANF file."
    DATA_TYPE            = CHARACTER
   START_BYTE            = 56
   BYTES                 = 10
  END_OBJECT

  OBJECT                 = COLUMN
    NAME                 = VOLUME_ID
    DESCRIPTION          = "CD-ROM volume in which the data file resides"
    DATA_TYPE            = CHARACTER
    START_BYTE           = 69
    BYTES                = 7
  END_OBJECT

END_OBJECT
END
```

A.6. NFF00376.LBL Example

```
CCSD3ZF0000100000001NJPL3IF0PDSX00000001

PDS_VERSION_ID               = PDS3
DATA_SET_ID                  = 'MGN-V-RDRS-5-SCVDR-V1.0'
PRODUCT_ID                   = 'NFF00376.1'
SOURCE_PRODUCT_ID            = 'SCVDR.00376-00399;1'

/* PHYSICAL DESCRIPTION OF THE FILE
RECORD_TYPE                  = FIXED_LENGTH
RECORD_BYTES                 = 32500
FILE_RECORDS                 = 5

/* LOCATION OF OBJECTS WITHIN THE FILE
^HEADER                      = ('NFF00376.1',21<BYTES>)
^HEADER_TABLE                = ('NFF00376.1',393<BYTES>)
^TABLE                       = ('NFF00376.1',551<BYTES>)

/* GENERAL PARAMETERS
SPACECRAFT_NAME              = 'MAGELLAN'
MISSION_PHASE_NAME           = 'MAPPING CYCLE 1'
```

```
INSTRUMENT_NAME               = 'RADAR SYSTEM'
TARGET_NAME                   = 'VENUS'
ORBIT_NUMBER                  = 376
START_TIME                    = 1990-09-15T16:22:21.074
STOP_TIME                     = 1990-09-15T16:59:27.022
PRODUCT_CREATION_TIME         = 1992-08-27T22:21:46
NOTE                          = 'INVERSION_FIT_FILE'
DESCRIPTION                   = "The Altimetry Inversion Fit File (NFF)
    contains the results of fitting the radar scattering cross sections
    contained in the accompanying Altimetry Inversion Data File to one or
    more theoretical models. The NFF contains a CCSD header, a keyword
    and value SFDU, a binary header record SFDU, and one or more binary
    data record SFDUs, sandwiched between starting and ending marker
    SFDUs."

/* DESCRIPTION OF OBJECTS WITHIN THE FILE
OBJECT                        = HEADER
 HEADER_TYPE                  = 'N/A'
 SFDU_FORMAT_ID               = 'NJPL1K00KL00'
 INTERCHANGE_FORMAT           = ASCII
 RECORD_TYPE                  = STREAM
 BYTES                        = 372
 RECORDS                      = 14
 DESCRIPTION                  = "SFDU keyword label (K-type)."
END_OBJECT                    = HEADER

OBJECT                        = HEADER_TABLE
 HEADER_TYPE                  = 'N/A'
 SFDU_FORMAT_ID               = 'NJPL1I000007'
 INTERCHANGE_FORMAT           = BINARY
 RECORD_TYPE                  = FIXED_LENGTH
 ROW_BYTES                    = 72
 ROWS                         = 1
 COLUMNS                      = 20
 ^STRUCTURE                   = 'SCVDRNFH.FMT'
 DESCRIPTION                  = "The single binary NFF header record
    contains constants that describe the fitting process, algorithm IDs,
    and the maximum sizes of arrays in the NFF data records."
END_OBJECT                    = HEADER_TABLE

OBJECT                        = TABLE
 SFDU_FORMAT_ID               = 'NJPL1I000008'
 INTERCHANGE_FORMAT           = BINARY
 RECORD_TYPE                  = UNDEFINED
 ROW_BYTES                    = 'UNK'
 ROWS                         = 712
 COLUMNS                      = 13
 ^STRUCTURE                   = 'SCVDRNFF.FMT'
 DESCRIPTION                  = "Each varying length NFF data record
    contains the result of fitting a scattering function from the
    corresponding ANF data record to one or more scattering models."
END_OBJECT                    = TABLE

END
```

A.7. OHF00376.LBL Example

```
CCSD3ZF0000100000001NJPL3IF0PDSX00000001

PDS_VERSION_ID                = PDS3
DATA_SET_ID                   = 'MGN-V-RDRS-5-SCVDR-V1.0'
PRODUCT_ID                    = 'OHF00376.1'
SOURCE_PRODUCT_ID             = 'SCVDR.00376-00399;1'

/* PHYSICAL DESCRIPTION OF THE FILE
RECORD_TYPE                   = FIXED_LENGTH
RECORD_BYTES                  = 32500
FILE_RECORDS                  = 1

/* LOCATION OF OBJECTS WITHIN THE FILE
^HEADER                       = ('OHF00376.1',21<BYTES>)
^TABLE                        = ('OHF00376.1',371<BYTES>)

/* GENERAL PARAMETERS
SPACECRAFT_NAME               = 'MAGELLAN'
MISSION_PHASE_NAME            = 'MAPPING CYCLE 1'
INSTRUMENT_NAME               = 'RADAR SYSTEM'
TARGET_NAME                   = 'VENUS'
ORBIT_NUMBER                  = 376
START_TIME                    = 1990-09-15T16:22:15.591
STOP_TIME                     = 1990-09-15T16:59:27.022
PRODUCT_CREATION_TIME         = 1992-08-27T22:21:46
NOTE                          = 'ORBIT_HEADER_FILE'
DESCRIPTION                   = "The Orbit Header File (OHF) identifies
    the orbit number, time frame, and orbital geometry for one Magellan
    orbit. The OHF contains only a CCSD header, a keyword and value SFDU,
    and a binary header record SFDU."

/* DESCRIPTION OF OBJECTS WITHIN THE FILE
OBJECT                        = HEADER
 HEADER_TYPE                  = 'N/A'
 SFDU_FORMAT_ID               = 'NJPL1K00KL00'
 INTERCHANGE_FORMAT           = ASCII
 RECORD_TYPE                  = STREAM
 BYTES                        = 350
 RECORDS                      = 13
 DESCRIPTION                  = "SFDU keyword label (K-type)."
END_OBJECT                    = HEADER

OBJECT                        = TABLE
 SFDU_FORMAT_ID               = 'NJPL1I000004'
 INTERCHANGE_FORMAT           = BINARY
 RECORD_TYPE                  = FIXED_LENGTH
 ROW_BYTES                    = 280
 ROWS                         = 1
 COLUMNS                      = 25
 ^STRUCTURE                   = 'SCVDROHF.FMT'
 DESCRIPTION                  = "The single binary OHF data record
    contains the number of data records in the other data files, the
    starting and ending times of the data taking periods, and the
    predicted Keplerian elements of the orbit."
```

```
END_OBJECT                    = TABLE

END
```

A.8. OIF00376.LBL Example

```
CCSD3ZF0000100000001NJPL3IF0PDSX00000001

PDS_VERSION_ID                = PDS3
DATA_SET_ID                   = 'MGN-V-RDRS-5-SCVDR-V1.0'
PRODUCT_ID                    = 'OIF00376.1'
SOURCE_PRODUCT_ID             = 'SCVDR.00376-00399;1'

/* PHYSICAL DESCRIPTION OF THE FILE
RECORD_TYPE                   = FIXED_LENGTH
RECORD_BYTES                  = 32500
FILE_RECORDS                  = 19

/* LOCATION OF OBJECTS WITHIN THE FILE
^HEADER                       = ('OIF00376.1',21<BYTES>)
^HEADER_TABLE                 = ('OIF00376.1',395<BYTES>)
^TABLE                        = ('OIF00376.1',543<BYTES>)

/* GENERAL PARAMETERS
SPACECRAFT_NAME               = 'MAGELLAN'
MISSION_PHASE_NAME            = 'MAPPING CYCLE 1'
INSTRUMENT_NAME               = 'RADAR SYSTEM'
TARGET_NAME                   = 'VENUS'
ORBIT_NUMBER                  = 376
START_TIME                    = 1990-09-15T16:22:21.985
STOP_TIME                     = 1990-09-15T16:26:21.602
PRODUCT_CREATION_TIME         = 1992-08-27T22:21:46
NOTE                          = 'OBLIQUE_SINUSOIDAL_IMAGE_FILE'
DESCRIPTION                   = "The Oblique Sinusoidal Image Data File
    (OIF) contains the results of fitting the radar backscatter
    cross-section measurements of a single Magellan orbit, from the
    oblique sinusoidal (polar) image file of the C-BIDR or F-BIDR
    product, to a quadratic function, along with a histogram of pixel
    values used in the fit. The OIF contains a CCSD header, a keyword and
    value SFDU, a binary header record SFDU, and one or more binary data
    record SFDUs, sandwiched between starting and ending marker SFDUs."
CONFIDENCE_LEVEL_NOTE         = "Results close to the South Pole (within
    2 degrees) may be unreliable."

/* DESCRIPTION OF OBJECTS WITHIN THE FILE
OBJECT                        = HEADER
 HEADER_TYPE                  = 'N/A'
 SFDU_FORMAT_ID               = 'NJPL1K00KL00'
 INTERCHANGE_FORMAT           = ASCII
 RECORD_TYPE                  = STREAM
 BYTES                        = 374
 RECORDS                      = 14
 DESCRIPTION                  = "SFDU keyword label (K-type)."
END_OBJECT                    = HEADER

OBJECT                        = HEADER_TABLE
```

```
 HEADER_TYPE                 = 'N/A'
 SFDU_FORMAT_ID              = 'NJPL1I000010'
 INTERCHANGE_FORMAT          = BINARY
 RECORD_TYPE                 = FIXED_LENGTH
 ROW_BYTES                   = 60
 ROWS                        = 1
 COLUMNS                     = 12
 ^STRUCTURE                  = 'SCVDRIMH.FMT'
 DESCRIPTION                 = "The single binary OIF header record
    contains constants that describe the fitting process, algorithm IDs,
    and the maximum sizes of arrays in the OIF data records."
END_OBJECT                   = HEADER_TABLE

OBJECT                       = TABLE
 SFDU_FORMAT_ID              = 'NJPL1I000012'
 INTERCHANGE_FORMAT          = BINARY
 RECORD_TYPE                 = UNDEFINED
 ROW_BYTES                   = 'UNK'
 ROWS                        = 609
 COLUMNS                     = 45
 ^STRUCTURE                  = 'SCVDRIMF.FMT'
 DESCRIPTION                 = "Each varying length OIF data record
    contains the result of fitting the radar backscatter function derived
    from approximately 9 rasters of the C-BIDR image, or approximately 27
    rasters of the F-BIDR image, to an n'th order polynomial."
END_OBJECT                   = TABLE

END
```

A.9. SIF00376.LBL Example

```
CCSD3ZF0000100000001NJPL3IF0PDSX00000001

PDS_VERSION_ID               = PDS3
DATA_SET_ID                  = 'MGN-V-RDRS-5-SCVDR-V1.0'
PRODUCT_ID                   = 'SIF00376.1'
SOURCE_PRODUCT_ID            = 'SCVDR.00376-00399;1'

/* PHYSICAL DESCRIPTION OF THE FILE
RECORD_TYPE                  = FIXED_LENGTH
RECORD_BYTES                 = 32500
FILE_RECORDS                 = 245

/* LOCATION OF OBJECTS WITHIN THE FILE
^HEADER                      = ('SIF00376.1',21<BYTES>)
^HEADER_TABLE                = ('SIF00376.1',395<BYTES>)
^TABLE                       = ('SIF00376.1',543<BYTES>)

/* GENERAL PARAMETERS
SPACECRAFT_NAME              = 'MAGELLAN'
MISSION_PHASE_NAME           = 'MAPPING CYCLE 1'
INSTRUMENT_NAME              = 'RADAR SYSTEM'
TARGET_NAME                  = 'VENUS'
ORBIT_NUMBER                 = 376
START_TIME                   = 1990-09-15T16:23:18.479
STOP_TIME                    = 1990-09-15T16:59:25.823
```

```
PRODUCT_CREATION_TIME         = 1992-08-27T22:21:46
NOTE                          = 'SINUSOIDAL_IMAGE_FILE'
DESCRIPTION                   = "The Sinusoidal Image Data File (SIF)
    contains the results of fitting the radar backscatter cross-section
    measurements of a single Magellan orbit, from the sinusoidal image
    file of the C-BIDR or F-BIDR product, to a quadratic function, along
    with a histogram of pixel values used in the fit. The OIF contains a
    CCSD header, a keyword and value SFDU, a binary header record SFDU,
    and one or more binary data record SFDUs, sandwiched between starting
    and ending marker SFDUs."

/* DESCRIPTION OF OBJECTS WITHIN THE FILE
OBJECT                        = HEADER
 HEADER_TYPE                  = 'N/A'
 SFDU_FORMAT_ID               = 'NJPL1K00KL00'
 INTERCHANGE_FORMAT           = ASCII
 RECORD_TYPE                  = STREAM
 BYTES                        = 374
 RECORDS                      = 14
 DESCRIPTION                  = "SFDU keyword label (K-type)."
END_OBJECT                    = HEADER

OBJECT                        = HEADER_TABLE
 HEADER_TYPE                  = 'N/A'
 SFDU_FORMAT_ID               = 'NJPL1I000010'
 INTERCHANGE_FORMAT           = BINARY
 RECORD_TYPE                  = FIXED_LENGTH
 ROW_BYTES                    = 60
 ROWS                         = 1
 COLUMNS                      = 12
 ^STRUCTURE                   = 'SCVDRIMH.FMT'
 DESCRIPTION                  = "The single binary SIF header record
    contains constants that describe the fitting process, algorithm IDs,
    and the maximum sizes of arrays in the SIF data records."
END_OBJECT                    = HEADER_TABLE

OBJECT                        = TABLE
 SFDU_FORMAT_ID               = 'NJPL1I000012'
 INTERCHANGE_FORMAT           = BINARY
 RECORD_TYPE                  = UNDEFINED
 ROW_BYTES                    = 'UNK'
 ROWS                         = 7343
 COLUMNS                      = 45
 ^STRUCTURE                   = 'SCVDRIMF.FMT'
 DESCRIPTION                  = "Each varying length SIF data record
    contains the result of fitting the radar backscatter function derived
    from approximately 9 rasters of the C-BIDR image, or approximately 27
    rasters of the F-BIDR image, to an n'th order polynomial."
END_OBJECT                    = TABLE

END
```

APPENDIX B

FORMAT FILES

B.1. SCVDRANF.FMT Example

```
CCSD3ZF0000100000001NJPL3IF0PDSX00000001

PDS_VERSION_ID                          = PDS3

OBJECT                                  = COLUMN
 NAME                                   = SFDU_AGGREGATE_HEADER
 START_BYTE                             = 1
 DATA_TYPE                              = CHARACTER
 BYTES                                  = 20
 UNIT                                   = 'N/A'
 OBJECT                                 = ALIAS
  ALIAS_NAME                            = NR_SFDU
  USAGE_NOTE                            = 'MAGELLAN STANFORD SCVDR SIS'
 END_OBJECT                             = ALIAS
 DESCRIPTION                            = "'NJPL1I00000060000nnnn', the
  number '0006' is registered with the NJPL SFDU authority as the
  'Altimetry Inversion Data Record'. 'nnnn' is the length in bytes of the
  remainder of the SFDU, which can vary from record to record."
END_OBJECT                              = COLUMN

OBJECT                                  = COLUMN
 NAME                                   = FOOTPRINT_NUMBER
 START_BYTE                             = 21
 DATA_TYPE                              = MSB_UNSIGNED_INTEGER
 BYTES                                  = 4
 UNIT                                   = 'N/A'
 OBJECT                                 = ALIAS
  ALIAS_NAME                            = NR_NFOOT
  USAGE_NOTE                            = 'MAGELLAN STANFORD SCVDR SIS'
 END_OBJECT                             = ALIAS
 DESCRIPTION                            = "Starting from 1, the number of
  the Altimetry Inversion Record in increasing order of Altimetry
  Footprint Time (FOOTPRINT_TIME)."
END_OBJECT                              = COLUMN

OBJECT                                  = COLUMN
 NAME                                   = BURST_NUMBER
 START_BYTE                             = 25
 DATA_TYPE                              = MSB_UNSIGNED_INTEGER
 BYTES                                  = 4
 UNIT                                   = 'N/A'
 OBJECT                                 = ALIAS
  ALIAS_NAME                            = NR_BURST
  USAGE_NOTE                            = 'MAGELLAN STANFORD SCVDR SIS'
 END_OBJECT                             = ALIAS
```

```
 DESCRIPTION                    = "The logical record number from
  the ALT-EDR burst SFDU most closely associated with this footprint. If
  the number of bursts averaged (NUMBER_OF_BURSTS_AVERAGE) is odd, the
  middle burst; if NUMBER_OF_BURSTS_AVERAGED is even, the earlier of the
  two middle bursts."
END_OBJECT                      = COLUMN

OBJECT                          = COLUMN
 NAME                           = FLAG_FIELDS
 START_BYTE                     = 29
 DATA_TYPE                      = MSB_UNSIGNED_INTEGER
 BYTES                          = 4
 UNIT                           = 'N/A'
 OBJECT                         = ALIAS
  ALIAS_NAME                    = NR_FLAGS
  USAGE_NOTE                    = 'MAGELLAN STANFORD SCVDR SIS'
 END_OBJECT                     = ALIAS
 DESCRIPTION                    = "Stanford Altimetry Inversion
  Record Flag Values (see Table 5-5a of the SCVDR SIS)."
END_OBJECT                      = COLUMN

OBJECT                          = COLUMN
 NAME                           = FOOTPRINT_TIME
 START_BYTE                     = 33
 DATA_TYPE                      = IEEE_REAL
 BYTES                          = 8
 UNIT                           = 'SECONDS'
 OBJECT                         = ALIAS
  ALIAS_NAME                    = NR_SCET
  USAGE_NOTE                    = 'MAGELLAN STANFORD SCVDR SIS'
 END_OBJECT                     = ALIAS
 DESCRIPTION                    = "The burst start time (seconds
  of TDB since J2000; see Section 1.5.4.2 of the SCVDR SIS) for the burst
  given by BURST_NUMBER."
END_OBJECT                      = COLUMN

OBJECT                          = COLUMN
 NAME                           = GROSS_DOPPLER_SHIFT
 START_BYTE                     = 41
 DATA_TYPE                      = IEEE_REAL
 BYTES                          = 8
 UNIT                           = 'HZ'
 OBJECT                         = ALIAS
  ALIAS_NAME                    = NR_GDOPP
  USAGE_NOTE                    = 'MAGELLAN STANFORD SCVDR SIS'
 END_OBJECT                     = ALIAS
 DESCRIPTION                    = "The Doppler shift resulting
  from motion of the spacecraft toward nadir at FOOTPRINT_TIME
  (GROSS_DOPPLER_SHIFT > 0 means the spacecraft altitude is decreasing)."
END_OBJECT                      = COLUMN

OBJECT                          = COLUMN
 NAME                           = SPACECRAFT_POSITION_VECTOR
 START_BYTE                     = 49
 DATA_TYPE                      = IEEE_REAL
```

```
 BYTES                                = 8
 ITEMS                                = 3
 UNIT                                 = 'KM'
 OBJECT                               = ALIAS
  ALIAS_NAME                          = NR_SCPOS
  USAGE_NOTE                          = 'MAGELLAN STANFORD SCVDR SIS'
 END_OBJECT                           = ALIAS
 DESCRIPTION                          = "The spacecraft position at
  FOOTPRINT_TIME, relative to the Venus center of mass, expressed in
  inertial coordinates."
END_OBJECT                            = COLUMN

OBJECT                                = COLUMN
 NAME                                 = SPACECRAFT_VELOCITY_VECTOR
 START_BYTE                           = 73
 DATA_TYPE                            = IEEE_REAL
 BYTES                                = 8
 ITEMS                                = 3
 UNIT                                 = 'KM/SECOND'
 OBJECT                               = ALIAS
  ALIAS_NAME                          = NR_SCVEL
  USAGE_NOTE                          = 'MAGELLAN STANFORD SCVDR SIS'
 END_OBJECT                           = ALIAS
 DESCRIPTION                          = "The spacecraft velocity at
  FOOTPRINT_TIME, relative to the Venus center of mass, expressed in
  inertial coordinates."
END_OBJECT                            = COLUMN

OBJECT                                = COLUMN
 NAME                                 = SUB_SPACECRAFT_POSITION_VECTOR
 START_BYTE                           = 97
 DATA_TYPE                            = IEEE_REAL
 BYTES                                = 8
 ITEMS                                = 3
 UNIT                                 = 'KM'
 OBJECT                               = ALIAS
  ALIAS_NAME                          = NR_SSPOS
  USAGE_NOTE                          = 'MAGELLAN STANFORD SCVDR SIS'
 END_OBJECT                           = ALIAS
 DESCRIPTION                          = "The position of the nadir
  point (on a reference sphere of 6051 km radius) at FOOTPRINT_TIME,
  relative to the Venus center of mass, expressed in inertial coordinates."
END_OBJECT                            = COLUMN

OBJECT                                = COLUMN
 NAME                                 = ALTIMETRY_ANTENNA_BORESIGHT_VECTOR
 START_BYTE                           = 121
 DATA_TYPE                            = IEEE_REAL
 BYTES                                = 8
 ITEMS                                = 3
 UNIT                                 = 'N/A'
 OBJECT                               = ALIAS
  ALIAS_NAME                          = NR_ALTA
  USAGE_NOTE                          = 'MAGELLAN STANFORD SCVDR SIS'
 END_OBJECT                           = ALIAS
```

```
 DESCRIPTION                    = "Unit vector along the axis of
  the altimetry antenna at FOOTPRINT_TIME, expressed in inertial
  coordinates."
END_OBJECT                      = COLUMN

OBJECT                          = COLUMN
 NAME                           = SAR_ANTENNA_BORESIGHT_VECTOR
 START_BYTE                     = 145
 DATA_TYPE                      = IEEE_REAL
 BYTES                          = 8
 ITEMS                          = 3
 UNIT                           = 'N/A'
 OBJECT                         = ALIAS
  ALIAS_NAME                    = NR_SARA
  USAGE_NOTE                    = 'MAGELLAN STANFORD SCVDR SIS'
 END_OBJECT                     = ALIAS
 DESCRIPTION                    = "Unit vector along the axis of
  the high-gain (SAR) antenna at FOOTPRINT_TIME, expressed in inertial
  coordinates."
END_OBJECT                      = COLUMN

OBJECT                          = COLUMN
 NAME                           = BIN_0_ROUND_TRIP_TIME
 START_BYTE                     = 169
 DATA_TYPE                      = IEEE_REAL
 BYTES                          = 8
 UNIT                           = 'SECONDS'
 OBJECT                         = ALIAS
  ALIAS_NAME                    = NR_RT0
  USAGE_NOTE                    = 'MAGELLAN STANFORD SCVDR SIS'
 END_OBJECT                     = ALIAS
 DESCRIPTION                    = "The round-trip light time
  corresponding to the first range bin (before peak detection and
  rotation) in the averaged altimetry echo at FOOTPRINT_TIME."
END_OBJECT                      = COLUMN

OBJECT                          = COLUMN
 NAME                           = INCREMENTAL_ROUND_TRIP_TIME
 START_BYTE                     = 177
 DATA_TYPE                      = IEEE_REAL
 BYTES                          = 8
 UNIT                           = 'SECONDS'
 OBJECT                         = ALIAS
  ALIAS_NAME                    = NR_RPK
  USAGE_NOTE                    = 'MAGELLAN STANFORD SCVDR SIS'
 END_OBJECT                     = ALIAS
 DESCRIPTION                    = "The position of the echo peak
  with respect to the range bin used in BIN_0_ROUND_TRIP_TIME (each range
  bin represents an additional 0.442 microseconds of round-trip delay
  beyond BIN_0_ROUND_TRIP_TIME)."
END_OBJECT                      = COLUMN

OBJECT                          = COLUMN
 NAME                           = LATITUDE_OF_NADIR
 START_BYTE                     = 185
```

```
 DATA_TYPE                          = IEEE_REAL
 BYTES                              = 4
 UNIT                               = 'DEGREES'
 OBJECT                             = ALIAS
  ALIAS_NAME                        = NR_LAT
  USAGE_NOTE                        = 'MAGELLAN STANFORD SCVDR SIS'
 END_OBJECT                         = ALIAS
 DESCRIPTION                        = "The body-fixed latitude of the
  nadir at FOOTPRINT_TIME, in the range of -90 (South Pole) to +90 (North
  Pole); the nominal latitude of the footprint."
END_OBJECT                          = COLUMN

OBJECT                              = COLUMN
 NAME                               = LONGITUDE_OF_NADIR
 START_BYTE                         = 189
 DATA_TYPE                          = IEEE_REAL
 BYTES                              = 4
 UNIT                               = 'DEGREES'
 OBJECT                             = ALIAS
  ALIAS_NAME                        = NR_LON
  USAGE_NOTE                        = 'MAGELLAN STANFORD SCVDR SIS'
 END_OBJECT                         = ALIAS
 DESCRIPTION                        = "The body-fixed longitude of
  the nadir at FOOTPRINT_TIME, in the range of 0-360. Periapsis nadir
  increases in longitude by about 1.48 degrees per day (about 0.2 degrees
  per orbit); the nominal footprint longitude."
END_OBJECT                          = COLUMN

OBJECT                              = COLUMN
 NAME                               = ALONG_TRACK_ALTIMETRY_FOOTPRINT
 START_BYTE                         = 193
 DATA_TYPE                          = IEEE_REAL
 BYTES                              = 4
 UNIT                               = 'KM'
 OBJECT                             = ALIAS
  ALIAS_NAME                        = NR_XFOOT
  USAGE_NOTE                        = 'MAGELLAN STANFORD SCVDR SIS'
 END_OBJECT                         = ALIAS
 DESCRIPTION                        = "The along-track dimension of
  the intersection of the 3-dB (two-way) altimetry antenna pattern with
  the surface when the antenna boresight is aimed at nadir (a very
  approximate measure of the along-track footprint dimension)."
END_OBJECT                          = COLUMN

OBJECT                              = COLUMN
 NAME                               = CROSS_TRACK_ALTIMETRY_FOOTPRINT
 START_BYTE                         = 197
 DATA_TYPE                          = IEEE_REAL
 BYTES                              = 4
 UNIT                               = 'KM'
 OBJECT                             = ALIAS
  ALIAS_NAME                        = NR_YFOOT
  USAGE_NOTE                        = 'MAGELLAN STANFORD SCVDR SIS'
 END_OBJECT                         = ALIAS
 DESCRIPTION                        = "The cross-track dimension of
```

```
  the intersection of the 3-dB (two-way) altimetry antenna pattern with
  the surface when the antenna boresight is aimed at nadir (a very
  approximate measure of the across-track footprint dimension)."
END_OBJECT                              = COLUMN

OBJECT                                  = COLUMN
 NAME                                   = PIONEER_VENUS_RADIUS_AT_NADIR
 START_BYTE                             = 201
 DATA_TYPE                              = IEEE_REAL
 BYTES                                  = 4
 UNIT                                   = 'KM'
 OBJECT                                 = ALIAS
  ALIAS_NAME                            = NR_PVRAD
  USAGE_NOTE                            = 'MAGELLAN STANFORD SCVDR SIS'
 END_OBJECT                             = ALIAS
 DESCRIPTION                            = "Radius of Venus at the nadir
  point as determined from Pioneer Venus data (provided by MIT in GIPS
  image format)."
END_OBJECT                              = COLUMN

OBJECT                                  = COLUMN
 NAME                                   = FIRST_ALT_BURST_USED
 START_BYTE                             = 205
 DATA_TYPE                              = MSB_UNSIGNED_INTEGER
 BYTES                                  = 4
 UNIT                                   = 'N/A'
 OBJECT                                 = ALIAS
  ALIAS_NAME                            = NR_BLO
  USAGE_NOTE                            = 'MAGELLAN STANFORD SCVDR SIS'
 END_OBJECT                             = ALIAS
 DESCRIPTION                            = "The number of the first burst
  included in the average altimetry echo for this record."
END_OBJECT                              = COLUMN

OBJECT                                  = COLUMN
 NAME                                   = LAST_ALT_BURST_USED
 START_BYTE                             = 209
 DATA_TYPE                              = MSB_UNSIGNED_INTEGER
 BYTES                                  = 4
 UNIT                                   = 'N/A'
 OBJECT                                 = ALIAS
  ALIAS_NAME                            = NR_BHI
  USAGE_NOTE                            = 'MAGELLAN STANFORD SCVDR SIS'
 END_OBJECT                             = ALIAS
 DESCRIPTION                            = "The number of the last burst
  included in the average altimetry echo for this record."
END_OBJECT                              = COLUMN

OBJECT                                  = COLUMN
 NAME                                   = NUMBER_OF_BURSTS_AVERAGED
 START_BYTE                             = 213
 DATA_TYPE                              = MSB_UNSIGNED_INTEGER
 BYTES                                  = 2
 UNIT                                   = 'N/A'
 OBJECT                                 = ALIAS
```

```
  ALIAS_NAME                          = NR_BAV
  USAGE_NOTE                          = 'MAGELLAN STANFORD SCVDR SIS'
 END_OBJECT                           = ALIAS
 DESCRIPTION                          = "The total number of altimeter
  bursts averaged to make this record."
END_OBJECT                            = COLUMN

OBJECT                                = COLUMN
 NAME                                 = G_MATRIX_ID_NUMBER
 START_BYTE                           = 215
 DATA_TYPE                            = MSB_UNSIGNED_INTEGER
 BYTES                                = 2
 UNIT                                 = 'N/A'
 OBJECT                               = ALIAS
  ALIAS_NAME                          = NR_GNUM
  USAGE_NOTE                          = 'MAGELLAN STANFORD SCVDR SIS'
 END_OBJECT                           = ALIAS
 DESCRIPTION                          = "Identifies the
  range-Doppler-angle array used to invert the range-Doppler data in this
  averaged echo. G-matrices are indexed from 0."
END_OBJECT                            = COLUMN

OBJECT                                = COLUMN
 NAME                                 = NUMBER_OF_ANGLES_IN_SOLUTION
 START_BYTE                           = 217
 DATA_TYPE                            = MSB_UNSIGNED_INTEGER
 BYTES                                = 2
 UNIT                                 = 'N/A'
 OBJECT                               = ALIAS
  ALIAS_NAME                          = NR_BLEN
  USAGE_NOTE                          = 'MAGELLAN STANFORD SCVDR SIS'
 END_OBJECT                           = ALIAS
 DESCRIPTION                          = "Number of angle increments in
  the solution for the scattering function from this average echo."
END_OBJECT                            = COLUMN

OBJECT                                = COLUMN
 NAME                                 = NUMBER_OF_ELEMENTS_SAVED_IN_CVM
 START_BYTE                           = 219
 DATA_TYPE                            = MSB_UNSIGNED_INTEGER
 BYTES                                = 2
 UNIT                                 = 'N/A'
 OBJECT                               = ALIAS
  ALIAS_NAME                          = NR_NCVM
  USAGE_NOTE                          = 'MAGELLAN STANFORD SCVDR SIS'
 END_OBJECT                           = ALIAS
 DESCRIPTION                          = "The number of covariance
  values stored in COVARIANCE_MATRIX (depends on COVARIANCE_MATRIX_FLAG
  in the ANF TABLE_HEADER object)."
END_OBJECT                            = COLUMN

OBJECT                                = COLUMN
 NAME                                 = SMOOTHING_FACTOR
 START_BYTE                           = 221
 DATA_TYPE                            = IEEE_REAL
```

```
 BYTES                                = 4
 UNIT                                 = 'N/A'
 OBJECT                               = ALIAS
  ALIAS_NAME                          = NR_GAMMA
  USAGE_NOTE                          = 'MAGELLAN STANFORD SCVDR SIS'
 END_OBJECT                           = ALIAS
 DESCRIPTION                          = "The value of the parameter
  used to minimize second differences in the scattering function solution
  for this average echo."
END_OBJECT                            = COLUMN

OBJECT                                = COLUMN
 NAME                                 = CHI_SQUARE_RESIDUAL_FROM_SOLUTION
 START_BYTE                           = 225
 DATA_TYPE                            = IEEE_REAL
 BYTES                                = 4
 UNIT                                 = 'N/A'
 OBJECT                               = ALIAS
  ALIAS_NAME                          = NR_CHISQ
  USAGE_NOTE                          = 'MAGELLAN STANFORD SCVDR SIS'
 END_OBJECT                           = ALIAS
 DESCRIPTION                          = "The residual from the weighted
  least-square error inversion for the scattering function."
END_OBJECT                            = COLUMN

OBJECT                                = COLUMN
 NAME                                 = RMS_SURFACE_TILT_FROM_DATA
 START_BYTE                           = 229
 DATA_TYPE                            = IEEE_REAL
 BYTES                                = 4
 UNIT                                 = 'DEGREES'
 OBJECT                               = ALIAS
  ALIAS_NAME                          = NR_RMSS
  USAGE_NOTE                          = 'MAGELLAN STANFORD SCVDR SIS'
 END_OBJECT                           = ALIAS
 DESCRIPTION                          = "RMS surface tilt theta-zero
  calculated from the NUMBER_OF_ANGLES_IN_SOLUTION points in the
  solution. This value is very sensitive to the value of
  NUMBER_OF_ANGLES_IN_SOLUTION."
END_OBJECT                            = COLUMN

OBJECT                                = COLUMN
 NAME                                 = THERMAL_NOISE_ESTIMATE
 START_BYTE                           = 233
 DATA_TYPE                            = IEEE_REAL
 BYTES                                = 4
 UNIT                                 = 'WATTS'
 OBJECT                               = ALIAS
  ALIAS_NAME                          = TN_SOL
  USAGE_NOTE                          = 'MAGELLAN STANFORD SCVDR SIS'
 END_OBJECT                           = ALIAS
 DESCRIPTION                          = "Thermal noise power estimate
  calculated as one of many variables in the chi-square solution for the
  surface scattering function SCATTERING_FUNCTION. Likely to be an
  overestimate since there is no attempt to account for radar clutter;
```

```
  THERMAL_NOISE_ESTIMATE includes contributions from Venus' surface, the
  radar equipment, and aliased echo signal in both time/range and
  frequency."
END_OBJECT                              = COLUMN

OBJECT                                  = COLUMN
 NAME                                   = ESTIMATED_VARIANCE_OF_TN_SOL
 START_BYTE                             = 237
 DATA_TYPE                              = IEEE_REAL
 BYTES                                  = 4
 UNIT                                   = 'WATTS'
 OBJECT                                 = ALIAS
  ALIAS_NAME                            = TN_SOLV
  USAGE_NOTE                            = 'MAGELLAN STANFORD SCVDR SIS'
 END_OBJECT                             = ALIAS
 DESCRIPTION                            = "Estimate of variance in
  THERMAL_NOISE_ESTIMATE from propagation of errors through solution
  procedure."
END_OBJECT                              = COLUMN

OBJECT                                  = COLUMN
 NAME                                   = SMALLEST_RANGE_DOPPLER_ARRAY_VALUE
 START_BYTE                             = 241
 DATA_TYPE                              = IEEE_REAL
 BYTES                                  = 4
 UNIT                                   = 'WATTS'
 OBJECT                                 = ALIAS
  ALIAS_NAME                            = TN_MIN
  USAGE_NOTE                            = 'MAGELLAN STANFORD SCVDR SIS'
 END_OBJECT                             = ALIAS
 DESCRIPTION                            = "Smallest value in averaged 16
  by 151 (frequency by range, respectively) array of processor output
  power. Likely to be an underestimate, since statistical variations will
  force the 'minimum' below the average."
END_OBJECT                              = COLUMN

OBJECT                                  = COLUMN
 NAME                                   = AVERAGE_OF_SMALL_VALUES
 START_BYTE                             = 245
 DATA_TYPE                              = IEEE_REAL
 BYTES                                  = 4
 UNIT                                   = 'WATTS'
 OBJECT                                 = ALIAS
  ALIAS_NAME                            = TN_AVG
  USAGE_NOTE                            = 'MAGELLAN STANFORD SCVDR SIS'
 END_OBJECT                             = ALIAS
 DESCRIPTION                            = "The average of range echo bin
  values from 10-20 range bins before the echo peak (divided by 16)."
END_OBJECT                              = COLUMN

OBJECT                                  = COLUMN
 NAME                                   = MINIMUM_IN_RANGE_ECHO
 START_BYTE                             = 249
 DATA_TYPE                              = IEEE_REAL
 BYTES                                  = 4
```

```
 UNIT                                = 'WATTS'
 OBJECT                              = ALIAS
  ALIAS_NAME                         = TN_R
  USAGE_NOTE                         = 'MAGELLAN STANFORD SCVDR SIS'
 END_OBJECT                          = ALIAS
 DESCRIPTION                         = "The minimum value in the range
  echo, divided by 16."
END_OBJECT                           = COLUMN

OBJECT                               = COLUMN
 NAME                                = SPARE
 START_BYTE                          = 253
 BYTES                               = 16
END_OBJECT                           = COLUMN

OBJECT                               = COLUMN
 NAME                                = DOPPLER_CENTROID
 START_BYTE                          = 269
 DATA_TYPE                           = IEEE_REAL
 BYTES                               = 4
 UNIT                                = 'HZ'
 OBJECT                              = ALIAS
  ALIAS_NAME                         = NR_DCENT
  USAGE_NOTE                         = 'MAGELLAN STANFORD SCVDR SIS'
 END_OBJECT                          = ALIAS
 DESCRIPTION                         = "The calculated center of the
  spectrum of the radar receiver signal."
END_OBJECT                           = COLUMN

OBJECT                               = COLUMN
 NAME                                = VARIANCE_OF_DOPPLER_CENTROID
 START_BYTE                          = 273
 DATA_TYPE                           = IEEE_REAL
 BYTES                               = 4
 UNIT                                = 'HZ'
 OBJECT                              = ALIAS
  ALIAS_NAME                         = NR_DCENTV
  USAGE_NOTE                         = 'MAGELLAN STANFORD SCVDR SIS'
 END_OBJECT                          = ALIAS
 DESCRIPTION                         = "Estimated variance of
  DOPPLER_CENTROID."
END_OBJECT                           = COLUMN

OBJECT                               = COLUMN
 NAME                                = DOPPLER_ROTATION_USED_FOR_SOLUTION
 START_BYTE                          = 277
 DATA_TYPE                           = IEEE_REAL
 BYTES                               = 4
 UNIT                                = 'HZ'
 OBJECT                              = ALIAS
  ALIAS_NAME                         = NR_FROT
  USAGE_NOTE                         = 'MAGELLAN STANFORD SCVDR SIS'
 END_OBJECT                          = ALIAS
 DESCRIPTION                         = "The offset of the echo from
  its nominal center bin position assumed to be due to surface effects
```

```
  (an integral multiple of 935 Hz, the width of a single frequency bin)."
END_OBJECT                              = COLUMN

OBJECT                                  = COLUMN
 NAME                                   = TRANSMITTER_A_FLAG
 START_BYTE                             = 281
 DATA_TYPE                              = UNSIGNED_INTEGER
 BYTES                                  = 1
 UNIT                                   = 'N/A'
 OBJECT                                 = ALIAS
  ALIAS_NAME                            = CL_TXA
  USAGE_NOTE                            = 'MAGELLAN STANFORD SCVDR SIS'
 END_OBJECT                             = ALIAS
 DESCRIPTION                            = "If set (1), transmitter A was
  used; if not set (0), transmitter B was used."
END_OBJECT                              = COLUMN

OBJECT                                  = COLUMN
 NAME                                   = RECEIVER_A_FLAG
 START_BYTE                             = 282
 DATA_TYPE                              = UNSIGNED_INTEGER
 BYTES                                  = 1
 UNIT                                   = 'N/A'
 OBJECT                                 = ALIAS
  ALIAS_NAME                            = CL_RXA
  USAGE_NOTE                            = 'MAGELLAN STANFORD SCVDR SIS'
 END_OBJECT                             = ALIAS
 DESCRIPTION                            = "If set (1), receiver A was
  used; if not set (0), receiver B was used."
END_OBJECT                              = COLUMN

OBJECT                                  = COLUMN
 NAME                                   = SPARE
 START_BYTE                             = 283
 BYTES                                  = 2
END_OBJECT                              = COLUMN

OBJECT                                  = COLUMN
 NAME                                   = END_TO_END_SYSTEM_CORRECTION
 START_BYTE                             = 285
 DATA_TYPE                              = IEEE_REAL
 BYTES                                  = 4
 UNIT                                   = 'N/A'
 OBJECT                                 = ALIAS
  ALIAS_NAME                            = CL_CPT0
  USAGE_NOTE                            = 'MAGELLAN STANFORD SCVDR SIS'
 END_OBJECT                             = ALIAS
 DESCRIPTION                            = "The end-to-end gain of the
  complete altimetry radar system for a closed loop test [if the antenna
  were removed and the outgoing (transmitted) signal were turned directly
  back to the receiver--including processing at Stanford. The value of
  END_TO_END_SYSTEM_CORRECTION is the measured attenuation during this
  test."
END_OBJECT                              = COLUMN
```

```
OBJECT                                  = COLUMN
 NAME                                   = CROSS_STRAPPING_CORRECTION
 START_BYTE                             = 289
 DATA_TYPE                              = IEEE_REAL
 BYTES                                  = 4
 UNIT                                   = 'N/A'
 OBJECT                                 = ALIAS
  ALIAS_NAME                            = CL_XSTRAP
  USAGE_NOTE                            = 'MAGELLAN STANFORD SCVDR SIS'
 END_OBJECT                             = ALIAS
 DESCRIPTION                            = "The attenuation caused by
  using transmitter A with receiver B, or vice versa."
END_OBJECT                              = COLUMN

OBJECT                                  = COLUMN
 NAME                                   = TRANSMITTER_POWER_CORRECTION
 START_BYTE                             = 293
 DATA_TYPE                              = IEEE_REAL
 BYTES                                  = 4
 UNIT                                   = 'N/A'
 OBJECT                                 = ALIAS
  ALIAS_NAME                            = CL_DCTX
  USAGE_NOTE                            = 'MAGELLAN STANFORD SCVDR SIS'
 END_OBJECT                             = ALIAS
 DESCRIPTION                            = "An estimated attenuation of
  the available power, relative to END_TO_END_SYSTEM_CORRECTION based on
  telemetered measurements of transmitter and output network temperatures."
END_OBJECT                              = COLUMN

OBJECT                                  = COLUMN
 NAME                                   = TRANSMITTER_STAGE_1_TEMPERATURE
 START_BYTE                             = 297
 DATA_TYPE                              = IEEE_REAL
 BYTES                                  = 4
 UNIT                                   = 'K'
 OBJECT                                 = ALIAS
  ALIAS_NAME                            = CL_TT1
  USAGE_NOTE                            = 'MAGELLAN STANFORD SCVDR SIS'
 END_OBJECT                             = ALIAS
 DESCRIPTION                            = "The telemetered temperature of
  the Transmitter Stage 1 Driver temperature, used to compute the
  transmit power."
END_OBJECT                              = COLUMN

OBJECT                                  = COLUMN
 NAME                                   = ONU_ALTIMETER_TEMPERATURE
 START_BYTE                             = 301
 DATA_TYPE                              = IEEE_REAL
 BYTES                                  = 4
 UNIT                                   = 'K'
 OBJECT                                 = ALIAS
  ALIAS_NAME                            = CL_TOA
  USAGE_NOTE                            = 'MAGELLAN STANFORD SCVDR SIS'
 END_OBJECT                             = ALIAS
 DESCRIPTION                            = "The telemetered temperature of
```

```
  the ONU Altimeter temperature, used to compute the transmit power."
END_OBJECT                              = COLUMN

OBJECT                                  = COLUMN
 NAME                                   = ATMOSPHERIC_ATTENUATION
 START_BYTE                             = 305
 DATA_TYPE                              = IEEE_REAL
 BYTES                                  = 4
 UNIT                                   = 'N/A'
 OBJECT                                 = ALIAS
  ALIAS_NAME                            = CL_ATMOS
  USAGE_NOTE                            = 'MAGELLAN STANFORD SCVDR SIS'
 END_OBJECT                             = ALIAS
 DESCRIPTION                            = "The expected attenuation due
  to the atmosphere for this nadir elevation
  (PIONEER_VENUS_RADIUS_AT_NADIR)."
END_OBJECT                              = COLUMN

OBJECT                                  = COLUMN
 NAME                                   = ANTENNA_PATTERN
 START_BYTE                             = 309
 DATA_TYPE                              = IEEE_REAL
 BYTES                                  = 4
 UNIT                                   = 'N/A'
 OBJECT                                 = ALIAS
  ALIAS_NAME                            = CL_ANT
  USAGE_NOTE                            = 'MAGELLAN STANFORD SCVDR SIS'
 END_OBJECT                             = ALIAS
 DESCRIPTION                            = "Always zero because the gain
  pattern of the antenna is accounted for in the G-matrix calculation."
END_OBJECT                              = COLUMN

OBJECT                                  = COLUMN
 NAME                                   = RECEIVER_TEMPERATURE
 START_BYTE                             = 313
 DATA_TYPE                              = IEEE_REAL
 BYTES                                  = 4
 UNIT                                   = 'K'
 OBJECT                                 = ALIAS
  ALIAS_NAME                            = CL_TRX
  USAGE_NOTE                            = 'MAGELLAN STANFORD SCVDR SIS'
 END_OBJECT                             = ALIAS
 DESCRIPTION                            = "Telemetered temperature of the
  receiver."
END_OBJECT                              = COLUMN

OBJECT                                  = COLUMN
 NAME                                   = RECEIVER_TEMPERATURE_ATTENUATION
 START_BYTE                             = 317
 DATA_TYPE                              = IEEE_REAL
 BYTES                                  = 4
 UNIT                                   = 'N/A'
 OBJECT                                 = ALIAS
  ALIAS_NAME                            = CL_DCT
  USAGE_NOTE                            = 'MAGELLAN STANFORD SCVDR SIS'
```

```
 END_OBJECT                          = ALIAS
 DESCRIPTION                         = "The portion of receiver
  attenuation that is dependent on receiver temperature."
END_OBJECT                           = COLUMN

OBJECT                               = COLUMN
 NAME                                = COMMANDABLE_ATTENUATION_CODE
 START_BYTE                          = 321
 DATA_TYPE                           = UNSIGNED_INTEGER
 BYTES                               = 1
 UNIT                                = 'N/A'
 OBJECT                              = ALIAS
  ALIAS_NAME                         = CL_RAC
  USAGE_NOTE                         = 'MAGELLAN STANFORD SCVDR SIS'
 END_OBJECT                          = ALIAS
 DESCRIPTION                         = "The 3-bit code specifying the
  amount of attenuation used in the receiver front end."
END_OBJECT                           = COLUMN

OBJECT                               = COLUMN
 NAME                                = SPARE
 START_BYTE                          = 322
 BYTES                               = 3
END_OBJECT                           = COLUMN

OBJECT                               = COLUMN
 NAME                                = RECEIVER_COMMANDABLE_ATTENUATION
 START_BYTE                          = 325
 DATA_TYPE                           = IEEE_REAL
 BYTES                               = 4
 UNIT                                = 'N/A'
 OBJECT                              = ALIAS
  ALIAS_NAME                         = CL_DCA
  USAGE_NOTE                         = 'MAGELLAN STANFORD SCVDR SIS'
 END_OBJECT                          = ALIAS
 DESCRIPTION                         = "The actual receiver
  attenuation specified by the attenuation code
  COMMANDABLE_ATTENUATION_CODE."
END_OBJECT                           = COLUMN

OBJECT                               = COLUMN
 NAME                                = TOTAL_AMPLITUDE_CORRECTION
 START_BYTE                          = 329
 DATA_TYPE                           = IEEE_REAL
 BYTES                               = 4
 UNIT                                = 'N/A'
 OBJECT                              = ALIAS
  ALIAS_NAME                         = CL_CALT
  USAGE_NOTE                         = 'MAGELLAN STANFORD SCVDR SIS'
 END_OBJECT                          = ALIAS
 DESCRIPTION                         = "The total amplitude correction
  expressed as an attenuation."
END_OBJECT                           = COLUMN

OBJECT                               = COLUMN
```

```
 NAME                                = JPL_SYNC_CODE
 START_BYTE                          = 333
 DATA_TYPE                           = MSB_UNSIGNED_INTEGER
 BYTES                               = 4
 UNIT                                = 'N/A'
 OBJECT                              = ALIAS
  ALIAS_NAME                         = SB_SYNC
  USAGE_NOTE                         = 'MAGELLAN STANFORD SCVDR SIS'
 END_OBJECT                          = ALIAS
 DESCRIPTION                         = "The JPL Sync code 0x03915ed3."
END_OBJECT                           = COLUMN

OBJECT                               = COLUMN
 NAME                                = BFQ_THRESHOLD_VALUES
 START_BYTE                          = 337
 DATA_TYPE                           = UNSIGNED_INTEGER
 BYTES                               = 1
 ITEMS                               = 24
 UNIT                                = 'N/A'
 OBJECT                              = ALIAS
  ALIAS_NAME                         = SB_THRESH
  USAGE_NOTE                         = 'MAGELLAN STANFORD SCVDR SIS'
 END_OBJECT                          = ALIAS
 DESCRIPTION                         = "Block Floating Point
  Thresholds from the SAR burst header."
END_OBJECT                           = COLUMN

OBJECT                               = COLUMN
 NAME                                = SPARE
 START_BYTE                          = 361
 BYTES                               = 2
END_OBJECT                           = COLUMN

OBJECT                               = COLUMN
 NAME                                = RADIOMETER_READING
 START_BYTE                          = 363
 DATA_TYPE                           = MSB_UNSIGNED_INTEGER
 BYTES                               = 2
 UNIT                                = 'N/A'
 OBJECT                              = ALIAS
  ALIAS_NAME                         = SB_RAD
  USAGE_NOTE                         = 'MAGELLAN STANFORD SCVDR SIS'
 END_OBJECT                          = ALIAS
 DESCRIPTION                         = "Raw value of the radiometer,
  measuring noise power of the high-gain antenna or, on alternating
  bursts, of a load at a known temperature."
END_OBJECT                           = COLUMN

OBJECT                               = COLUMN
 NAME                                = RADAR_CLOCK
 START_BYTE                          = 365
 DATA_TYPE                           = UNSIGNED_INTEGER
 BYTES                               = 1
 ITEMS                               = 8
 UNIT                                = 'N/A'
```

```
 OBJECT                          = ALIAS
  ALIAS_NAME                     = SB_RCLK
  USAGE_NOTE                     = 'MAGELLAN STANFORD SCVDR SIS'
 END_OBJECT                      = ALIAS
 DESCRIPTION                     = "The 52-bit spacecraft clock
  value."
END_OBJECT                       = COLUMN

OBJECT                           = COLUMN
 NAME                            = SPARE
 START_BYTE                      = 373
 BYTES                           = 2
END_OBJECT                       = COLUMN

OBJECT                           = COLUMN
 NAME                            = BIT_FIELDS
 START_BYTE                      = 375
 DATA_TYPE                       = UNSIGNED_INTEGER
 BYTES                           = 1
 ITEMS                           = 10
 UNIT                            = 'N/A'
 OBJECT                          = ALIAS
  ALIAS_NAME                     = SB_SAB_B
  USAGE_NOTE                     = 'MAGELLAN STANFORD SCVDR SIS'
 END_OBJECT                      = ALIAS
 DESCRIPTION                     = "Radar instrument status fields."
END_OBJECT                       = COLUMN

OBJECT                           = COLUMN
 NAME                            = BUFFER_MEMORY_CHECKOUT
 START_BYTE                      = 385
 DATA_TYPE                       = MSB_UNSIGNED_INTEGER
 BYTES                           = 2
 UNIT                            = 'N/A'
 OBJECT                          = ALIAS
  ALIAS_NAME                     = SB_BMC_FLAG
  USAGE_NOTE                     = 'MAGELLAN STANFORD SCVDR SIS'
 END_OBJECT                      = ALIAS
 DESCRIPTION                     = "Buffer memory checkout flag."
END_OBJECT                       = COLUMN

OBJECT                           = COLUMN
 NAME                            = SPARE
 START_BYTE                      = 387
 BYTES                           = 18
END_OBJECT                       = COLUMN

OBJECT                           = COLUMN
 NAME                            = SCATTERING_FUNCTION
 START_BYTE                      = 405
 DATA_TYPE                       = IEEE_REAL
 BYTES                           = 4
 ITEMS                           = 'UNK'
 UNIT                            = 'N/A'
 OBJECT                          = ALIAS
```

```
  ALIAS_NAME                          = NR_SIG0
  USAGE_NOTE                          = 'MAGELLAN STANFORD SCVDR SIS'
 END_OBJECT                           = ALIAS
 DESCRIPTION                          = "The Sigma-zero function
  obtained by inverting the average altimetry radar echo from bursts
  FIRST_ALT_BURST_USED through LAST_ALT_BURST_USED. The function is a
  vector of n = NUMBER_OF_ANGLES_IN_SOLUTION numbers for the (effective)
  incidence angles given by SOLUTION_ANGLES."
END_OBJECT                            = COLUMN

OBJECT                                = COLUMN
 NAME                                 = SOLUTION_ANGLES
 START_BYTE                           = 'UNK'
 DATA_TYPE                            = IEEE_REAL
 BYTES                                = 4
 ITEMS                                = 'UNK'
 UNIT                                 = 'RADIANS'
 OBJECT                               = ALIAS
  ALIAS_NAME                          = NR_ANG
  USAGE_NOTE                          = 'MAGELLAN STANFORD SCVDR SIS'
 END_OBJECT                           = ALIAS
 DESCRIPTION                          = "The n =
  NUMBER_OF_ANGLES_IN_SOLUTION angles at which the scattering function
  solution has been obtained. The default angles are spaced by 0.5
  degrees, starting at 0.25. That is, the solution angles are 0.25, 0.75,
  1.25, 1.75, ... NUMBER_OF_ANGLES_IN_SOLUTION * 0.5-0.25 degrees; note,
  however, that SOLUTION_ANGLES is given in radians."
END_OBJECT                            = COLUMN

OBJECT                                = COLUMN
 NAME                                 = COVARIANCE_MATRIX
 START_BYTE                           = 'UNK'
 DATA_TYPE                            = IEEE_REAL
 BYTES                                = 4
 ITEMS                                = 'UNK'
 UNIT                                 = 'N/A'
 OBJECT                               = ALIAS
  ALIAS_NAME                          = NR_CVM
  USAGE_NOTE                          = 'MAGELLAN STANFORD SCVDR SIS'
 END_OBJECT                           = ALIAS
 DESCRIPTION                          = "Matrix of estimated
  covariances of SCATTERING_FUNCTION and thermal noise estimates."
END_OBJECT                            = COLUMN

END
```

B.2. SCVDRANH.FMT Example

```
CCSD3ZF0000100000001NJPL3IF0PDSX00000001

PDS_VERSION_ID                        = PDS3

OBJECT                                = COLUMN
 NAME                                 = SFDU_AGGREGATE_HEADER
 START_BYTE                           = 1
 DATA_TYPE                            = CHARACTER
```

```
 BYTES                                  = 20
 UNIT                                   = 'N/A'
 OBJECT                                 = ALIAS
  ALIAS_NAME                            = NH_SFDU
  USAGE_NOTE                            = 'MAGELLAN STANFORD SCVDR SIS'
 END_OBJECT                             = ALIAS
 DESCRIPTION                            = "'NJPL1I00000500000052', the
  number '0005' is registered with the NJPL SFDU authority as the
  'Altimetry Inversion Header Record'."
END_OBJECT                              = COLUMN

OBJECT                                  = COLUMN
 NAME                                   = ORBIT_NUMBER
 START_BYTE                             = 21
 DATA_TYPE                              = MSB_INTEGER
 BYTES                                  = 4
 UNIT                                   = 'N/A'
 OBJECT                                 = ALIAS
  ALIAS_NAME                            = NH_ORB
  USAGE_NOTE                            = 'MAGELLAN STANFORD SCVDR SIS'
 END_OBJECT                             = ALIAS
 DESCRIPTION                            = "The Magellan orbit number for
  the data represented in these data records."
END_OBJECT                              = COLUMN

OBJECT                                  = COLUMN
 NAME                                   = ORBIT_VERSION
 START_BYTE                             = 25
 DATA_TYPE                              = MSB_INTEGER
 BYTES                                  = 4
 UNIT                                   = 'N/A'
 OBJECT                                 = ALIAS
  ALIAS_NAME                            = NH_VER
  USAGE_NOTE                            = 'MAGELLAN STANFORD SCVDR SIS'
 END_OBJECT                             = ALIAS
 DESCRIPTION                            = "The version of the altimetry
  data file used for these results. Obtained from the VERSION_ID keyword
  of the corresponding ALT-EDR Orbit Header File (Note: This turns out
  not to be a good indicator of the version of the data file; the Orbit
  Header File itself is rarely updated)."
END_OBJECT                              = COLUMN

OBJECT                                  = COLUMN
 NAME                                   = ALTINV_MAJOR_VERSION_NUMBER
 START_BYTE                             = 29
 DATA_TYPE                              = MSB_INTEGER
 BYTES                                  = 2
 UNIT                                   = 'N/A'
 OBJECT                                 = ALIAS
  ALIAS_NAME                            = NH_ALTINV_MAJOR
  USAGE_NOTE                            = 'MAGELLAN STANFORD SCVDR SIS'
 END_OBJECT                             = ALIAS
 DESCRIPTION                            = "The major software version
  number of the Stanford program ALTINV used to obtain the scattering
  function solution."
```

```
END_OBJECT                              = COLUMN

OBJECT                                  = COLUMN
 NAME                                   = ALTINV_MINOR_VERSION_NUMBER
 START_BYTE                             = 31
 DATA_TYPE                              = MSB_INTEGER
 BYTES                                  = 2
 UNIT                                   = 'N/A'
 OBJECT                                 = ALIAS
  ALIAS_NAME                            = NH_ALTINV_MINOR
  USAGE_NOTE                            = 'MAGELLAN STANFORD SCVDR SIS'
 END_OBJECT                             = ALIAS
 DESCRIPTION                            = "The minor software version
  number of the Stanford program ALTINV used to obtain the scattering
  function solution."
END_OBJECT                              = COLUMN

OBJECT                                  = COLUMN
 NAME                                   = ALT_MAJOR_VERSION_NUMBER
 START_BYTE                             = 33
 DATA_TYPE                              = MSB_INTEGER
 BYTES                                  = 2
 UNIT                                   = 'N/A'
 OBJECT                                 = ALIAS
  ALIAS_NAME                            = NH_ALT_MAJOR
  USAGE_NOTE                            = 'MAGELLAN STANFORD SCVDR SIS'
 END_OBJECT                             = ALIAS
 DESCRIPTION                            = "The major software version
  number of the Stanford program ALT used to compute the range-Doppler
  array from the raw altimetry data."
END_OBJECT                              = COLUMN

OBJECT                                  = COLUMN
 NAME                                   = ALT_MINOR_VERSION_NUMBER
 START_BYTE                             = 35
 DATA_TYPE                              = MSB_INTEGER
 BYTES                                  = 2
 UNIT                                   = 'N/A'
 OBJECT                                 = ALIAS
  ALIAS_NAME                            = NH_ALT_MINOR
  USAGE_NOTE                            = 'MAGELLAN STANFORD SCVDR SIS'
 END_OBJECT                             = ALIAS
 DESCRIPTION                            = "The minor software version
  number of the Stanford program ALT used to compute the range-Doppler
  array from the raw altimetry data."
END_OBJECT                              = COLUMN

OBJECT                                  = COLUMN
 NAME                                   = COVARIANCE_MATRIX_FLAG
 START_BYTE                             = 37
 DATA_TYPE                              = UNSIGNED_INTEGER
 BYTES                                  = 1
 UNIT                                   = 'N/A'
 OBJECT                                 = ALIAS
  ALIAS_NAME                            = NH_CVMF
```

```
  USAGE_NOTE                          = 'MAGELLAN STANFORD SCVDR SIS'
 END_OBJECT                           = ALIAS
 DESCRIPTION                          = "If set (1) the upper
  triangular portion (in row-major order) of the covariance matrix is
  saved in COVARIANCE_MATRIX; if not set (0), only the diagonal is saved."
END_OBJECT                            = COLUMN

OBJECT                                = COLUMN
 NAME                                 = INVERSION_METHOD_ID
 START_BYTE                           = 38
 DATA_TYPE                            = UNSIGNED_INTEGER
 BYTES                                = 1
 UNIT                                 = 'N/A'
 OBJECT                               = ALIAS
  ALIAS_NAME                          = NH_METH_INV
  USAGE_NOTE                          = 'MAGELLAN STANFORD SCVDR SIS'
 END_OBJECT                           = ALIAS
 DESCRIPTION                          = "The code number for the
  specific method of overdetermined least squares used to compute the
  inversions (see Section 5.4.1 of the SCVDR SIS)."
END_OBJECT                            = COLUMN

OBJECT                                = COLUMN
 NAME                                 = VARIANCE_ESTIMATION_METHOD_ID
 START_BYTE                           = 39
 DATA_TYPE                            = UNSIGNED_INTEGER
 BYTES                                = 1
 UNIT                                 = 'N/A'
 OBJECT                               = ALIAS
  ALIAS_NAME                          = NH_METH_SIG
  USAGE_NOTE                          = 'MAGELLAN STANFORD SCVDR SIS'
 END_OBJECT                           = ALIAS
 DESCRIPTION                          = "The code number for the method
  used to estimate the statistical uncertainty in the input data. The
  resulting variance is used in a weighted least squares fit and
  propagated to form an estimate of the inverted uncertainty in the
  solution."
END_OBJECT                            = COLUMN

OBJECT                                = COLUMN
 NAME                                 = CONSTRAINT_VARIANCE_METHOD_ID
 START_BYTE                           = 40
 DATA_TYPE                            = UNSIGNED_INTEGER
 BYTES                                = 1
 UNIT                                 = 'N/A'
 OBJECT                               = ALIAS
  ALIAS_NAME                          = NH_METH_GAMSIG
  USAGE_NOTE                          = 'MAGELLAN STANFORD SCVDR SIS'
 END_OBJECT                           = ALIAS
 DESCRIPTION                          = "The code number for the method
  used to assign weight to the smoothing constraint that controls the
  shape of the inversion. Determines the scale of smoothing parameter
  SMOOTHING_FACTOR (see Section 5.4.1 of the SCVDR SIS)."
END_OBJECT                            = COLUMN
```

```
OBJECT                                  = COLUMN
 NAME                                   = THERMAL_NOISE_METHOD_ID
 START_BYTE                             = 41
 DATA_TYPE                              = UNSIGNED_INTEGER
 BYTES                                  = 1
 UNIT                                   = 'N/A'
 OBJECT                                 = ALIAS
  ALIAS_NAME                            = NH_METH_THERMAL
  USAGE_NOTE                            = 'MAGELLAN STANFORD SCVDR SIS'
 END_OBJECT                             = ALIAS
 DESCRIPTION                            = "The code number for the method
  used to account for the effects of thermal noise on the observations."
END_OBJECT                              = COLUMN

OBJECT                                  = COLUMN
 NAME                                   = NON_DELTA_SPECTRAL_FILTER_FLAG
 START_BYTE                             = 42
 DATA_TYPE                              = UNSIGNED_INTEGER
 BYTES                                  = 1
 UNIT                                   = 'N/A'
 OBJECT                                 = ALIAS
  ALIAS_NAME                            = NH_SPECF
  USAGE_NOTE                            = 'MAGELLAN STANFORD SCVDR SIS'
 END_OBJECT                             = ALIAS
 DESCRIPTION                            = "If set (1), the Doppler
  spectrum has been convolved with an FIR filter before the inversion
  process. The nominal filter is [0.25 0.50 0.25] but is not saved in the
  SCVDR. If not set (0), no filter has been used (preferred)."
END_OBJECT                              = COLUMN

OBJECT                                  = COLUMN
 NAME                                   = DOPPLER_ROTATION_METHOD_ID
 START_BYTE                             = 43
 DATA_TYPE                              = UNSIGNED_INTEGER
 BYTES                                  = 1
 UNIT                                   = 'N/A'
 OBJECT                                 = ALIAS
  ALIAS_NAME                            = NH_METH_FROT
  USAGE_NOTE                            = 'MAGELLAN STANFORD SCVDR SIS'
 END_OBJECT                             = ALIAS
 DESCRIPTION                            = "The code number for the method
  used to account for unexpected Doppler shifts in the observed echo
  spectrum (see Section 5.4.1 of the SCVDR SIS)."
END_OBJECT                              = COLUMN

OBJECT                                  = COLUMN
 NAME                                   = SPARE
 START_BYTE                             = 44
 BYTES                                  = 1
END_OBJECT                              = COLUMN

OBJECT                                  = COLUMN
 NAME                                   = NUMBER_OF_DATA_RECORDS
 START_BYTE                             = 45
 DATA_TYPE                              = MSB_INTEGER
```

```
 BYTES                                = 4
 UNIT                                 = 'N/A'
 OBJECT                               = ALIAS
  ALIAS_NAME                          = NH_NREC
  USAGE_NOTE                          = 'MAGELLAN STANFORD SCVDR SIS'
 END_OBJECT                           = ALIAS
 DESCRIPTION                          = "The number of altimetry
  inversion records that follow this header."
END_OBJECT                            = COLUMN

OBJECT                                = COLUMN
 NAME                                 = RANGE_ECHO_PROCESSING_ID
 START_BYTE                           = 49
 DATA_TYPE                            = UNSIGNED_INTEGER
 BYTES                                = 1
 UNIT                                 = 'N/A'
 OBJECT                               = ALIAS
  ALIAS_NAME                          = NH_METH_ECHO
  USAGE_NOTE                          = 'MAGELLAN STANFORD SCVDR SIS'
 END_OBJECT                           = ALIAS
 DESCRIPTION                          = "The code number for the method
  used to process the range echo before the inversion (see Section 5.4.1
  of the SCVDR SIS)."
END_OBJECT                            = COLUMN

OBJECT                                = COLUMN
 NAME                                 = MAXIMUM_ANGLE_METHOD_ID
 START_BYTE                           = 50
 DATA_TYPE                            = UNSIGNED_INTEGER
 BYTES                                = 1
 UNIT                                 = 'N/A'
 OBJECT                               = ALIAS
  ALIAS_NAME                          = NH_METH_BMAX
  USAGE_NOTE                          = 'MAGELLAN STANFORD SCVDR SIS'
 END_OBJECT                           = ALIAS
 DESCRIPTION                          = "The code number for the method
  used to determine the maximum solution angle in the inversion (see
  Section 5.4.1 of the SCVDR SIS)."
END_OBJECT                            = COLUMN

OBJECT                                = COLUMN
 NAME                                 = PULSE_COMPRESSION_ID
 START_BYTE                           = 51
 DATA_TYPE                            = MSB_INTEGER
 BYTES                                = 2
 UNIT                                 = 'N/A'
 OBJECT                               = ALIAS
  ALIAS_NAME                          = NH_HID
  USAGE_NOTE                          = 'MAGELLAN STANFORD SCVDR SIS'
 END_OBJECT                           = ALIAS
 DESCRIPTION                          = "The code number for the
  correlation kernel used in the radar pulse compression stage, before
  the range-Doppler array is computed (see Section 5.4.1 of the SCVDR
  SIS)."
END_OBJECT                            = COLUMN
```

```
OBJECT                                  = COLUMN
 NAME                                   = COMP_MAJOR_VERSION_ID
 START_BYTE                             = 53
 DATA_TYPE                              = MSB_INTEGER
 BYTES                                  = 2
 UNIT                                   = 'N/A'
 OBJECT                                 = ALIAS
  ALIAS_NAME                            = NH_COMP_MAJOR
  USAGE_NOTE                            = 'MAGELLAN STANFORD SCVDR SIS'
 END_OBJECT                             = ALIAS
 DESCRIPTION                            = "The major version number of
  the Stanford calibration software COMP used to compensate the input
  data for amplitude and timing effects."
END_OBJECT                              = COLUMN

OBJECT                                  = COLUMN
 NAME                                   = COMP_MINOR_VERSION_ID
 START_BYTE                             = 55
 DATA_TYPE                              = MSB_INTEGER
 BYTES                                  = 2
 UNIT                                   = 'N/A'
 OBJECT                                 = ALIAS
  ALIAS_NAME                            = NH_COMP_MINOR
  USAGE_NOTE                            = 'MAGELLAN STANFORD SCVDR SIS'
 END_OBJECT                             = ALIAS
 DESCRIPTION                            = "The minor version number of
  the Stanford calibration software COMP used to compensate the input
  data for amplitude and timing effects."
END_OBJECT                              = COLUMN

OBJECT                                  = COLUMN
 NAME                                   = MAX_NUMBER_OF_SOLUTION_ANGLES
 START_BYTE                             = 57
 DATA_TYPE                              = MSB_INTEGER
 BYTES                                  = 2
 UNIT                                   = 'N/A'
 OBJECT                                 = ALIAS
  ALIAS_NAME                            = NH_MAXB
  USAGE_NOTE                            = 'MAGELLAN STANFORD SCVDR SIS'
 END_OBJECT                             = ALIAS
 DESCRIPTION                            = "The largest number of elements
  that will appear in any scattering function (SCATTERING_FUNCTION) in
  this orbit, equal to the largest value of NUMBER_OF_ANGLES_IN_SOLUTION.
  The maximum size in bytes is thus 4 * MAX_NUMBER_OF_SOLUTION_ANGLES."
END_OBJECT                              = COLUMN

OBJECT                                  = COLUMN
 NAME                                   = MAX_NUMBER_OF_ELEMENTS_IN_CVM
 START_BYTE                             = 59
 DATA_TYPE                              = MSB_INTEGER
 BYTES                                  = 2
 UNIT                                   = 'N/A'
 OBJECT                                 = ALIAS
  ALIAS_NAME                            = NH_MAXN
  USAGE_NOTE                            = 'MAGELLAN STANFORD SCVDR SIS'
```

```
 END_OBJECT                          = ALIAS
 DESCRIPTION                         = "The largest number of elements
  that will appear in any covariance matrix (COVARIANCE_MATRIX) in this
  orbit, equal to the largest value of NUMBER_OF_ELEMENTS_SAVED_IN_CVM.
  The maximum size in bytes is thus 4 * MAX_NUMBER_OF_ELEMENTS_IN_CVM."
END_OBJECT                           = COLUMN

OBJECT                               = COLUMN
 NAME                                = SPARE
 START_BYTE                          = 61
 BYTES                               = 12
END_OBJECT                           = COLUMN

END
```

B.3. SCVDREDF.FMT Example

```
CCSD3ZF0000100000001NJPL3IF0PDSX00000001

PDS_VERSION_ID                       = PDS3

OBJECT                               = COLUMN
 NAME                                = SFDU_AGGREGATE_HEADER
 START_BYTE                          = 1
 DATA_TYPE                           = CHARACTER
 BYTES                               = 20
 UNIT                                = 'N/A'
 OBJECT                              = ALIAS
  ALIAS_NAME                         = ER_SFDU
  USAGE_NOTE                         = 'MAGELLAN STANFORD SCVDR SIS'
 END_OBJECT                          = ALIAS
 DESCRIPTION                         = "'NJPL1I00002200000220', the
  number '0022' is registered with the NJPL SFDU authority as the
  'Emissivity Data Record'. The final '00000220' signifies that the
  remainder of the SFDU is 220 bytes in length."
END_OBJECT                           = COLUMN

OBJECT                               = COLUMN
 NAME                                = FOOTPRINT_NUMBER
 START_BYTE                          = 21
 DATA_TYPE                           = MSB_UNSIGNED_INTEGER
 BYTES                               = 4
 UNIT                                = 'N/A'
 OBJECT                              = ALIAS
  ALIAS_NAME                         = ER_NFOOT
  USAGE_NOTE                         = 'MAGELLAN STANFORD SCVDR SIS'
 END_OBJECT                          = ALIAS
 DESCRIPTION                         = "Starting from 1, the number of
  the Emissivity Data Record by increasing emissivity footprint time
  (S_C_EMISSIVITY_EPOCH), starting at 1."
END_OBJECT                           = COLUMN

OBJECT                               = COLUMN
 NAME                                = SAB_NUMBER
 START_BYTE                          = 25
 DATA_TYPE                           = MSB_UNSIGNED_INTEGER
```

```
 BYTES                                = 4
 UNIT                                 = 'N/A'
 OBJECT                               = ALIAS
  ALIAS_NAME                          = ER_BURST
  USAGE_NOTE                          = 'MAGELLAN STANFORD SCVDR SIS'
 END_OBJECT                           = ALIAS
 DESCRIPTION                          = "The number assigned to the
  burst header that contains the antenna measurement (as opposed to the
  calibration measurement) referenced by this Stanford emissivity data
  record."
END_OBJECT                            = COLUMN

OBJECT                                = COLUMN
 NAME                                 = FLAGS
 START_BYTE                           = 29
 DATA_TYPE                            = MSB_UNSIGNED_INTEGER
 BYTES                                = 4
 UNIT                                 = 'N/A'
 OBJECT                               = ALIAS
  ALIAS_NAME                          = ER_FLAGS
  USAGE_NOTE                          = 'MAGELLAN STANFORD SCVDR SIS'
 END_OBJECT                           = ALIAS
 DESCRIPTION                          = "Stanford Emissivity Data
  Record Flag Values (see Table 5-16 of the SCVDR SIS)."
END_OBJECT                            = COLUMN

OBJECT                                = COLUMN
 NAME                                 = S_C_EMISSIVITY_EPOCH
 START_BYTE                           = 33
 DATA_TYPE                            = IEEE_REAL
 BYTES                                = 8
 UNIT                                 = 'SECONDS'
 OBJECT                               = ALIAS
  ALIAS_NAME                          = ER_SCET
  USAGE_NOTE                          = 'MAGELLAN STANFORD SCVDR SIS'
 END_OBJECT                           = ALIAS
 DESCRIPTION                          = "The ephemeris time (seconds of
  TDB since J2000) at which the emissivity measurement was made."
END_OBJECT                            = COLUMN

OBJECT                                = COLUMN
 NAME                                 = S_C_POSITION_VECTOR
 START_BYTE                           = 41
 DATA_TYPE                            = IEEE_REAL
 BYTES                                = 4
 ITEMS                                = 3
 UNIT                                 = 'KM'
 OBJECT                               = ALIAS
  ALIAS_NAME                          = ER_SCPOS
  USAGE_NOTE                          = 'MAGELLAN STANFORD SCVDR SIS'
 END_OBJECT                           = ALIAS
 DESCRIPTION                          = "The S/C position at
  S_C_EMISSIVITY_EPOCH, relative to the Venus center of mass, expressed
  in inertial coordinates."
END_OBJECT                            = COLUMN
```

```
OBJECT                                  = COLUMN
 NAME                                   = ALTIMETER_POINTING_VECTOR
 START_BYTE                             = 53
 DATA_TYPE                              = IEEE_REAL
 BYTES                                  = 4
 ITEMS                                  = 3
 UNIT                                   = 'N/A'
 OBJECT                                 = ALIAS
  ALIAS_NAME                            = ER_ALTA
  USAGE_NOTE                            = 'MAGELLAN STANFORD SCVDR SIS'
 END_OBJECT                             = ALIAS
 DESCRIPTION                            = "The altimetry antenna pointing
  vector at S_C_EMISSIVITY_EPOCH expressed as a unit vector in inertial
  coordinates."
END_OBJECT                              = COLUMN

OBJECT                                  = COLUMN
 NAME                                   = SAR_POINTING_VECTOR
 START_BYTE                             = 65
 DATA_TYPE                              = IEEE_REAL
 BYTES                                  = 4
 ITEMS                                  = 3
 UNIT                                   = 'N/A'
 OBJECT                                 = ALIAS
  ALIAS_NAME                            = ER_SARA
  USAGE_NOTE                            = 'MAGELLAN STANFORD SCVDR SIS'
 END_OBJECT                             = ALIAS
 DESCRIPTION                            = "The HGA pointing vector at
  S/C_EMISSIVITY_EPOCH, expressed as a unit vector in inertial
  coordinates."
END_OBJECT                              = COLUMN

OBJECT                                  = COLUMN
 NAME                                   = FOOTPRINT_LATITUDE
 START_BYTE                             = 77
 DATA_TYPE                              = IEEE_REAL
 BYTES                                  = 4
 UNIT                                   = 'DEGREES'
 OBJECT                                 = ALIAS
  ALIAS_NAME                            = ER_LAT
  USAGE_NOTE                            = 'MAGELLAN STANFORD SCVDR SIS'
 END_OBJECT                             = ALIAS
 DESCRIPTION                            = "The body-fixed latitude, at
  S_C_EMISSIVITY_EPOCH, of the boresight intercept point (obtained from
  the C-BIDR Processing Parameters file)."
END_OBJECT                              = COLUMN

OBJECT                                  = COLUMN
 NAME                                   = FOOTPRINT_LONGITUDE
 START_BYTE                             = 81
 DATA_TYPE                              = IEEE_REAL
 BYTES                                  = 4
 UNIT                                   = 'DEGREES'
 OBJECT                                 = ALIAS
  ALIAS_NAME                            = ER_LON
```

```
  USAGE_NOTE                          = 'MAGELLAN STANFORD SCVDR SIS'
 END_OBJECT                           = ALIAS
 DESCRIPTION                          = "The body-fixed longitude, at
  S/C_EMISSIVITY_EPOCH, of the boresight intercept point (obtained from
  the C-BIDR Processing Parameters file)."
END_OBJECT                            = COLUMN

OBJECT                                = COLUMN
 NAME                                 = AZIMUTH_FROM_FOOTPRINT_TO_S_C
 START_BYTE                           = 85
 DATA_TYPE                            = IEEE_REAL
 BYTES                                = 4
 UNIT                                 = 'DEGREES'
 OBJECT                               = ALIAS
  ALIAS_NAME                          = ER_AZIMUTH
  USAGE_NOTE                          = 'MAGELLAN STANFORD SCVDR SIS'
 END_OBJECT                           = ALIAS
 DESCRIPTION                          = "At (FOOTPRINT_LATITUDE,
  FOOTPRINT_LONGITUDE) the spacecraft azimuth measured positive toward
  the east from local north."
END_OBJECT                            = COLUMN

OBJECT                                = COLUMN
 NAME                                 = POLARIZATION
 START_BYTE                           = 89
 DATA_TYPE                            = CHARACTER
 BYTES                                = 2
 UNIT                                 = 'N/A'
 OBJECT                               = ALIAS
  ALIAS_NAME                          = ER_POLN
  USAGE_NOTE                          = 'MAGELLAN STANFORD SCVDR SIS'
 END_OBJECT                           = ALIAS
 DESCRIPTION                          = "Horizontal received ('HH') or
  vertical received ('VV')."
END_OBJECT                            = COLUMN

OBJECT                                = COLUMN
 NAME                                 = SPARE
 START_BYTE                           = 91
 BYTES                                = 2
END_OBJECT                            = COLUMN

OBJECT                                = COLUMN
 NAME                                 = FOOTPRINT_PLANETARY_RADIUS
 START_BYTE                           = 93
 DATA_TYPE                            = IEEE_REAL
 BYTES                                = 4
 UNIT                                 = 'KM'
 OBJECT                               = ALIAS
  ALIAS_NAME                          = ER_RADIUS
  USAGE_NOTE                          = 'MAGELLAN STANFORD SCVDR SIS'
 END_OBJECT                           = ALIAS
 DESCRIPTION                          = "The estimated planetary radius
  at the boresight intercept point (obtained from the C-BIDR Processing
  Parameters file)."
```

```
END_OBJECT                              = COLUMN

OBJECT                                  = COLUMN
 NAME                                   = FOOTPRINT_INCIDENCE_ANGLE
 START_BYTE                             = 97
 DATA_TYPE                              = IEEE_REAL
 BYTES                                  = 4
 UNIT                                   = 'DEGREES'
 OBJECT                                 = ALIAS
  ALIAS_NAME                            = ER_INC
  USAGE_NOTE                            = 'MAGELLAN STANFORD SCVDR SIS'
 END_OBJECT                             = ALIAS
 DESCRIPTION                            = "The incidence angle at the
  boresight intercept point (obtained from the C-BIDR Processing
  Parameters file)."
END_OBJECT                              = COLUMN

OBJECT                                  = COLUMN
 NAME                                   = SAR_STATUS_FOR_PRECEDING_BURST
 START_BYTE                             = 101
 DATA_TYPE                              = UNSIGNED_INTEGER
 BYTES                                  = 1
 ITEMS                                  = 10
 UNIT                                   = 'N/A'
 OBJECT                                 = ALIAS
  ALIAS_NAME                            = ER_SS_PREV
  USAGE_NOTE                            = 'MAGELLAN STANFORD SCVDR SIS'
 END_OBJECT                             = ALIAS
 DESCRIPTION                            = "The original SAB header status
  field from the burst preceding the Antenna Measurement, of interest
  because the Antenna Measurement actually occurs during this burst."
END_OBJECT                              = COLUMN

OBJECT                                  = COLUMN
 NAME                                   = SAR_STATUS_FOR_ANTENNA_BURST
 START_BYTE                             = 111
 DATA_TYPE                              = UNSIGNED_INTEGER
 BYTES                                  = 1
 ITEMS                                  = 10
 UNIT                                   = 'N/A'
 OBJECT                                 = ALIAS
  ALIAS_NAME                            = ER_SS_ANT
  USAGE_NOTE                            = 'MAGELLAN STANFORD SCVDR SIS'
 END_OBJECT                             = ALIAS
 DESCRIPTION                            = "The original SAB header status
  field used for the radiometry (emissivity) measurement."
END_OBJECT                              = COLUMN

OBJECT                                  = COLUMN
 NAME                                   = SAR_STATUS_FOR_CALIBRATION_BURST
 START_BYTE                             = 121
 DATA_TYPE                              = UNSIGNED_INTEGER
 BYTES                                  = 1
 ITEMS                                  = 10
 UNIT                                   = 'N/A'
```

```
 OBJECT                                = ALIAS
  ALIAS_NAME                           = ER_SS_CAL
  USAGE_NOTE                           = 'MAGELLAN STANFORD SCVDR SIS'
 END_OBJECT                            = ALIAS
 DESCRIPTION                           = "The original SAB header status
  field used for the radiometry (emissivity) calibration."
END_OBJECT                             = COLUMN

OBJECT                                 = COLUMN
 NAME                                  = TRANSMITTER_A_FLAG
 START_BYTE                            = 131
 DATA_TYPE                             = UNSIGNED_INTEGER
 BYTES                                 = 1
 UNIT                                  = 'N/A'
 OBJECT                                = ALIAS
  ALIAS_NAME                           = ER_XMTA
  USAGE_NOTE                           = 'MAGELLAN STANFORD SCVDR SIS'
 END_OBJECT                            = ALIAS
 DESCRIPTION                           = "If set (1), transmitter A was
  active; if not set (0) transmitter B was active."
END_OBJECT                             = COLUMN

OBJECT                                 = COLUMN
 NAME                                  = RECEIVER_A_FLAG
 START_BYTE                            = 132
 DATA_TYPE                             = UNSIGNED_INTEGER
 BYTES                                 = 1
 UNIT                                  = 'N/A'
 OBJECT                                = ALIAS
  ALIAS_NAME                           = ER_RCVA
  USAGE_NOTE                           = 'MAGELLAN STANFORD SCVDR SIS'
 END_OBJECT                            = ALIAS
 DESCRIPTION                           = "If set (1), receiver A was
  active; if not set (0), receiver B was active."
END_OBJECT                             = COLUMN

OBJECT                                 = COLUMN
 NAME                                  = ONU_A_FLAG
 START_BYTE                            = 133
 DATA_TYPE                             = UNSIGNED_INTEGER
 BYTES                                 = 1
 UNIT                                  = 'N/A'
 OBJECT                                = ALIAS
  ALIAS_NAME                           = ER_ONUA
  USAGE_NOTE                           = 'MAGELLAN STANFORD SCVDR SIS'
 END_OBJECT                            = ALIAS
 DESCRIPTION                           = "If set (1), ONU A was active;
  if not set (0), ONU B was active."
END_OBJECT                             = COLUMN

OBJECT                                 = COLUMN
 NAME                                  = SPARE
 START_BYTE                            = 134
 BYTES                                 = 3
END_OBJECT                             = COLUMN
```

```
OBJECT                                  = COLUMN
 NAME                                   = CALIBRATED_RADIOMETRY_SIGNAL
 START_BYTE                             = 137
 DATA_TYPE                              = IEEE_REAL
 BYTES                                  = 4
 UNIT                                   = 'N/A'
 OBJECT                                 = ALIAS
  ALIAS_NAME                            = ER_S
  USAGE_NOTE                            = 'MAGELLAN STANFORD SCVDR SIS'
 END_OBJECT                             = ALIAS
 DESCRIPTION                            = "The difference between the
  antenna radiometry (emissivity) measurement ANT and the calibration
  measurement COMPENSATED_CALIB_MEASUREMENT (CALIBRATED_RADIOMETRY_SIGNAL
  = ANT - COMPENSATED_CALIB_MEASUREMENT), in units of radiometer counts.
  This value has been corrected for non-systematic radiometric effects,
  but has not been corrected for systematic errors."
END_OBJECT                              = COLUMN

OBJECT                                  = COLUMN
 NAME                                   = CORRECTED_RADIOMETRY_SIGNAL
 START_BYTE                             = 141
 DATA_TYPE                              = IEEE_REAL
 BYTES                                  = 4
 UNIT                                   = 'N/A'
 OBJECT                                 = ALIAS
  ALIAS_NAME                            = ER_SPRIME
  USAGE_NOTE                            = 'MAGELLAN STANFORD SCVDR SIS'
 END_OBJECT                             = ALIAS
 DESCRIPTION                            = "The radiometer signal after
  correction for systematic errors in units of radiometer counts."
END_OBJECT                              = COLUMN

OBJECT                                  = COLUMN
 NAME                                   = COMPENSATED_CALIB_MEASUREMENT
 START_BYTE                             = 145
 DATA_TYPE                              = IEEE_REAL
 BYTES                                  = 4
 UNIT                                   = 'N/A'
 OBJECT                                 = ALIAS
  ALIAS_NAME                            = ER_CAL
  USAGE_NOTE                            = 'MAGELLAN STANFORD SCVDR SIS'
 END_OBJECT                             = ALIAS
 DESCRIPTION                            = "The radiometer measurement
  when it is connected to the reference load, in units of radiometer
  counts. This value has been corrected for non-systematic radiometric
  effects."
END_OBJECT                              = COLUMN

OBJECT                                  = COLUMN
 NAME                                   = RECEIVER_PHYSICAL_TEMPERATURE
 START_BYTE                             = 149
 DATA_TYPE                              = IEEE_REAL
 BYTES                                  = 4
 UNIT                                   = 'K'
 OBJECT                                 = ALIAS
```

```
  ALIAS_NAME                          = ER_TRCV
  USAGE_NOTE                          = 'MAGELLAN STANFORD SCVDR SIS'
 END_OBJECT                           = ALIAS
 DESCRIPTION                          = "The physical temperature of
  the SAR receiver as reported from telemetry in image Processing
  Parameter files."
END_OBJECT                            = COLUMN

OBJECT                                = COLUMN
 NAME                                 = SENSOR_INPUT_NOISE_TEMPERATURE
 START_BYTE                           = 153
 DATA_TYPE                            = IEEE_REAL
 BYTES                                = 4
 UNIT                                 = 'K'
 OBJECT                               = ALIAS
  ALIAS_NAME                          = ER_TSI
  USAGE_NOTE                          = 'MAGELLAN STANFORD SCVDR SIS'
 END_OBJECT                           = ALIAS
 DESCRIPTION                          = "The system temperature of the
  sensor RF input port, obtained from the radiometry (emissivity) signal
  and compensated for receiver gain and temperature."
END_OBJECT                            = COLUMN

OBJECT                                = COLUMN
 NAME                                 = CABLE_TEMPERATURE_SENSORS
 START_BYTE                           = 157
 DATA_TYPE                            = IEEE_REAL
 BYTES                                = 4
 ITEMS                                = 5
 UNIT                                 = 'K'
 OBJECT                               = ALIAS
  ALIAS_NAME                          = ER_TSEN
  USAGE_NOTE                          = 'MAGELLAN STANFORD SCVDR SIS'
 END_OBJECT                           = ALIAS
 DESCRIPTION                          = "The physical temperatures
  reported by five sensors along the cable between the antenna and the
  receiver front end."
END_OBJECT                            = COLUMN

OBJECT                                = COLUMN
 NAME                                 = HGA_ANTENNA_NOISE_TEMPERATURE
 START_BYTE                           = 177
 DATA_TYPE                            = IEEE_REAL
 BYTES                                = 4
 UNIT                                 = 'K'
 OBJECT                               = ALIAS
  ALIAS_NAME                          = ER_TANT
  USAGE_NOTE                          = 'MAGELLAN STANFORD SCVDR SIS'
 END_OBJECT                           = ALIAS
 DESCRIPTION                          = "The system temperature of the
  HGA antenna, determined from the sensor input noise temperature and the
  loss and physical temperature of the HGA cable."
END_OBJECT                            = COLUMN

OBJECT                                = COLUMN
```

```
 NAME                                = HGA_REFLECTOR_PHYSICAL_TEMP
 START_BYTE                          = 181
 DATA_TYPE                           = IEEE_REAL
 BYTES                               = 4
 UNIT                                = 'K'
 OBJECT                              = ALIAS
  ALIAS_NAME                         = ER_THGA
  USAGE_NOTE                         = 'MAGELLAN STANFORD SCVDR SIS'
 END_OBJECT                          = ALIAS
 DESCRIPTION                         = "High gain antenna physical
  temperature obtained from engineering telemetry channel E-0100."
END_OBJECT                           = COLUMN

OBJECT                               = COLUMN
 NAME                                = S_BAND_FEED_PHYSICAL_TEMP
 START_BYTE                          = 185
 DATA_TYPE                           = IEEE_REAL
 BYTES                               = 4
 UNIT                                = 'K'
 OBJECT                              = ALIAS
  ALIAS_NAME                         = ER_TSFEED
  USAGE_NOTE                         = 'MAGELLAN STANFORD SCVDR SIS'
 END_OBJECT                          = ALIAS
 DESCRIPTION                         = "S-Band feed physical
  temperature obtained from engineering telemetry channel E-0098."
END_OBJECT                           = COLUMN

OBJECT                               = COLUMN
 NAME                                = REFLECTED_SKY_TEMPERATURE
 START_BYTE                          = 189
 DATA_TYPE                           = IEEE_REAL
 BYTES                               = 4
 UNIT                                = 'K'
 OBJECT                              = ALIAS
  ALIAS_NAME                         = ER_TSKY
  USAGE_NOTE                         = 'MAGELLAN STANFORD SCVDR SIS'
 END_OBJECT                          = ALIAS
 DESCRIPTION                         = "The sky brightness in the
  forward scatter (specular) direction, nominally equal to
  COSMIC_BACKGROUND_TEMPERATURE but computed according to
  TSKY_COMPUTATION_METHOD."
END_OBJECT                           = COLUMN

OBJECT                               = COLUMN
 NAME                                = SOLID_ANGLE_SUBTENDED_BY_VENUS
 START_BYTE                          = 193
 DATA_TYPE                           = IEEE_REAL
 BYTES                               = 4
 UNIT                                = 'RADIANS'
 OBJECT                              = ALIAS
  ALIAS_NAME                         = ER_OMEGAV
  USAGE_NOTE                         = 'MAGELLAN STANFORD SCVDR SIS'
 END_OBJECT                          = ALIAS
 DESCRIPTION                         = "The solid angle subtended by
  the Venus disk at the spacecraft."
```

```
END_OBJECT                              = COLUMN

OBJECT                                  = COLUMN
 NAME                                   = ONE_WAY_TRANSMISSION_RAY_PATH_TO_BIP
 START_BYTE                             = 197
 DATA_TYPE                              = IEEE_REAL
 BYTES                                  = 4
 UNIT                                   = 'N/A'
 OBJECT                                 = ALIAS
  ALIAS_NAME                            = ER_ALPHA
  USAGE_NOTE                            = 'MAGELLAN STANFORD SCVDR SIS'
 END_OBJECT                             = ALIAS
 DESCRIPTION                            = "The one-way power transmission
  factor for the atmosphere between the point at (FOOTPRINT_LATITUDE,
  FOOTPRINT_LONGITUDE, FOOTPRINT_PLANETARY_RADIUS) and the spacecraft
  using the atmospheric model."
END_OBJECT                              = COLUMN

OBJECT                                  = COLUMN
 NAME                                   = SURFACE_PHYSICAL_TEMP
 START_BYTE                             = 201
 DATA_TYPE                              = IEEE_REAL
 BYTES                                  = 4
 UNIT                                   = 'K'
 OBJECT                                 = ALIAS
  ALIAS_NAME                            = ER_TSURF
  USAGE_NOTE                            = 'MAGELLAN STANFORD SCVDR SIS'
 END_OBJECT                             = ALIAS
 DESCRIPTION                            = "The physical temperature of
  the surface obtained from the assumed radius at the boresight intercept
  point (FOOTPRINT_PLANETARY_RADIUS) and the (Magellan-adopted) model for
  atmospheric structure."
END_OBJECT                              = COLUMN

OBJECT                                  = COLUMN
 NAME                                   = UPWELLING_ATMOSPHERIC_EMISSION_T
 START_BYTE                             = 205
 DATA_TYPE                              = IEEE_REAL
 BYTES                                  = 4
 UNIT                                   = 'K'
 OBJECT                                 = ALIAS
  ALIAS_NAME                            = ER_TUP
  USAGE_NOTE                            = 'MAGELLAN STANFORD SCVDR SIS'
 END_OBJECT                             = ALIAS
 DESCRIPTION                            = "The effective temperature of
  the atmosphere resulting from self-emission along the ray path
  determined by the HGA."
END_OBJECT                              = COLUMN

OBJECT                                  = COLUMN
 NAME                                   = DOWNWELLING_ATMOSPHERIC_EMISSION_T
 START_BYTE                             = 209
 DATA_TYPE                              = IEEE_REAL
 BYTES                                  = 4
 UNIT                                   = 'K'
```

```
 OBJECT                                 = ALIAS
  ALIAS_NAME                            = ER_TDN
  USAGE_NOTE                            = 'MAGELLAN STANFORD SCVDR SIS'
 END_OBJECT                             = ALIAS
 DESCRIPTION                            = "The effective temperature of
  the atmosphere observed at the surface along an incoming ray that,
  after specular reflection from the (average) spherical surface, would
  reach the spacecraft."
END_OBJECT                              = COLUMN

OBJECT                                  = COLUMN
 NAME                                   = SURFACE_BRIGHTNESS_TEMP
 START_BYTE                             = 213
 DATA_TYPE                              = IEEE_REAL
 BYTES                                  = 4
 UNIT                                   = 'K'
 OBJECT                                 = ALIAS
  ALIAS_NAME                            = ER_TB
  USAGE_NOTE                            = 'MAGELLAN STANFORD SCVDR SIS'
 END_OBJECT                             = ALIAS
 DESCRIPTION                            = "The brightness temperature of
  the Venus surface derived from the radiometry (emissivity) measurements."
END_OBJECT                              = COLUMN

OBJECT                                  = COLUMN
 NAME                                   = SURFACE_BRIGHTNESS_TEMP_VARIANCE
 START_BYTE                             = 217
 DATA_TYPE                              = IEEE_REAL
 BYTES                                  = 4
 UNIT                                   = 'N/A'
 OBJECT                                 = ALIAS
  ALIAS_NAME                            = ER_TBV
  USAGE_NOTE                            = 'MAGELLAN STANFORD SCVDR SIS'
 END_OBJECT                             = ALIAS
 DESCRIPTION                            = "Variance of the derived Venus
  brightness temperature using the method identified by
  VARIANCE_ESTIMATION_COMP_METHOD."
END_OBJECT                              = COLUMN

OBJECT                                  = COLUMN
 NAME                                   = EMISSIVITY
 START_BYTE                             = 221
 DATA_TYPE                              = IEEE_REAL
 BYTES                                  = 4
 UNIT                                   = 'N/A'
 OBJECT                                 = ALIAS
  ALIAS_NAME                            = ER_EMISS
  USAGE_NOTE                            = 'MAGELLAN STANFORD SCVDR SIS'
 END_OBJECT                             = ALIAS
 DESCRIPTION                            = "The emissivity of the Venus
  surface."
END_OBJECT                              = COLUMN

OBJECT                                  = COLUMN
 NAME                                   = EMISSIVITY_VARIANCE
```

```
 START_BYTE                          = 225
 DATA_TYPE                           = IEEE_REAL
 BYTES                               = 4
 UNIT                                = 'N/A'
 OBJECT                              = ALIAS
  ALIAS_NAME                         = ER_EMISSV
  USAGE_NOTE                         = 'MAGELLAN STANFORD SCVDR SIS'
 END_OBJECT                          = ALIAS
 DESCRIPTION                         = "Variance of the derived
  emissivity using the method identified by
  VARIANCE_ESTIMATION_COMP_METHOD."
END_OBJECT                           = COLUMN

OBJECT                               = COLUMN
 NAME                                = SPARE
 START_BYTE                          = 229
 BYTES                               = 12
END_OBJECT                           = COLUMN

END
```

B.4. SCVDREDH.FMT Example

```
CCSD3ZF0000100000001NJPL3IF0PDSX00000001

PDS_VERSION_ID                       = PDS3

OBJECT                               = COLUMN
 NAME                                = SFDU_AGGREGATE_HEADER
 START_BYTE                          = 1
 DATA_TYPE                           = CHARACTER
 BYTES                               = 20
 UNIT                                = 'N/A'
 OBJECT                              = ALIAS
  ALIAS_NAME                         = EH_SFDU
  USAGE_NOTE                         = 'MAGELLAN STANFORD SCVDR SIS'
 END_OBJECT                          = ALIAS
 DESCRIPTION                         = "'NJPL1I00002100000072', the
  number '0021' is registered with the NJPL SFDU authority as the
  'Emissivity Header Record'. The '00000072' signifies that the remainder
  of the SFDU is 72 bytes in length."
END_OBJECT                           = COLUMN

OBJECT                               = COLUMN
 NAME                                = ORBIT_NUMBER
 START_BYTE                          = 21
 DATA_TYPE                           = MSB_INTEGER
 BYTES                               = 4
 UNIT                                = 'N/A'
 OBJECT                              = ALIAS
  ALIAS_NAME                         = EH_ORB
  USAGE_NOTE                         = 'MAGELLAN STANFORD SCVDR SIS'
 END_OBJECT                          = ALIAS
 DESCRIPTION                         = "The Magellan orbit number for
  the data represented in these data records."
END_OBJECT                           = COLUMN
```

```
OBJECT                                  = COLUMN
 NAME                                   = VERSION_NUMBER
 START_BYTE                             = 25
 DATA_TYPE                              = MSB_INTEGER
 BYTES                                  = 4
 UNIT                                   = 'N/A'
 OBJECT                                 = ALIAS
  ALIAS_NAME                            = EH_VER
  USAGE_NOTE                            = 'MAGELLAN STANFORD SCVDR SIS'
 END_OBJECT                             = ALIAS
 DESCRIPTION                            = "The orbit version number for
  these data. Obtained from the VERSION_ID keyword of the corresponding
  C-BIDR Orbit Header File (Note: This turns out not to be a good
  indicator of the version of the data file; the Orbit Header File itself
  is rarely updated)."
END_OBJECT                              = COLUMN

OBJECT                                  = COLUMN
 NAME                                   = RADI_MAJOR_VERSION_NUMBER
 START_BYTE                             = 29
 DATA_TYPE                              = MSB_INTEGER
 BYTES                                  = 2
 UNIT                                   = 'N/A'
 OBJECT                                 = ALIAS
  ALIAS_NAME                            = EH_RADI_MAJOR
  USAGE_NOTE                            = 'MAGELLAN STANFORD SCVDR SIS'
 END_OBJECT                             = ALIAS
 DESCRIPTION                            = "The number of the major
  software version of Stanford program RADI used to process these data."
END_OBJECT                              = COLUMN

OBJECT                                  = COLUMN
 NAME                                   = RADI_MINOR_VERSION_NUMBER
 START_BYTE                             = 31
 DATA_TYPE                              = MSB_INTEGER
 BYTES                                  = 2
 UNIT                                   = 'N/A'
 OBJECT                                 = ALIAS
  ALIAS_NAME                            = EH_RADI_MINOR
  USAGE_NOTE                            = 'MAGELLAN STANFORD SCVDR SIS'
 END_OBJECT                             = ALIAS
 DESCRIPTION                            = "The number of the minor
  software version of Stanford program RADI used to process these data."
END_OBJECT                              = COLUMN

OBJECT                                  = COLUMN
 NAME                                   = NUMBER_OF_DATA_RECORDS
 START_BYTE                             = 33
 DATA_TYPE                              = MSB_INTEGER
 BYTES                                  = 4
 UNIT                                   = 'N/A'
 OBJECT                                 = ALIAS
  ALIAS_NAME                            = EH_NREC
  USAGE_NOTE                            = 'MAGELLAN STANFORD SCVDR SIS'
 END_OBJECT                             = ALIAS
```

```
 DESCRIPTION                          = "The number of emissivity
  records in this file."
END_OBJECT                            = COLUMN

OBJECT                                = COLUMN
 NAME                                 = RADP_MAJOR_VERSION_NUMBER
 START_BYTE                           = 37
 DATA_TYPE                            = MSB_INTEGER
 BYTES                                = 2
 UNIT                                 = 'N/A'
 OBJECT                               = ALIAS
  ALIAS_NAME                          = EH_RADP_MAJOR
  USAGE_NOTE                          = 'MAGELLAN STANFORD SCVDR SIS'
 END_OBJECT                           = ALIAS
 DESCRIPTION                          = "The number of the major
  software version of Stanford program RADP used to process these data."
END_OBJECT                            = COLUMN

OBJECT                                = COLUMN
 NAME                                 = RADP_MINOR_VERSION_NUMBER
 START_BYTE                           = 39
 DATA_TYPE                            = MSB_INTEGER
 BYTES                                = 2
 UNIT                                 = 'N/A'
 OBJECT                               = ALIAS
  ALIAS_NAME                          = EH_RADP_MINOR
  USAGE_NOTE                          = 'MAGELLAN STANFORD SCVDR SIS'
 END_OBJECT                           = ALIAS
 DESCRIPTION                          = "The number of the minor
  software version of Stanford program RADP used to process these data."
END_OBJECT                            = COLUMN

OBJECT                                = COLUMN
 NAME                                 = ENGEX_MAJOR_VERSION_NUMBER
 START_BYTE                           = 41
 DATA_TYPE                            = MSB_INTEGER
 BYTES                                = 2
 UNIT                                 = 'N/A'
 OBJECT                               = ALIAS
  ALIAS_NAME                          = EH_ENGEX_MAJOR
  USAGE_NOTE                          = 'MAGELLAN STANFORD SCVDR SIS'
 END_OBJECT                           = ALIAS
 DESCRIPTION                          = "The number of the minor
  software version of Stanford program ENGEX used to process these data."
END_OBJECT                            = COLUMN

OBJECT                                = COLUMN
 NAME                                 = ENGEX_MINOR_VERSION_NUMBER
 START_BYTE                           = 43
 DATA_TYPE                            = MSB_INTEGER
 BYTES                                = 2
 UNIT                                 = 'N/A'
 OBJECT                               = ALIAS
  ALIAS_NAME                          = EH_ENGEX_MINOR
  USAGE_NOTE                          = 'MAGELLAN STANFORD SCVDR SIS'
```

```
 END_OBJECT                          = ALIAS
 DESCRIPTION                         = "The number of the minor
  software version of Stanford program ENGEX used to process these data."
END_OBJECT                           = COLUMN

OBJECT                               = COLUMN
 NAME                                = SABEX_MAJOR_VERSION_NUMBER
 START_BYTE                          = 45
 DATA_TYPE                           = MSB_INTEGER
 BYTES                               = 2
 UNIT                                = 'N/A'
 OBJECT                              = ALIAS
  ALIAS_NAME                         = EH_SABEX_MAJOR
  USAGE_NOTE                         = 'MAGELLAN STANFORD SCVDR SIS'
 END_OBJECT                          = ALIAS
 DESCRIPTION                         = "The number of the major
  software version of Stanford program SABEX used to process these data."
END_OBJECT                           = COLUMN

OBJECT                               = COLUMN
 NAME                                = SABEX_MINOR_VERSION_NUMBER
 START_BYTE                          = 47
 DATA_TYPE                           = MSB_INTEGER
 BYTES                               = 2
 UNIT                                = 'N/A'
 OBJECT                              = ALIAS
  ALIAS_NAME                         = EH_SABEX_MINOR
  USAGE_NOTE                         = 'MAGELLAN STANFORD SCVDR SIS'
 END_OBJECT                          = ALIAS
 DESCRIPTION                         = "The number of the minor
  software version of Stanford program SABEX used to process these data."
END_OBJECT                           = COLUMN

OBJECT                               = COLUMN
 NAME                                = RCOMP_MAJOR_VERSION_NUMBER
 START_BYTE                          = 49
 DATA_TYPE                           = MSB_INTEGER
 BYTES                               = 2
 UNIT                                = 'N/A'
 OBJECT                              = ALIAS
  ALIAS_NAME                         = EH_RCOMP_MAJOR
  USAGE_NOTE                         = 'MAGELLAN STANFORD SCVDR SIS'
 END_OBJECT                          = ALIAS
 DESCRIPTION                         = "The number of the major
  software version of Stanford program RCOMP used to process these data."
END_OBJECT                           = COLUMN

OBJECT                               = COLUMN
 NAME                                = RCOMP_MINOR_VERSION_NUMBER
 START_BYTE                          = 51
 DATA_TYPE                           = MSB_INTEGER
 BYTES                               = 2
 UNIT                                = 'N/A'
 OBJECT                              = ALIAS
  ALIAS_NAME                         = EH_RCOMP_MINOR
```

```
  USAGE_NOTE                          = 'MAGELLAN STANFORD SCVDR SIS'
 END_OBJECT                           = ALIAS
 DESCRIPTION                          = "The number of the minor
  software version of Stanford program RCOMP used to process these data."
END_OBJECT                            = COLUMN

OBJECT                                = COLUMN
 NAME                                 = RADIATIVE_TRANSFER_MODEL_ID
 START_BYTE                           = 53
 DATA_TYPE                            = MSB_INTEGER
 BYTES                                = 2
 UNIT                                 = 'N/A'
 OBJECT                               = ALIAS
  ALIAS_NAME                          = EH_RATM_MAJOR
  USAGE_NOTE                          = 'MAGELLAN STANFORD SCVDR SIS'
 END_OBJECT                           = ALIAS
 DESCRIPTION                          = "The number of the major
  software version of Stanford program RATM used to process these data."
END_OBJECT                            = COLUMN

OBJECT                                = COLUMN
 NAME                                 = QUATERNION_COMPUTATION_METHOD
 START_BYTE                           = 55
 DATA_TYPE                            = UNSIGNED_INTEGER
 BYTES                                = 1
 UNIT                                 = 'N/A'
 OBJECT                               = ALIAS
  ALIAS_NAME                          = EH_METH_QUAT
  USAGE_NOTE                          = 'MAGELLAN STANFORD SCVDR SIS'
 END_OBJECT                           = ALIAS
 DESCRIPTION                          = "The code number for the
  specific method for determining the quaternion correction (if any; see
  Section 5.7 of the SCVDR SIS)."
END_OBJECT                            = COLUMN

OBJECT                                = COLUMN
 NAME                                 = TSKY_COMPUTATION_METHOD
 START_BYTE                           = 56
 DATA_TYPE                            = UNSIGNED_INTEGER
 BYTES                                = 1
 UNIT                                 = 'N/A'
 OBJECT                               = ALIAS
  ALIAS_NAME                          = EH_METH_TSKY
  USAGE_NOTE                          = 'MAGELLAN STANFORD SCVDR SIS'
 END_OBJECT                           = ALIAS
 DESCRIPTION                          = "The code number for the
  specific method for determining sky temperature as seen at the surface
  of Venus (see Section 5.7 of the SCVDR SIS)."
END_OBJECT                            = COLUMN

OBJECT                                = COLUMN
 NAME                                 = VENUS_DISK_BRIGHTNESS_COMP_METHOD
 START_BYTE                           = 57
 DATA_TYPE                            = UNSIGNED_INTEGER
 BYTES                                = 1
```

```
 UNIT                                = 'N/A'
 OBJECT                              = ALIAS
  ALIAS_NAME                         = EH_METH_TVENUS
  USAGE_NOTE                         = 'MAGELLAN STANFORD SCVDR SIS'
 END_OBJECT                          = ALIAS
 DESCRIPTION                         = "The code number for the
  specific method of determining the effective global temperature of
  Venus as seen at the spacecraft (see Section 5.7 of the SCVDR SIS)."
END_OBJECT                           = COLUMN

OBJECT                               = COLUMN
 NAME                                = BEAM_EFFICIENCY_COMP_METHOD
 START_BYTE                          = 58
 DATA_TYPE                           = UNSIGNED_INTEGER
 BYTES                               = 1
 UNIT                                = 'N/A'
 OBJECT                              = ALIAS
  ALIAS_NAME                         = EH_METH_BEAM_EFF
  USAGE_NOTE                         = 'MAGELLAN STANFORD SCVDR SIS'
 END_OBJECT                          = ALIAS
 DESCRIPTION                         = "The code number for the
  specific method of determining high-gain antenna beam efficiency (see
  Section 5.7 of the SCVDR SIS)."
END_OBJECT                           = COLUMN

OBJECT                               = COLUMN
 NAME                                = REFLECTIVITY_COMP_METHOD
 START_BYTE                          = 59
 DATA_TYPE                           = UNSIGNED_INTEGER
 BYTES                               = 1
 UNIT                                = 'N/A'
 OBJECT                              = ALIAS
  ALIAS_NAME                         = EH_METH_RHO
  USAGE_NOTE                         = 'MAGELLAN STANFORD SCVDR SIS'
 END_OBJECT                          = ALIAS
 DESCRIPTION                         = "The code number for the
  specific method for estimating the surface Fresnel reflectivity
  appropriate for the sky brightness reflection at the surface (see
  Section 5.7 of the SCVDR SIS)."
END_OBJECT                           = COLUMN

OBJECT                               = COLUMN
 NAME                                = VARIANCE_ESTIMATION_COMP_METHOD
 START_BYTE                          = 60
 DATA_TYPE                           = UNSIGNED_INTEGER
 BYTES                               = 1
 UNIT                                = 'N/A'
 OBJECT                              = ALIAS
  ALIAS_NAME                         = EH_METH_VAR
  USAGE_NOTE                         = 'MAGELLAN STANFORD SCVDR SIS'
 END_OBJECT                          = ALIAS
 DESCRIPTION                         = "The code number for the
  specific method of determining the variance expected in the estimates
  of Venus surface brightness and emissivity (see Section 5.7 of the
  SCVDR SIS)."
```

```
END_OBJECT                              = COLUMN

OBJECT                                  = COLUMN
 NAME                                   = SYSTEMATIC_ERROR_CORRECTION_METHOD
 START_BYTE                             = 61
 DATA_TYPE                              = UNSIGNED_INTEGER
 BYTES                                  = 1
 UNIT                                   = 'N/A'
 OBJECT                                 = ALIAS
  ALIAS_NAME                            = EH_METH_SYST
  USAGE_NOTE                            = 'MAGELLAN STANFORD SCVDR SIS'
 END_OBJECT                             = ALIAS
 DESCRIPTION                            = "The code number for the
  specific method for correcting the radiometry signal for systematic
  effects (such as capacitive discharge associated with altimeter bursts;
  see Section 5.7 of the SCVDR SIS)."
END_OBJECT                              = COLUMN

OBJECT                                  = COLUMN
 NAME                                   = GEOMETRY_COMPUTATION_METHOD
 START_BYTE                             = 62
 DATA_TYPE                              = UNSIGNED_INTEGER
 BYTES                                  = 1
 UNIT                                   = 'N/A'
 OBJECT                                 = ALIAS
  ALIAS_NAME                            = EH_METH_GEOM
  USAGE_NOTE                            = 'MAGELLAN STANFORD SCVDR SIS'
 END_OBJECT                             = ALIAS
 DESCRIPTION                            = "The code number for the
  specific method for computing the spacecraft position, velocity and
  orientation (see Section 5.7 of the SCVDR SIS)."
END_OBJECT                              = COLUMN

OBJECT                                  = COLUMN
 NAME                                   = SOURCE_OF_TELEMETRY_INFO
 START_BYTE                             = 63
 DATA_TYPE                              = UNSIGNED_INTEGER
 BYTES                                  = 1
 UNIT                                   = 'N/A'
 OBJECT                                 = ALIAS
  ALIAS_NAME                            = EH_METH_TELEM
  USAGE_NOTE                            = 'MAGELLAN STANFORD SCVDR SIS'
 END_OBJECT                             = ALIAS
 DESCRIPTION                            = "The code number for the
  specific method for computing and conditioning the spacecraft telemetry
  signals (see Section 5.7 of the SCVDR SIS)."
END_OBJECT                              = COLUMN

OBJECT                                  = COLUMN
 NAME                                   = SPARE
 START_BYTE                             = 64
 BYTES                                  = 1
END_OBJECT                              = COLUMN

OBJECT                                  = COLUMN
```

```
 NAME                                = VENUS_TEMPERATURE
 START_BYTE                          = 65
 DATA_TYPE                           = IEEE_REAL
 BYTES                               = 4
 UNIT                                = 'K'
 OBJECT                              = ALIAS
  ALIAS_NAME                         = EH_TVENUS
  USAGE_NOTE                         = 'MAGELLAN STANFORD SCVDR SIS'
 END_OBJECT                          = ALIAS
 DESCRIPTION                         = "The effective (global)
  brightness temperature of Venus as seen at the spacecraft (nominally
  635K)."
END_OBJECT                           = COLUMN

OBJECT                               = COLUMN
 NAME                                = COSMIC_BACKGROUND_TEMPERATURE
 START_BYTE                          = 69
 DATA_TYPE                           = IEEE_REAL
 BYTES                               = 4
 UNIT                                = 'K'
 OBJECT                              = ALIAS
  ALIAS_NAME                         = EH_TCOSMIC
  USAGE_NOTE                         = 'MAGELLAN STANFORD SCVDR SIS'
 END_OBJECT                          = ALIAS
 DESCRIPTION                         = "The cosmic background
  temperature (nominally 3K) for emissivity measurements at Venus."
END_OBJECT                           = COLUMN

OBJECT                               = COLUMN
 NAME                                = BEAM_EFFICIENCY
 START_BYTE                          = 73
 DATA_TYPE                           = IEEE_REAL
 BYTES                               = 4
 UNIT                                = 'N/A'
 OBJECT                              = ALIAS
  ALIAS_NAME                         = EH_BEAM_EFF
  USAGE_NOTE                         = 'MAGELLAN STANFORD SCVDR SIS'
 END_OBJECT                          = ALIAS
 DESCRIPTION                         = "The high-gain antenna beam
  efficiency used for interpreting emissivity measurements (nominally
  0.8)."
END_OBJECT                           = COLUMN

OBJECT                               = COLUMN
 NAME                                = ANTENNA_RADIATION_EFFICIENCY
 START_BYTE                          = 77
 DATA_TYPE                           = IEEE_REAL
 BYTES                               = 4
 UNIT                                = 'N/A'
 OBJECT                              = ALIAS
  ALIAS_NAME                         = EH_RAD_EFF
  USAGE_NOTE                         = 'MAGELLAN STANFORD SCVDR SIS'
 END_OBJECT                          = ALIAS
 DESCRIPTION                         = "The high-gain antenna
  radiation efficiency used for interpreting emissivity measurements
```

```
  (nominally 0.977)."
END_OBJECT                              = COLUMN

OBJECT                                  = COLUMN
 NAME                                   = SPARE
 START_BYTE                             = 81
 BYTES                                  = 12
END_OBJECT                              = COLUMN

END
```

B.5. SCVDRGMF.FMT Example

```
CCSD3ZF0000100000001NJPL3IF0PDSX00000001

PDS_VERSION_ID                          = PDS3

OBJECT                                  = COLUMN
 NAME                                   = SFDU_AGGREGATE_HEADER
 START_BYTE                             = 1
 DATA_TYPE                              = CHARACTER
 BYTES                                  = 20
 UNIT                                   = 'N/A'
 OBJECT                                 = ALIAS
  ALIAS_NAME                            = GR_SFDU
  USAGE_NOTE                            = 'MAGELLAN STANFORD SCVDR SIS'
 END_OBJECT                             = ALIAS
 DESCRIPTION                            = "'NJPL1I0000240000nnnn', the
  number '0024' is registered with the NJPL SFDU authority as the
  'G-Matrix Data Record'. 'nnnn' is the length in bytes of the remainder
  of the SFDU, which varies from record to record."
END_OBJECT                              = COLUMN

OBJECT                                  = COLUMN
 NAME                                   = G_MATRIX_ID_NUMBER
 START_BYTE                             = 21
 DATA_TYPE                              = MSB_INTEGER
 BYTES                                  = 2
 UNIT                                   = 'N/A'
 OBJECT                                 = ALIAS
  ALIAS_NAME                            = GR_GNUM
  USAGE_NOTE                            = 'MAGELLAN STANFORD SCVDR SIS'
 END_OBJECT                             = ALIAS
 DESCRIPTION                            = "The identifier for the
  G-matrix. G-matrices are indexed from 0."
END_OBJECT                              = COLUMN

OBJECT                                  = COLUMN
 NAME                                   = ORBIT_NUMBER
 START_BYTE                             = 23
 DATA_TYPE                              = MSB_INTEGER
 BYTES                                  = 2
 UNIT                                   = 'N/A'
 OBJECT                                 = ALIAS
  ALIAS_NAME                            = GR_ORB
  USAGE_NOTE                            = 'MAGELLAN STANFORD SCVDR SIS'
```

```
 END_OBJECT                             = ALIAS
 DESCRIPTION                            = "The orbit number for which the
  G-matrix was computed."
END_OBJECT                              = COLUMN

OBJECT                                  = COLUMN
 NAME                                   = BURST_NUMBER_WITHIN_ORBIT
 START_BYTE                             = 25
 DATA_TYPE                              = MSB_UNSIGNED_INTEGER
 BYTES                                  = 4
 UNIT                                   = 'N/A'
 OBJECT                                 = ALIAS
  ALIAS_NAME                            = GR_BURST
  USAGE_NOTE                            = 'MAGELLAN STANFORD SCVDR SIS'
 END_OBJECT                             = ALIAS
 DESCRIPTION                            = "The burst number within orbit
  ORBIT_NUMBER for which the G-matrix was computed."
END_OBJECT                              = COLUMN

OBJECT                                  = COLUMN
 NAME                                   = SPARE
 START_BYTE                             = 29
 BYTES                                  = 4
END_OBJECT                              = COLUMN

OBJECT                                  = COLUMN
 NAME                                   = BURST_TIME
 START_BYTE                             = 33
 DATA_TYPE                              = IEEE_REAL
 BYTES                                  = 8
 UNIT                                   = 'SECONDS'
 OBJECT                                 = ALIAS
  ALIAS_NAME                            = GR_SCET
  USAGE_NOTE                            = 'MAGELLAN STANFORD SCVDR SIS'
 END_OBJECT                             = ALIAS
 DESCRIPTION                            = "The time at which burst
  BURST_NUMBER_WITHIN_ORBIT was transmitted (seconds past J2000)."
END_OBJECT                              = COLUMN

OBJECT                                  = COLUMN
 NAME                                   = NADIR_LATITUDE
 START_BYTE                             = 41
 DATA_TYPE                              = IEEE_REAL
 BYTES                                  = 4
 UNIT                                   = 'DEGREES'
 OBJECT                                 = ALIAS
  ALIAS_NAME                            = GR_LAT
  USAGE_NOTE                            = 'MAGELLAN STANFORD SCVDR SIS'
 END_OBJECT                             = ALIAS
 DESCRIPTION                            = "The latitude at the nadir
  point for the G-matrix calculation."
END_OBJECT                              = COLUMN

OBJECT                                  = COLUMN
 NAME                                   = NADIR_LONGITUDE
```

```
 START_BYTE                          = 45
 DATA_TYPE                           = IEEE_REAL
 BYTES                               = 4
 UNIT                                = 'DEGREES'
 OBJECT                              = ALIAS
  ALIAS_NAME                         = GR_LON
  USAGE_NOTE                         = 'MAGELLAN STANFORD SCVDR SIS'
 END_OBJECT                          = ALIAS
 DESCRIPTION                         = "The longitude at the nadir for
  the G-matrix calculation."
END_OBJECT                           = COLUMN

OBJECT                               = COLUMN
 NAME                                = SPACECRAFT_POSITION
 START_BYTE                          = 49
 DATA_TYPE                           = IEEE_REAL
 BYTES                               = 8
 ITEMS                               = 3
 UNIT                                = 'KM'
 OBJECT                              = ALIAS
  ALIAS_NAME                         = GR_SCPOS
  USAGE_NOTE                         = 'MAGELLAN STANFORD SCVDR SIS'
 END_OBJECT                          = ALIAS
 DESCRIPTION                         = "The spacecraft position at
  BURST_TIME, relative to the Venus center of mass, expressed in inertial
  coordinates."
END_OBJECT                           = COLUMN

OBJECT                               = COLUMN
 NAME                                = SPACECRAFT_VELOCITY
 START_BYTE                          = 73
 DATA_TYPE                           = IEEE_REAL
 BYTES                               = 8
 ITEMS                               = 3
 UNIT                                = 'KM/SECOND'
 OBJECT                              = ALIAS
  ALIAS_NAME                         = GR_SCVEL
  USAGE_NOTE                         = 'MAGELLAN STANFORD SCVDR SIS'
 END_OBJECT                          = ALIAS
 DESCRIPTION                         = "The spacecraft velocity at
  BURST_TIME, relative to the Venus center of mass, expressed in inertial
  coordinates."
END_OBJECT                           = COLUMN

OBJECT                               = COLUMN
 NAME                                = ALTIMETER_POINTING_VECTOR
 START_BYTE                          = 97
 DATA_TYPE                           = IEEE_REAL
 BYTES                               = 8
 ITEMS                               = 3
 UNIT                                = 'N/A'
 OBJECT                              = ALIAS
  ALIAS_NAME                         = GR_ALTA
  USAGE_NOTE                         = 'MAGELLAN STANFORD SCVDR SIS'
 END_OBJECT                          = ALIAS
```

```
 DESCRIPTION                          = "The unit vector along the axis
  of the altimetry antenna at BURST_TIME, expressed in inertial
  coordinates."
END_OBJECT                            = COLUMN

OBJECT                                = COLUMN
 NAME                                 = SAR_POINTING_VECTOR
 START_BYTE                           = 121
 DATA_TYPE                            = IEEE_REAL
 BYTES                                = 8
 ITEMS                                = 3
 UNIT                                 = 'N/A'
 OBJECT                               = ALIAS
  ALIAS_NAME                          = GR_SARA
  USAGE_NOTE                          = 'MAGELLAN STANFORD SCVDR SIS'
 END_OBJECT                           = ALIAS
 DESCRIPTION                          = "The unit vector along the axis
  of the high-gain (SAR) antenna at BURST_TIME, expressed in inertial
  coordinates."
END_OBJECT                            = COLUMN

OBJECT                                = COLUMN
 NAME                                 = NUMBER_OF_ANGLES
 START_BYTE                           = 145
 DATA_TYPE                            = MSB_INTEGER
 BYTES                                = 2
 UNIT                                 = 'N/A'
 OBJECT                               = ALIAS
  ALIAS_NAME                          = GR_BLEN
  USAGE_NOTE                          = 'MAGELLAN STANFORD SCVDR SIS'
 END_OBJECT                           = ALIAS
 DESCRIPTION                          = "The number of angles in the
  calculated G-matrix."
END_OBJECT                            = COLUMN

OBJECT                                = COLUMN
 NAME                                 = NUMBER_OF_RANGES
 START_BYTE                           = 147
 DATA_TYPE                            = MSB_INTEGER
 BYTES                                = 2
 UNIT                                 = 'N/A'
 OBJECT                               = ALIAS
  ALIAS_NAME                          = GR_RLEN
  USAGE_NOTE                          = 'MAGELLAN STANFORD SCVDR SIS'
 END_OBJECT                           = ALIAS
 DESCRIPTION                          = "The number of ranges in the
  calculated G-matrix."
END_OBJECT                            = COLUMN

OBJECT                                = COLUMN
 NAME                                 = NUMBER_OF_FREQUENCIES
 START_BYTE                           = 149
 DATA_TYPE                            = MSB_INTEGER
 BYTES                                = 2
 UNIT                                 = 'N/A'
```

```
 OBJECT                                = ALIAS
  ALIAS_NAME                           = GR_FLEN
  USAGE_NOTE                           = 'MAGELLAN STANFORD SCVDR SIS'
 END_OBJECT                            = ALIAS
 DESCRIPTION                           = "The number of frequencies in
  the calculated G-matrix (an odd number)."
END_OBJECT                             = COLUMN

OBJECT                                 = COLUMN
 NAME                                  = HIGHEST_RANGE_ALIASING_INCLUDED
 START_BYTE                            = 151
 DATA_TYPE                             = MSB_INTEGER
 BYTES                                 = 2
 UNIT                                  = 'N/A'
 OBJECT                                = ALIAS
  ALIAS_NAME                           = GR_RALIAS
  USAGE_NOTE                           = 'MAGELLAN STANFORD SCVDR SIS'
 END_OBJECT                            = ALIAS
 DESCRIPTION                           = "The highest order of range
  aliasing included in the computation of the G-matrix. If 0, no aliasing
  was considered; if 1, the contribution due to the first range
  ambiguity, etc."
END_OBJECT                             = COLUMN

OBJECT                                 = COLUMN
 NAME                                  = HIGHEST_FREQ_ALIASING_INCLUDED
 START_BYTE                            = 153
 DATA_TYPE                             = MSB_INTEGER
 BYTES                                 = 2
 UNIT                                  = 'N/A'
 OBJECT                                = ALIAS
  ALIAS_NAME                           = GR_FALIAS
  USAGE_NOTE                           = 'MAGELLAN STANFORD SCVDR SIS'
 END_OBJECT                            = ALIAS
 DESCRIPTION                           = "The highest order of frequency
  aliasing included in the computation of the G-matrix. If 0, no aliasing
  was considered; if 1, the contributions due to the first positive and
  negative frequency aliasing, etc."
END_OBJECT                             = COLUMN

OBJECT                                 = COLUMN
 NAME                                  = SPARE
 START_BYTE                            = 155
 BYTES                                 = 18
END_OBJECT                             = COLUMN

OBJECT                                 = COLUMN
 NAME                                  = ANGLE_VECTOR
 START_BYTE                            = 173
 DATA_TYPE                             = IEEE_REAL
 BYTES                                 = 4
 ITEMS                                 = 'UNK'
 UNIT                                  = 'RADIANS'
 OBJECT                                = ALIAS
  ALIAS_NAME                           = GR_B
```

```
  USAGE_NOTE                          = 'MAGELLAN STANFORD SCVDR SIS'
 END_OBJECT                           = ALIAS
 DESCRIPTION                          = "The vector of nb =
  NUMBER_OF_ANGLES angles for which the G-matrix was calculated
  (radians). Entries in ANGLE_VECTOR are monotonically increasing from an
  initial 0 radians, which is implicit and not included in the vector.
  Entries ANGLE_VECTOR[n] and ANGLE_VECTOR[n+1] thus bound the nth angle
  interval, which has nominal value (ANGLE_VECTOR[n] +
  ANGLE_VECTOR[n+1])/2."
END_OBJECT                            = COLUMN

OBJECT                                = COLUMN
 NAME                                 = RANGE_VECTOR
 START_BYTE                           = 'UNK'
 DATA_TYPE                            = IEEE_REAL
 BYTES                                = 4
 ITEMS                                = 'UNK'
 UNIT                                 = 'SECONDS'
 OBJECT                               = ALIAS
  ALIAS_NAME                          = GR_R
  USAGE_NOTE                          = 'MAGELLAN STANFORD SCVDR SIS'
 END_OBJECT                           = ALIAS
 DESCRIPTION                          = "The vector of nr =
  NUMBER_OF_RANGES ranges for which the G-matrix was calculated
  (seconds). Entries in RANGE_VECTOR are monotonically increasing from an
  initial 0 seconds, which is implicit and not included in the vector.
  Entries RANGE_VECTOR[n] and RANGE_VECTOR[n+1] thus bound the nth range
  interval, which has nominal value (RANGE_VECTOR[n] +
  RANGE_VECTOR[n+1])/2."
END_OBJECT                            = COLUMN

OBJECT                                = COLUMN
 NAME                                 = FREQUENCY_VECTOR
 START_BYTE                           = 'UNK'
 DATA_TYPE                            = IEEE_REAL
 BYTES                                = 4
 ITEMS                                = 'UNK'
 UNIT                                 = 'HZ'
 OBJECT                               = ALIAS
  ALIAS_NAME                          = GR_F
  USAGE_NOTE                          = 'MAGELLAN STANFORD SCVDR SIS'
 END_OBJECT                           = ALIAS
 DESCRIPTION                          = "The vector of nf =
  NUMBER_OF_FREQUENCIES frequencies for which the G-matrix was calculated
  (Hz). Entries in FREQUENCY_VECTOR are monotonically increasing and
  denote frequencies at the centers of nominal frequency bins.
  FREQUENCY_VECTOR has an odd number of elements; the center element is
  zero and the remainder are symmetric (positive and negative
  frequencies) about this center value."
END_OBJECT                            = COLUMN

OBJECT                                = COLUMN
 NAME                                 = ANGLE_RANGE_G_MATRIX
 START_BYTE                           = 'UNK'
 DATA_TYPE                            = IEEE_REAL
```

```
 BYTES                                = 4
 ITEMS                                = 'UNK'
 UNIT                                 = 'N/A'
 OBJECT                               = ALIAS
  ALIAS_NAME                          = GR_GBR
  USAGE_NOTE                          = 'MAGELLAN STANFORD SCVDR SIS'
 END_OBJECT                           = ALIAS
 DESCRIPTION                          = "The (aliased) G-matrix in
  angle-range space, with NUMBER_OF_RANGES rows and NUMBER_OF_ANGLES
  columns, stored in row-major order for a total of nrb =
  NUMBER_OF_RANGES * NUMBER_OF_ANGLES entries. The first row is
  associated with the first element in RANGE_VECTOR, and each element in
  a row is associated with the corresponding element in ANGLE_VECTOR."
END_OBJECT                            = COLUMN

OBJECT                                = COLUMN
 NAME                                 = ANGLE_DOPPLER_G_MATRIX
 START_BYTE                           = 'UNK'
 DATA_TYPE                            = IEEE_REAL
 BYTES                                = 4
 ITEMS                                = 'UNK'
 UNIT                                 = 'N/A'
 OBJECT                               = ALIAS
  ALIAS_NAME                          = GR_GBF
  USAGE_NOTE                          = 'MAGELLAN STANFORD SCVDR SIS'
 END_OBJECT                           = ALIAS
 DESCRIPTION                          = "The (aliased) G-matrix in
  angle-frequency space, with NUMBER_OF_FREQUENCIES rows and
  NUMBER_OF_ANGLES columns, stored in row-major order for a total of nfb
  = NUMBER_OF_FREQUENCIES * NUMBER_OF_ANGELES entries. The first row is
  associated with the first element in FREQUENCY_VECTOR, and each element
  in a row is associated with the corresponding element in ANGLE_VECTOR."
END_OBJECT                            = COLUMN

END
```

B.6. SCVDRGMH.FMT Example

```
CCSD3ZF0000100000001NJPL3IF0PDSX00000001

PDS_VERSION_ID                        = PDS3

OBJECT                                = COLUMN
 NAME                                 = SFDU_AGGREGATE_HEADER
 START_BYTE                           = 1
 DATA_TYPE                            = CHARACTER
 BYTES                                = 20
 UNIT                                 = 'N/A'
 OBJECT                               = ALIAS
  ALIAS_NAME                          = GH_SFDU
  USAGE_NOTE                          = 'MAGELLAN STANFORD SCVDR SIS'
 END_OBJECT                           = ALIAS
 DESCRIPTION                          = "'NJPL1I00002300000024', the
  number '0023' is registered with the NJPL SFDU authority as the
  'G-Matrix Header Record', '00000024' signifies that the remainder of
  this SFDU is 24 bytes in length."
```

```
END_OBJECT                              = COLUMN

OBJECT                                  = COLUMN
 NAME                                   = NUMBER_OF_G_MATRICES
 START_BYTE                             = 21
 DATA_TYPE                              = MSB_INTEGER
 BYTES                                  = 2
 UNIT                                   = 'N/A'
 OBJECT                                 = ALIAS
  ALIAS_NAME                            = GH_NG
  USAGE_NOTE                            = 'MAGELLAN STANFORD SCVDR SIS'
 END_OBJECT                             = ALIAS
 DESCRIPTION                            = "The number of G-matrices
  contained in this file."
END_OBJECT                              = COLUMN

OBJECT                                  = COLUMN
 NAME                                   = MAX_DIM_ANGLE_VECTOR
 START_BYTE                             = 23
 DATA_TYPE                              = MSB_INTEGER
 BYTES                                  = 2
 UNIT                                   = 'N/A'
 OBJECT                                 = ALIAS
  ALIAS_NAME                            = GH_MAXB
  USAGE_NOTE                            = 'MAGELLAN STANFORD SCVDR SIS'
 END_OBJECT                             = ALIAS
 DESCRIPTION                            = "The largest value of
  NUMBER_OF_ANGLES in this file."
END_OBJECT                              = COLUMN

OBJECT                                  = COLUMN
 NAME                                   = MAX_DIM_RANGE_VECTOR
 START_BYTE                             = 25
 DATA_TYPE                              = MSB_INTEGER
 BYTES                                  = 2
 UNIT                                   = 'N/A'
 OBJECT                                 = ALIAS
  ALIAS_NAME                            = GH_MAXR
  USAGE_NOTE                            = 'MAGELLAN STANFORD SCVDR SIS'
 END_OBJECT                             = ALIAS
 DESCRIPTION                            = "The largest value of
  NUMBER_OF_RANGES in this file."
END_OBJECT                              = COLUMN

OBJECT                                  = COLUMN
 NAME                                   = MAX_DIM_FREQUENCY_VECTOR
 START_BYTE                             = 27
 DATA_TYPE                              = MSB_INTEGER
 BYTES                                  = 2
 UNIT                                   = 'N/A'
 OBJECT                                 = ALIAS
  ALIAS_NAME                            = GH_MAXF
  USAGE_NOTE                            = 'MAGELLAN STANFORD SCVDR SIS'
 END_OBJECT                             = ALIAS
 DESCRIPTION                            = "The largest value of
```

```
  NUMBER_OF_FREQUENCIES in this file."
END_OBJECT                              = COLUMN

OBJECT                                  = COLUMN
 NAME                                   = MAX_DIM_ANGLE_RANGE_G_MATRIX
 START_BYTE                             = 29
 DATA_TYPE                              = MSB_INTEGER
 BYTES                                  = 4
 UNIT                                   = 'N/A'
 OBJECT                                 = ALIAS
  ALIAS_NAME                            = GH_MAXBR
  USAGE_NOTE                            = 'MAGELLAN STANFORD SCVDR SIS'
 END_OBJECT                             = ALIAS
 DESCRIPTION                            = "The largest value of the
  product NUMBER_OF_ANGLES * NUMBER_OF_RANGES in this file."
END_OBJECT                              = COLUMN

OBJECT                                  = COLUMN
 NAME                                   = MAX_DIM_ANGLE_FREQUENCY_G_MATRIX
 START_BYTE                             = 33
 DATA_TYPE                              = MSB_INTEGER
 BYTES                                  = 4
 UNIT                                   = 'N/A'
 OBJECT                                 = ALIAS
  ALIAS_NAME                            = GH_MAXBF
  USAGE_NOTE                            = 'MAGELLAN STANFORD SCVDR SIS'
 END_OBJECT                             = ALIAS
 DESCRIPTION                            = "The largest value of the
  product NUMBER_OF_ANGLES * NUMBER_OF_FREQUENCIES in this file."
END_OBJECT                              = COLUMN

OBJECT                                  = COLUMN
 NAME                                   = SPARE
 START_BYTE                             = 37
 BYTES                                  = 8
END_OBJECT                              = COLUMN

END
```

B.7. SCVDRIMF.FMT Example

```
CCSD3ZF0000100000001NJPL3IF0PDSX00000001

PDS_VERSION_ID                          = PDS3

OBJECT                                  = COLUMN
 NAME                                   = SFDU_AGGREGATE_HEADER
 START_BYTE                             = 1
 DATA_TYPE                              = CHARACTER
 BYTES                                  = 20
 UNIT                                   = 'N/A'
 OBJECT                                 = ALIAS
  ALIAS_NAME                            = IR_SFDU
  USAGE_NOTE                            = 'MAGELLAN STANFORD SCVDR SIS'
 END_OBJECT                             = ALIAS
 DESCRIPTION                            = "'NJPL1I0000120000nnnn', the
```

```
  designator '0012' is registered with the NJPL SFDU authority as the
  'Image Data Record'. 'nnnn' is the length in bytes of the remainder of
  the SFDU, which can vary from record to record."
END_OBJECT                              = COLUMN

OBJECT                                  = COLUMN
 NAME                                   = FOOTPRINT_NUMBER
 START_BYTE                             = 21
 DATA_TYPE                              = MSB_UNSIGNED_INTEGER
 BYTES                                  = 4
 UNIT                                   = 'N/A'
 OBJECT                                 = ALIAS
  ALIAS_NAME                            = IR_NFOOT
  USAGE_NOTE                            = 'MAGELLAN STANFORD SCVDR SIS'
 END_OBJECT                             = ALIAS
 DESCRIPTION                            = "Starting from 1, the number of
  the Image Data Record by increasing Image Footprint Time
  (FOOTPRINT_TIME)."
END_OBJECT                              = COLUMN

OBJECT                                  = COLUMN
 NAME                                   = BURST_COUNT_FOR_CLOSEST_BURST
 START_BYTE                             = 25
 DATA_TYPE                              = MSB_UNSIGNED_INTEGER
 BYTES                                  = 4
 UNIT                                   = 'N/A'
 OBJECT                                 = ALIAS
  ALIAS_NAME                            = IR_BURST
  USAGE_NOTE                            = 'MAGELLAN STANFORD SCVDR SIS'
 END_OBJECT                             = ALIAS
 DESCRIPTION                            = "The burst for which the
  Mid-Range Point is closest to the footprint center."
END_OBJECT                              = COLUMN

OBJECT                                  = COLUMN
 NAME                                   = FLAG_FIELDS
 START_BYTE                             = 29
 DATA_TYPE                              = MSB_UNSIGNED_INTEGER
 BYTES                                  = 4
 UNIT                                   = 'N/A'
 OBJECT                                 = ALIAS
  ALIAS_NAME                            = IR_FLAGS
  USAGE_NOTE                            = 'MAGELLAN STANFORD SCVDR SIS'
 END_OBJECT                             = ALIAS
 DESCRIPTION                            = "Stanford Image Data Record
  Flag Values."
END_OBJECT                              = COLUMN

OBJECT                                  = COLUMN
 NAME                                   = FOOTPRINT_TIME
 START_BYTE                             = 33
 DATA_TYPE                              = IEEE_REAL
 BYTES                                  = 8
 UNIT                                   = 'SECONDS'
 OBJECT                                 = ALIAS
```

```
  ALIAS_NAME                          = IR_SCET
  USAGE_NOTE                          = 'MAGELLAN STANFORD SCVDR SIS'
 END_OBJECT                           = ALIAS
 DESCRIPTION                          = "The burst start time (seconds
  of TDB since J2000) for the associated burst."
END_OBJECT                            = COLUMN

OBJECT                                = COLUMN
 NAME                                 = SPACECRAFT_POSITION_VECTOR
 START_BYTE                           = 41
 DATA_TYPE                            = IEEE_REAL
 BYTES                                = 4
 ITEMS                                = 3
 UNIT                                 = 'KM'
 OBJECT                               = ALIAS
  ALIAS_NAME                          = IR_SCPOS
  USAGE_NOTE                          = 'MAGELLAN STANFORD SCVDR SIS'
 END_OBJECT                           = ALIAS
 DESCRIPTION                          = "The spacecraft position for
  the associated burst, relative to the Venus center of mass and
  expressed in the Venus Body Fixed 1985 coordinate system."
END_OBJECT                            = COLUMN

OBJECT                                = COLUMN
 NAME                                 = SPACECRAFT_VELOCITY_VECTOR
 START_BYTE                           = 53
 DATA_TYPE                            = IEEE_REAL
 BYTES                                = 4
 ITEMS                                = 3
 UNIT                                 = 'KM/SECOND'
 OBJECT                               = ALIAS
  ALIAS_NAME                          = IR_SCVEL
  USAGE_NOTE                          = 'MAGELLAN STANFORD SCVDR SIS'
 END_OBJECT                           = ALIAS
 DESCRIPTION                          = "The spacecraft velocity for
  the associated burst, relative to the Venus center of mass and
  expressed in Venus Body Fixed 1985 coordinates."
END_OBJECT                            = COLUMN

OBJECT                                = COLUMN
 NAME                                 = SAR_ANTENNA_UNIT_BORESIGHT_VECTOR
 START_BYTE                           = 65
 DATA_TYPE                            = IEEE_REAL
 BYTES                                = 4
 ITEMS                                = 3
 UNIT                                 = 'N/A'
 OBJECT                               = ALIAS
  ALIAS_NAME                          = IR_BPV
  USAGE_NOTE                          = 'MAGELLAN STANFORD SCVDR SIS'
 END_OBJECT                           = ALIAS
 DESCRIPTION                          = "The unit vector along the axis
  of the SAR antenna for the associated burst, expressed in Venus Body
  Fixed 1985 coordinates."
END_OBJECT                            = COLUMN
```

```
OBJECT                                  = COLUMN
 NAME                                   = BORESIGHT_INTERCEPT_POINT
 START_BYTE                             = 77
 DATA_TYPE                              = IEEE_REAL
 BYTES                                  = 4
 ITEMS                                  = 3
 UNIT                                   = 'KM'
 OBJECT                                 = ALIAS
  ALIAS_NAME                            = IR_BIP
  USAGE_NOTE                            = 'MAGELLAN STANFORD SCVDR SIS'
 END_OBJECT                             = ALIAS
 DESCRIPTION                            = "The position of the boresight
  intercept point on Venus' surface for the associated burst, expressed
  in Venus Body Fixed 1985 coordinates."
END_OBJECT                              = COLUMN

OBJECT                                  = COLUMN
 NAME                                   = FOOTPRINT_LATITUDE
 START_BYTE                             = 89
 DATA_TYPE                              = IEEE_REAL
 BYTES                                  = 4
 UNIT                                   = 'DEGREES'
 OBJECT                                 = ALIAS
  ALIAS_NAME                            = IR_LAT
  USAGE_NOTE                            = 'MAGELLAN STANFORD SCVDR SIS'
 END_OBJECT                             = ALIAS
 DESCRIPTION                            = "The body-fixed latitude of the
  footprint center, in the range of -90 (South Pole) to +90 (North Pole)."
END_OBJECT                              = COLUMN

OBJECT                                  = COLUMN
 NAME                                   = FOOTPRINT_LONGITUDE
 START_BYTE                             = 93
 DATA_TYPE                              = IEEE_REAL
 BYTES                                  = 4
 UNIT                                   = 'DEGREES'
 OBJECT                                 = ALIAS
  ALIAS_NAME                            = IR_LON
  USAGE_NOTE                            = 'MAGELLAN STANFORD SCVDR SIS'
 END_OBJECT                             = ALIAS
 DESCRIPTION                            = "The body-fixed longitude of
  the footprint center in the range of 0 - 360."
END_OBJECT                              = COLUMN

OBJECT                                  = COLUMN
 NAME                                   = AZIMUTH_FROM_FOOTPRINT_TO_S_C
 START_BYTE                             = 97
 DATA_TYPE                              = IEEE_REAL
 BYTES                                  = 4
 UNIT                                   = 'DEGREES'
 OBJECT                                 = ALIAS
  ALIAS_NAME                            = IR_AZIMUTH
  USAGE_NOTE                            = 'MAGELLAN STANFORD SCVDR SIS'
 END_OBJECT                             = ALIAS
 DESCRIPTION                            = "At the footprint center
```

```
  (FOOTPRINT_LATITUDE, FOOTPRINT_LONGITUDE) the spacecraft azimuth
  measured positive toward the east from local north."
END_OBJECT                              = COLUMN

OBJECT                                  = COLUMN
 NAME                                   = POLARIZATION
 START_BYTE                             = 101
 DATA_TYPE                              = CHARACTER
 BYTES                                  = 2
 UNIT                                   = 'N/A'
 OBJECT                                 = ALIAS
  ALIAS_NAME                            = IR_POLN
  USAGE_NOTE                            = 'MAGELLAN STANFORD SCVDR SIS'
 END_OBJECT                             = ALIAS
 DESCRIPTION                            = "Horizontal transmitted and
  horizontal received ('HH') or vertical transmitted and vertical
  received ('VV')."
END_OBJECT                              = COLUMN

OBJECT                                  = COLUMN
 NAME                                   = SPARE
 START_BYTE                             = 103
 BYTES                                  = 2
END_OBJECT                              = COLUMN

OBJECT                                  = COLUMN
 NAME                                   = ALONG_TRACK_FOOTPRINT_SIZE
 START_BYTE                             = 105
 DATA_TYPE                              = IEEE_REAL
 BYTES                                  = 4
 UNIT                                   = 'KM'
 OBJECT                                 = ALIAS
  ALIAS_NAME                            = IR_XFOOT
  USAGE_NOTE                            = 'MAGELLAN STANFORD SCVDR SIS'
 END_OBJECT                             = ALIAS
 DESCRIPTION                            = "The along-track dimension of
  the Venus surface area described by this data record (nominally 9
  C-BIDR image lines, or 2.025 km)."
END_OBJECT                              = COLUMN

OBJECT                                  = COLUMN
 NAME                                   = CROSS_TRACK_FOOTPRINT_SIZE
 START_BYTE                             = 109
 DATA_TYPE                              = IEEE_REAL
 BYTES                                  = 4
 UNIT                                   = 'KM'
 OBJECT                                 = ALIAS
  ALIAS_NAME                            = IR_YFOOT
  USAGE_NOTE                            = 'MAGELLAN STANFORD SCVDR SIS'
 END_OBJECT                             = ALIAS
 DESCRIPTION                            = "The across-track dimension of
  the Venus surface area described by this data record."
END_OBJECT                              = COLUMN

OBJECT                                  = COLUMN
```

```
 NAME                                = MID_RANGE_POINT_LATITUDE
 START_BYTE                          = 113
 DATA_TYPE                           = IEEE_REAL
 BYTES                               = 4
 UNIT                                = 'DEGREES'
 OBJECT                              = ALIAS
  ALIAS_NAME                         = IR_MRP_LAT
  USAGE_NOTE                         = 'MAGELLAN STANFORD SCVDR SIS'
 END_OBJECT                          = ALIAS
 DESCRIPTION                         = "The latitude of the Mid-Range
  Point for the associated burst."
END_OBJECT                           = COLUMN

OBJECT                               = COLUMN
 NAME                                = MID_RANGE_POINT_LONGITUDE
 START_BYTE                          = 117
 DATA_TYPE                           = IEEE_REAL
 BYTES                               = 4
 UNIT                                = 'DEGREES'
 OBJECT                              = ALIAS
  ALIAS_NAME                         = IR_MRP_LON
  USAGE_NOTE                         = 'MAGELLAN STANFORD SCVDR SIS'
 END_OBJECT                          = ALIAS
 DESCRIPTION                         = "The longitude of the Mid-Range
  Point for the associated burst."
END_OBJECT                           = COLUMN

OBJECT                               = COLUMN
 NAME                                = MID_RANGE_POINT_INCIDENCE_ANGLE
 START_BYTE                          = 121
 DATA_TYPE                           = IEEE_REAL
 BYTES                               = 4
 UNIT                                = 'DEGREES'
 OBJECT                              = ALIAS
  ALIAS_NAME                         = IR_MRP_INC
  USAGE_NOTE                         = 'MAGELLAN STANFORD SCVDR SIS'
 END_OBJECT                          = ALIAS
 DESCRIPTION                         = "The incidence angle at the
  Mid-Range Point for the associated burst."
END_OBJECT                           = COLUMN

OBJECT                               = COLUMN
 NAME                                = MID_RANGE_POINT_C1_COORDINATE
 START_BYTE                          = 125
 DATA_TYPE                           = MSB_INTEGER
 BYTES                               = 4
 UNIT                                = 'N/A'
 OBJECT                              = ALIAS
  ALIAS_NAME                         = IR_MRP_C1
  USAGE_NOTE                         = 'MAGELLAN STANFORD SCVDR SIS'
 END_OBJECT                          = ALIAS
 DESCRIPTION                         = "The C1 coordinate at the
  Mid-Range Point for the associated burst in units of 225 m pixels."
END_OBJECT                           = COLUMN
```

```
OBJECT                                  = COLUMN
 NAME                                   = MID_RANGE_POINT_C2_COORDINATE
 START_BYTE                             = 129
 DATA_TYPE                              = MSB_INTEGER
 BYTES                                  = 4
 UNIT                                   = 'N/A'
 OBJECT                                 = ALIAS
  ALIAS_NAME                            = IR_MRP_C2
  USAGE_NOTE                            = 'MAGELLAN STANFORD SCVDR SIS'
 END_OBJECT                             = ALIAS
 DESCRIPTION                            = "The C2 coordinate at the
  Mid-Range Point for the associated burst in units of 225 m pixels."
END_OBJECT                              = COLUMN

OBJECT                                  = COLUMN
 NAME                                   = BIP_LATITUDE
 START_BYTE                             = 133
 DATA_TYPE                              = IEEE_REAL
 BYTES                                  = 4
 UNIT                                   = 'DEGREES'
 OBJECT                                 = ALIAS
  ALIAS_NAME                            = IR_BIP_LAT
  USAGE_NOTE                            = 'MAGELLAN STANFORD SCVDR SIS'
 END_OBJECT                             = ALIAS
 DESCRIPTION                            = "The latitude at the Boresight
  Intercept Point for the associated burst (the Boresight Intercept Point
  is the point on the Venus surface where the HGA boresight would
  intercept the surface, after accounting for atmospheric refraction and
  the Magellan-adopted model for topography)."
END_OBJECT                              = COLUMN

OBJECT                                  = COLUMN
 NAME                                   = BIP_LONGITUDE
 START_BYTE                             = 137
 DATA_TYPE                              = IEEE_REAL
 BYTES                                  = 4
 UNIT                                   = 'DEGREES'
 OBJECT                                 = ALIAS
  ALIAS_NAME                            = IR_BIP_LON
  USAGE_NOTE                            = 'MAGELLAN STANFORD SCVDR SIS'
 END_OBJECT                             = ALIAS
 DESCRIPTION                            = "The longitude at the Boresight
  Intercept Point for the associated burst."
END_OBJECT                              = COLUMN

OBJECT                                  = COLUMN
 NAME                                   = BIP_INCIDENCE_ANGLE
 START_BYTE                             = 141
 DATA_TYPE                              = IEEE_REAL
 BYTES                                  = 4
 UNIT                                   = 'DEGREES'
 OBJECT                                 = ALIAS
  ALIAS_NAME                            = IR_BIP_INC
  USAGE_NOTE                            = 'MAGELLAN STANFORD SCVDR SIS'
 END_OBJECT                             = ALIAS
```

```
 DESCRIPTION                    = "The incidence angle at the
  Boresight Intercept Point for the associated burst."
END_OBJECT                      = COLUMN

OBJECT                          = COLUMN
 NAME                           = BIP_ELEVATION
 START_BYTE                     = 145
 DATA_TYPE                      = IEEE_REAL
 BYTES                          = 4
 UNIT                           = 'KM'
 OBJECT                         = ALIAS
  ALIAS_NAME                    = IR_BIP_ELEV
  USAGE_NOTE                    = 'MAGELLAN STANFORD SCVDR SIS'
 END_OBJECT                     = ALIAS
 DESCRIPTION                    = "The elevation (above the 6051
  km reference surface) at the Boresight Intercept Point for the
  associated burst."
END_OBJECT                      = COLUMN

OBJECT                          = COLUMN
 NAME                           = APPARENT_RANGE_S_C_TO_BIP
 START_BYTE                     = 149
 DATA_TYPE                      = IEEE_REAL
 BYTES                          = 4
 UNIT                           = 'KM'
 OBJECT                         = ALIAS
  ALIAS_NAME                    = IR_BIP_RANGE
  USAGE_NOTE                    = 'MAGELLAN STANFORD SCVDR SIS'
 END_OBJECT                     = ALIAS
 DESCRIPTION                    = "The apparent slant range from
  the spacecraft to the Boresight Intercept Point for the associated
  burst."
END_OBJECT                      = COLUMN

OBJECT                          = COLUMN
 NAME                           = NORMALIZING_FACTOR_FOR_PIXELS
 START_BYTE                     = 153
 DATA_TYPE                      = IEEE_REAL
 BYTES                          = 4
 UNIT                           = 'N/A'
 OBJECT                         = ALIAS
  ALIAS_NAME                    = IR_MRP_BS_COEF
  USAGE_NOTE                    = 'MAGELLAN STANFORD SCVDR SIS'
 END_OBJECT                     = ALIAS
 DESCRIPTION                    = "The Muhleman Law backscatter
  coefficient at the Mid-Range Point reported on the CBIDR tape. Note:
  this value was not computed correctly."
END_OBJECT                      = COLUMN

OBJECT                          = COLUMN
 NAME                           = LOWEST_INCIDENCE_ANGLE
 START_BYTE                     = 157
 DATA_TYPE                      = IEEE_REAL
 BYTES                          = 4
 UNIT                           = 'DEGREES'
```

```
 OBJECT                                = ALIAS
  ALIAS_NAME                           = IR_THETA_OFFSET
  USAGE_NOTE                           = 'MAGELLAN STANFORD SCVDR SIS'
 END_OBJECT                            = ALIAS
 DESCRIPTION                           = "The smallest angle represented
  by the scattering data array."
END_OBJECT                             = COLUMN

OBJECT                                 = COLUMN
 NAME                                  = HIGHEST_INCIDENCE_ANGLE
 START_BYTE                            = 161
 DATA_TYPE                             = IEEE_REAL
 BYTES                                 = 4
 UNIT                                  = 'DEGREES'
 OBJECT                                = ALIAS
  ALIAS_NAME                           = IR_THETA_MAX
  USAGE_NOTE                           = 'MAGELLAN STANFORD SCVDR SIS'
 END_OBJECT                            = ALIAS
 DESCRIPTION                           = "The largest angle represented
  by the scattering data array."
END_OBJECT                             = COLUMN

OBJECT                                 = COLUMN
 NAME                                  = LOWEST_ANGLE_FOR_FIT
 START_BYTE                            = 165
 DATA_TYPE                             = IEEE_REAL
 BYTES                                 = 4
 UNIT                                  = 'DEGREES'
 OBJECT                                = ALIAS
  ALIAS_NAME                           = IR_THLO
  USAGE_NOTE                           = 'MAGELLAN STANFORD SCVDR SIS'
 END_OBJECT                            = ALIAS
 DESCRIPTION                           = "The smallest incidence angle
  for which at least one pixel was found in the block; the smallest
  incidence angle used in the polynomial fit."
END_OBJECT                             = COLUMN

OBJECT                                 = COLUMN
 NAME                                  = HIGHEST_ANGLE_FOR_FIT
 START_BYTE                            = 169
 DATA_TYPE                             = IEEE_REAL
 BYTES                                 = 4
 UNIT                                  = 'DEGREES'
 OBJECT                                = ALIAS
  ALIAS_NAME                           = IR_THHI
  USAGE_NOTE                           = 'MAGELLAN STANFORD SCVDR SIS'
 END_OBJECT                            = ALIAS
 DESCRIPTION                           = "The largest incidence angle
  for which at least one pixel was found in the block; the largest
  incidence angle used in the polynomial fit."
END_OBJECT                             = COLUMN

OBJECT                                 = COLUMN
 NAME                                  = LOWEST_VALID_BIN_FOR_ANGLE_FIT
 START_BYTE                            = 173
```

```
 DATA_TYPE                          = UNSIGNED_INTEGER
 BYTES                              = 1
 UNIT                               = 'N/A'
 OBJECT                             = ALIAS
  ALIAS_NAME                        = IR_BMIN
  USAGE_NOTE                        = 'MAGELLAN STANFORD SCVDR SIS'
 END_OBJECT                         = ALIAS
 DESCRIPTION                        = "The smallest bin number for
  which data were used in the polynomial fit (0 <
  LOWEST_VALID_BIN_FOR_ANGLE_FIT < 99)."
END_OBJECT                          = COLUMN

OBJECT                              = COLUMN
 NAME                               = HIGHEST_VALID_BIN_FOR_ANGLE_FIT
 START_BYTE                         = 174
 DATA_TYPE                          = UNSIGNED_INTEGER
 BYTES                              = 1
 UNIT                               = 'N/A'
 OBJECT                             = ALIAS
  ALIAS_NAME                        = IR_BMAX
  USAGE_NOTE                        = 'MAGELLAN STANFORD SCVDR SIS'
 END_OBJECT                         = ALIAS
 DESCRIPTION                        = "The largest bin number for
  which data were used in the polynomial fit (0 <
  HIGHEST_VALID_BIN_FOR_ANGLE_FIT < 99)."
END_OBJECT                          = COLUMN

OBJECT                              = COLUMN
 NAME                               = NUMBER_OF_ANGLES_IN_IR_BINS
 START_BYTE                         = 175
 DATA_TYPE                          = UNSIGNED_INTEGER
 BYTES                              = 1
 UNIT                               = 'N/A'
 OBJECT                             = ALIAS
  ALIAS_NAME                        = IR_NTH
  USAGE_NOTE                        = 'MAGELLAN STANFORD SCVDR SIS'
 END_OBJECT                         = ALIAS
 DESCRIPTION                        = "The dimension of the array
  IR_BINS (equal to HIGHEST_VALID_BIN_FOR_ANGLE_FIT -
  LOWEST_VALID_BIN_FOR_ANGLE_FIT + 1)."
END_OBJECT                          = COLUMN

OBJECT                              = COLUMN
 NAME                               = SIZE_OF_POLYNOMIAL_FIT
 START_BYTE                         = 176
 DATA_TYPE                          = UNSIGNED_INTEGER
 BYTES                              = 1
 UNIT                               = 'N/A'
 OBJECT                             = ALIAS
  ALIAS_NAME                        = IR_POLYSIZE
  USAGE_NOTE                        = 'MAGELLAN STANFORD SCVDR SIS'
 END_OBJECT                         = ALIAS
 DESCRIPTION                        = "The number of coefficients in
  the fitted polynomial; one more than the highest power in the
  polynomial."
```

```
END_OBJECT                              = COLUMN

OBJECT                                  = COLUMN
 NAME                                   = CHI_SQUARE_VALUE_FROM_LINEAR_FIT
 START_BYTE                             = 177
 DATA_TYPE                              = IEEE_REAL
 BYTES                                  = 4
 UNIT                                   = 'N/A'
 OBJECT                                 = ALIAS
  ALIAS_NAME                            = IR_CHISQ
  USAGE_NOTE                            = 'MAGELLAN STANFORD SCVDR SIS'
 END_OBJECT                             = ALIAS
 DESCRIPTION                            = "The residual from the weighted
  least-square error fit for the polynomial."
END_OBJECT                              = COLUMN

OBJECT                                  = COLUMN
 NAME                                   = COEFFICIENTS_FOR_POLYNOMIAL_FIT
 START_BYTE                             = 181
 DATA_TYPE                              = IEEE_REAL
 BYTES                                  = 4
 ITEMS                                  = 3
 UNIT                                   = 'N/A'
 OBJECT                                 = ALIAS
  ALIAS_NAME                            = IR_COEFS
  USAGE_NOTE                            = 'MAGELLAN STANFORD SCVDR SIS'
 END_OBJECT                             = ALIAS
 DESCRIPTION                            = "The coefficients for the
  fitted polynomial to the scattering function, which is expanded about
  (LOWEST_ANGLE_FOR_FIT + HIGHEST_ANGLE_FOR_FIT)/2. The first coefficient
  (COEFFICIENTS_FOR_POLYNOMIAL_FIT[0]) is the constant term, the second
  coefficient (COEFFICIENTS_FOR_POLYNOMIAL_FIT[1]) is the linear term."
END_OBJECT                              = COLUMN

OBJECT                                  = COLUMN
 NAME                                   = LOWEST_VALID_INTENSITY_BIN
 START_BYTE                             = 193
 DATA_TYPE                              = UNSIGNED_INTEGER
 BYTES                                  = 1
 UNIT                                   = 'N/A'
 OBJECT                                 = ALIAS
  ALIAS_NAME                            = IR_IMIN
  USAGE_NOTE                            = 'MAGELLAN STANFORD SCVDR SIS'
 END_OBJECT                             = ALIAS
 DESCRIPTION                            = "The smallest pixel intensity
  represented by the pixel intensity histogram (0 <
  LOWEST_VALID_INTENSITY_BIN < 255)."
END_OBJECT                              = COLUMN

OBJECT                                  = COLUMN
 NAME                                   = HIGHEST_VALID_INTENSITY_BIN
 START_BYTE                             = 194
 DATA_TYPE                              = UNSIGNED_INTEGER
 BYTES                                  = 1
 UNIT                                   = 'N/A'
```

```
 OBJECT                                = ALIAS
  ALIAS_NAME                           = IR_IMAX
  USAGE_NOTE                           = 'MAGELLAN STANFORD SCVDR SIS'
 END_OBJECT                            = ALIAS
 DESCRIPTION                           = "The highest pixel intensity
  represented by the pixel intensity histogram (0 <
  HIGHEST_VALID_INTENSITY_BIN < 255)."
END_OBJECT                             = COLUMN

OBJECT                                 = COLUMN
 NAME                                  = NUMBER_OF_LEVELS_IN_IR_I_COUNT
 START_BYTE                            = 195
 DATA_TYPE                             = UNSIGNED_INTEGER
 BYTES                                 = 1
 UNIT                                  = 'N/A'
 OBJECT                                = ALIAS
  ALIAS_NAME                           = IR_NI
  USAGE_NOTE                           = 'MAGELLAN STANFORD SCVDR SIS'
 END_OBJECT                            = ALIAS
 DESCRIPTION                           = "The dimension of array
  HISTOGRAM_OF_PIXEL_VALUES (NUMBER_OF_LEVELS_IN_IR_I_COUNT =
  HIGHEST_VALID_INTENSITY_BIN - LOWEST_VALID_INTENSITY_BIN + 1)."
END_OBJECT                             = COLUMN

OBJECT                                 = COLUMN
 NAME                                  = SPARE
 START_BYTE                            = 196
 BYTES                                 = 13
END_OBJECT                             = COLUMN

OBJECT                                 = COLUMN
 NAME                                  = CUMULATIVE_INTENSITY
 START_BYTE                            = 209
 DATA_TYPE                             = IEEE_REAL
 BYTES                                 = 4
 UNIT                                  = 'N/A'
 OBJECT                                = ALIAS
  ALIAS_NAME                           = IR_INTEN
  USAGE_NOTE                           = 'MAGELLAN STANFORD SCVDR SIS'
 END_OBJECT                            = ALIAS
 DESCRIPTION                           = "The sum of the intensities of
  all pixels assigned to this incidence angle bin."
END_OBJECT                             = COLUMN

OBJECT                                 = COLUMN
 NAME                                  = NUMBER_OF_PIXELS
 START_BYTE                            = 213
 DATA_TYPE                             = MSB_UNSIGNED_INTEGER
 BYTES                                 = 4
 UNIT                                  = 'N/A'
 OBJECT                                = ALIAS
  ALIAS_NAME                           = IR_COUNT
  USAGE_NOTE                           = 'MAGELLAN STANFORD SCVDR SIS'
 END_OBJECT                            = ALIAS
 DESCRIPTION                           = "The number of pixels assigned
```

```
  to this incidence angle bin."
END_OBJECT                              = COLUMN

OBJECT                                  = COLUMN
 NAME                                   = STANDARD_DEVIATION
 START_BYTE                             = 217
 DATA_TYPE                              = IEEE_REAL
 BYTES                                  = 4
 UNIT                                   = 'N/A'
 OBJECT                                 = ALIAS
  ALIAS_NAME                            = IR_SDEV
  USAGE_NOTE                            = 'MAGELLAN STANFORD SCVDR SIS'
 END_OBJECT                             = ALIAS
 DESCRIPTION                            = "The standard deviation of the
  weighted intensities for this incidence angle bin."
END_OBJECT                              = COLUMN

OBJECT                                  = COLUMN
 NAME                                   = HISTOGRAM_OF_PIXEL_VALUES
 START_BYTE                             = 221
 DATA_TYPE                              = MSB_UNSIGNED_INTEGER
 BYTES                                  = 4
 ITEMS                                  = 'UNK'
 UNIT                                   = 'N/A'
 OBJECT                                 = ALIAS
  ALIAS_NAME                            = IR_I_COUNT
  USAGE_NOTE                            = 'MAGELLAN STANFORD SCVDR SIS'
 END_OBJECT                             = ALIAS
 DESCRIPTION                            = "For up to 256 Intensity
  Levels, the number of pixels at each of m =
  NUMBER_OF_LEVELS_IN_IR_I_COUNT intensity levels."
END_OBJECT                              = COLUMN

END
```

B.8. SCVDRIMH.FMT Example

```
CCSD3ZF0000100000001NJPL3IF0PDSX00000001

PDS_VERSION_ID                          = PDS3

OBJECT                                  = COLUMN
 NAME                                   = SFDU_AGGREGATE_HEADER
 START_BYTE                             = 1
 DATA_TYPE                              = CHARACTER
 BYTES                                  = 20
 UNIT                                   = 'N/A'
 OBJECT                                 = ALIAS
  ALIAS_NAME                            = IH_SFDU
  USAGE_NOTE                            = 'MAGELLAN STANFORD SCVDR SIS'
 END_OBJECT                             = ALIAS
 DESCRIPTION                            = "'NJPL1I00001000000040', the
  number '0010' is registered with the NJPL SFDU authority as the 'Image
  Header Record'. '00000040' indicates that the remainder of this SFDU is
  40 bytes in length."
END_OBJECT                              = COLUMN
```

```
OBJECT                                  = COLUMN
 NAME                                   = ORBIT_NUMBER
 START_BYTE                             = 21
 DATA_TYPE                              = MSB_INTEGER
 BYTES                                  = 4
 UNIT                                   = 'N/A'
 OBJECT                                 = ALIAS
  ALIAS_NAME                            = IH_ORB
  USAGE_NOTE                            = 'MAGELLAN STANFORD SCVDR SIS'
 END_OBJECT                             = ALIAS
 DESCRIPTION                            = "The Magellan orbit number for
  the data represented in these data records."
END_OBJECT                              = COLUMN

OBJECT                                  = COLUMN
 NAME                                   = VERSION_NUMBER
 START_BYTE                             = 25
 DATA_TYPE                              = MSB_INTEGER
 BYTES                                  = 4
 UNIT                                   = 'N/A'
 OBJECT                                 = ALIAS
  ALIAS_NAME                            = IH_VER
  USAGE_NOTE                            = 'MAGELLAN STANFORD SCVDR SIS'
 END_OBJECT                             = ALIAS
 DESCRIPTION                            = "The version of the image data
  file used for these results. Obtained from the VERSION_ID keyword of
  the corresponding C-BIDR (or F-BIDR) Orbit Header File (Note: This
  turns out not to be a good indicator of the version of the data file;
  the Orbit Header File itself is rarely updated)."
END_OBJECT                              = COLUMN

OBJECT                                  = COLUMN
 NAME                                   = NUMBER_OF_IMAGE_DATA_RECORDS
 START_BYTE                             = 29
 DATA_TYPE                              = MSB_INTEGER
 BYTES                                  = 4
 UNIT                                   = 'N/A'
 OBJECT                                 = ALIAS
  ALIAS_NAME                            = IH_NREC
  USAGE_NOTE                            = 'MAGELLAN STANFORD SCVDR SIS'
 END_OBJECT                             = ALIAS
 DESCRIPTION                            = "The number of image records
  that follow this header."
END_OBJECT                              = COLUMN

OBJECT                                  = COLUMN
 NAME                                   = NUMBER_OF_IMAGE_LINES_PER_RECORD
 START_BYTE                             = 33
 DATA_TYPE                              = MSB_INTEGER
 BYTES                                  = 4
 UNIT                                   = 'N/A'
 OBJECT                                 = ALIAS
  ALIAS_NAME                            = IH_SQLSIDE
  USAGE_NOTE                            = 'MAGELLAN STANFORD SCVDR SIS'
 END_OBJECT                             = ALIAS
```

```
 DESCRIPTION                          = "The number of C-BIDR (or
  F-BIDR) image lines compressed to form one output processed record
  (nominally 9)."
END_OBJECT                            = COLUMN

OBJECT                                = COLUMN
 NAME                                 = SOURCE_DATA_TYPE
 START_BYTE                           = 37
 DATA_TYPE                            = UNSIGNED_INTEGER
 BYTES                                = 1
 UNIT                                 = 'N/A'
 OBJECT                               = ALIAS
  ALIAS_NAME                          = IH_BIDRF
  USAGE_NOTE                          = 'MAGELLAN STANFORD SCVDR SIS'
 END_OBJECT                           = ALIAS
 DESCRIPTION                          = "Set to binary 0 if source data
  are from an F-BIDR, set to 1 if from a C-BIDR."
END_OBJECT                            = COLUMN

OBJECT                                = COLUMN
 NAME                                 = FITTING_METHOD_FLAG
 START_BYTE                           = 38
 DATA_TYPE                            = UNSIGNED_INTEGER
 BYTES                                = 1
 UNIT                                 = 'N/A'
 OBJECT                               = ALIAS
  ALIAS_NAME                          = IH_LSQR
  USAGE_NOTE                          = 'MAGELLAN STANFORD SCVDR SIS'
 END_OBJECT                           = ALIAS
 DESCRIPTION                          = "Zero for chi-square fitting to
  determine polynomial coefficients, 1 for linear least squares fitting."
END_OBJECT                            = COLUMN

OBJECT                                = COLUMN
 NAME                                 = RMAP_MAJOR_SOFTWARE_VERSION
 START_BYTE                           = 39
 DATA_TYPE                            = MSB_INTEGER
 BYTES                                = 2
 UNIT                                 = 'N/A'
 OBJECT                               = ALIAS
  ALIAS_NAME                          = IH_RMAP_MAJOR
  USAGE_NOTE                          = 'MAGELLAN STANFORD SCVDR SIS'
 END_OBJECT                           = ALIAS
 DESCRIPTION                          = "The major software version
  number of the Stanford program RMAP used to obtain the scattering
  function from the image data."
END_OBJECT                            = COLUMN

OBJECT                                = COLUMN
 NAME                                 = RMAP_MINOR_SOFTWARE_VERSION
 START_BYTE                           = 41
 DATA_TYPE                            = MSB_INTEGER
 BYTES                                = 2
 UNIT                                 = 'N/A'
 OBJECT                               = ALIAS
```

```
  ALIAS_NAME                          = IH_RMAP_MINOR
  USAGE_NOTE                          = 'MAGELLAN STANFORD SCVDR SIS'
 END_OBJECT                           = ALIAS
 DESCRIPTION                          = "The minor software version
  number of the Stanford program RMAP used to obtain the scattering
  function from the image data."
END_OBJECT                            = COLUMN

OBJECT                                = COLUMN
 NAME                                 = MAX_NUMBER_OF_ANGLES
 START_BYTE                           = 43
 DATA_TYPE                            = MSB_INTEGER
 BYTES                                = 2
 UNIT                                 = 'N/A'
 OBJECT                               = ALIAS
  ALIAS_NAME                          = IH_MAXB
  USAGE_NOTE                          = 'MAGELLAN STANFORD SCVDR SIS'
 END_OBJECT                           = ALIAS
 DESCRIPTION                          = "The largest value of
  NUMBER_OF_ANGLES_IN_IR_BINS that will appear in this orbit."
END_OBJECT                            = COLUMN

OBJECT                                = COLUMN
 NAME                                 = MAX_HISTOGRAM_SIZE
 START_BYTE                           = 45
 DATA_TYPE                            = MSB_INTEGER
 BYTES                                = 2
 UNIT                                 = 'N/A'
 OBJECT                               = ALIAS
  ALIAS_NAME                          = IH_MAXI
  USAGE_NOTE                          = 'MAGELLAN STANFORD SCVDR SIS'
 END_OBJECT                           = ALIAS
 DESCRIPTION                          = "The largest value of
  NUMBER_OF_LEVELS_IN_I_COUNT that will appear in this orbit."
END_OBJECT                            = COLUMN

OBJECT                                = COLUMN
 NAME                                 = SPARE
 START_BYTE                           = 47
 BYTES                                = 14
END_OBJECT                            = COLUMN

END
```

B.9. SCVDRNFF.FMT Example

```
CCSD3ZF0000100000001NJPL3IF0PDSX00000001

PDS_VERSION_ID                        = PDS3

OBJECT                                = COLUMN
 NAME                                 = SFDU_AGGREGATE_HEADER
 START_BYTE                           = 1
 DATA_TYPE                            = CHARACTER
 BYTES                                = 20
 UNIT                                 = 'N/A'
```

```
 OBJECT                                = ALIAS
  ALIAS_NAME                           = FR_SFDU
  USAGE_NOTE                           = 'MAGELLAN STANFORD SCVDR SIS'
 END_OBJECT                            = ALIAS
 DESCRIPTION                           = "'NJPL1I0000080000nnnn', the
  number '0008' is registered with the NJPL SFDU authority as the
  'Inversion Fit Data Record'. 'nnnn' is the length in bytes of the
  remainder of the SFDU, which can vary from record to record."
END_OBJECT                             = COLUMN

OBJECT                                 = COLUMN
 NAME                                  = FOOTPRINT_NUMBER
 START_BYTE                            = 21
 DATA_TYPE                             = MSB_UNSIGNED_INTEGER
 BYTES                                 = 4
 UNIT                                  = 'N/A'
 OBJECT                                = ALIAS
  ALIAS_NAME                           = FR_NFOOT
  USAGE_NOTE                           = 'MAGELLAN STANFORD SCVDR SIS'
 END_OBJECT                            = ALIAS
 DESCRIPTION                           = "Starting from 1, the number of
  the Inversion Fit Data Record; equal to the Footprint Number
  FOOTPRINT_NUMBER in the corresponding Altimetry Inversion Data Record."
END_OBJECT                             = COLUMN

OBJECT                                 = COLUMN
 NAME                                  = NUMBER_OF_SCATTERING_LAWS
 START_BYTE                            = 25
 DATA_TYPE                             = MSB_UNSIGNED_INTEGER
 BYTES                                 = 4
 UNIT                                  = 'N/A'
 OBJECT                                = ALIAS
  ALIAS_NAME                           = FR_NLAW
  USAGE_NOTE                           = 'MAGELLAN STANFORD SCVDR SIS'
 END_OBJECT                            = ALIAS
 DESCRIPTION                           = "The number of synthetic
  scattering laws compared against the scattering solution; 'synthetic'
  scattering laws can include Hagfors, exponential, Gaussian, Rayleigh,
  and Muhleman.."
END_OBJECT                             = COLUMN

OBJECT                                 = COLUMN
 NAME                                  = SPARE
 START_BYTE                            = 29
 BYTES                                 = 4
END_OBJECT                             = COLUMN

OBJECT                                 = CONTAINER
 NAME                                  = SCATTERING_LAW_FITS_CONTAINER
 START_BYTE                            = 33
 BYTES                                 = 36
 REPETITIONS                           = 'UNK'
 OBJECT                                = ALIAS
  ALIAS_NAME                           = FR_SSLF_T
  USAGE_NOTE                           = 'MAGELLAN STANFORD SCVDR SIS'
```

```
END_OBJECT                          = ALIAS
DESCRIPTION                         = "A collection of best fit
   scattering models to the observed scattering law in the
   SCATTERING_FUNCTION array of the corresponding ANF file.
   The fits are made using the formal ANF COVARIANCE_MATRIX.
   The number of repetitions is NUMBER_OF_SCATTERING_LAWS and
   each repetition contains the results of a single least-squares
   fit of the empirical scattering function to a particular
   scattering model."

OBJECT                              = COLUMN
 NAME                               = SCATTERING_LAW_ID
 START_BYTE                         = 1
 DATA_TYPE                          = CHARACTER
 BYTES                              = 4
 UNIT                               = 'N/A'
 OBJECT                             = ALIAS
  ALIAS_NAME                        = FR_SLAW
  USAGE_NOTE                        = 'MAGELLAN STANFORD SCVDR SIS'
 END_OBJECT                         = ALIAS
 DESCRIPTION                        = "A 4-letter identifier for one
 of several analytic scattering functions which can be fitted to FR_SIG0."
END_OBJECT                          = COLUMN

OBJECT                              = COLUMN
 NAME                               = FLAG_FIELDS_FOR_FIT
 START_BYTE                         = 5
 DATA_TYPE                          = MSB_UNSIGNED_INTEGER
 BYTES                              = 4
 UNIT                               = 'N/A'
 OBJECT                             = ALIAS
  ALIAS_NAME                        = FR_FLAGS
  USAGE_NOTE                        = 'MAGELLAN STANFORD SCVDR SIS'
 END_OBJECT                         = ALIAS
 DESCRIPTION                        = "Stanford Inversion Fit Record
 Flag Values."
END_OBJECT                          = COLUMN

OBJECT                              = COLUMN
 NAME                               = FIT_PARAMETER_1
 START_BYTE                         = 9
 DATA_TYPE                          = IEEE_REAL
 BYTES                              = 4
 UNIT                               = 'N/A'
 OBJECT                             = ALIAS
  ALIAS_NAME                        = FR_P1
  USAGE_NOTE                        = 'MAGELLAN STANFORD SCVDR SIS'
 END_OBJECT                         = ALIAS
 DESCRIPTION                        = "Scattering law parameter #1."
END_OBJECT                          = COLUMN

OBJECT                              = COLUMN
 NAME                               = FIT_PARAMETER_1_VARIANCE
 START_BYTE                         = 13
 DATA_TYPE                          = IEEE_REAL
```

```
  BYTES                          = 4
  UNIT                           = 'N/A'
  OBJECT                         = ALIAS
   ALIAS_NAME                    = FR_P1V
   USAGE_NOTE                    = 'MAGELLAN STANFORD SCVDR SIS'
  END_OBJECT                     = ALIAS
  DESCRIPTION                    = "Variance in FIT_PARAMETER_1."
END_OBJECT                       = COLUMN

OBJECT                           = COLUMN
  NAME                           = FIT_PARAMETER_2
  START_BYTE                     = 17
  DATA_TYPE                      = IEEE_REAL
  BYTES                          = 4
  UNIT                           = 'N/A'
  OBJECT                         = ALIAS
   ALIAS_NAME                    = FR_P2
   USAGE_NOTE                    = 'MAGELLAN STANFORD SCVDR SIS'
  END_OBJECT                     = ALIAS
  DESCRIPTION                    = "Scattering law parameter #2."
END_OBJECT                       = COLUMN

OBJECT                           = COLUMN
  NAME                           = FIT_PARAMETER_2_VARIANCE
  START_BYTE                     = 21
  DATA_TYPE                      = IEEE_REAL
  BYTES                          = 4
  UNIT                           = 'N/A'
  OBJECT                         = ALIAS
   ALIAS_NAME                    = FR_P2V
   USAGE_NOTE                    = 'MAGELLAN STANFORD SCVDR SIS'
  END_OBJECT                     = ALIAS
  DESCRIPTION                    = "Variance in FIT_PARAMETER_2."
END_OBJECT                       = COLUMN

OBJECT                           = COLUMN
  NAME                           = RMS_SLOPE
  START_BYTE                     = 25
  DATA_TYPE                      = IEEE_REAL
  BYTES                          = 4
  UNIT                           = 'RADIANS'
  OBJECT                         = ALIAS
   ALIAS_NAME                    = FR_RMSS
   USAGE_NOTE                    = 'MAGELLAN STANFORD SCVDR SIS'
  END_OBJECT                     = ALIAS
  DESCRIPTION                    = "RMS Tilt for Fitted Function."
END_OBJECT                       = COLUMN

OBJECT                           = COLUMN
  NAME                           = RMS_SLOPE_VARIANCE
  START_BYTE                     = 29
  DATA_TYPE                      = IEEE_REAL
  BYTES                          = 4
  UNIT                           = 'N/A'
  OBJECT                         = ALIAS
```

```
   ALIAS_NAME                          = FR_RMSV
   USAGE_NOTE                          = 'MAGELLAN STANFORD SCVDR SIS'
  END_OBJECT                           = ALIAS
  DESCRIPTION                          = "Variance of RMS_SLOPE."
 END_OBJECT                            = COLUMN

 OBJECT                                = COLUMN
  NAME                                 = RESIDUAL_ERROR_IN_FIT
  START_BYTE                           = 33
  DATA_TYPE                            = IEEE_REAL
  BYTES                                = 4
  UNIT                                 = 'N/A'
  OBJECT                               = ALIAS
   ALIAS_NAME                          = FR_RESID
   USAGE_NOTE                          = 'MAGELLAN STANFORD SCVDR SIS'
  END_OBJECT                           = ALIAS
  DESCRIPTION                          = "Residual between analytic
  function and scattering function from inversion of data for best
  choices of FIT_PARAMETER_1 and FIT_PARAMETER_2."
 END_OBJECT                            = COLUMN

END_OBJECT                             = CONTAINER

END
```

B.10. SCVDRNFH.FMT Example

```
CCSD3ZF0000100000001NJPL3IF0PDSX00000001

PDS_VERSION_ID                         = PDS3

OBJECT                                 = COLUMN
 NAME                                  = SFDU_AGGREGATE_HEADER
 START_BYTE                            = 1
 DATA_TYPE                             = CHARACTER
 BYTES                                 = 20
 UNIT                                  = 'N/A'
 OBJECT                                = ALIAS
  ALIAS_NAME                           = FH_SFDU
  USAGE_NOTE                           = 'MAGELLAN STANFORD SCVDR SIS'
 END_OBJECT                            = ALIAS
 DESCRIPTION                           = "'NJPL1I00000700000052', the
  number '0007' is registered with the NJPL SFDU authority as the
  'Stanford Inversion Fit Header Record'. '00000052' signifies that the
  remainder of this SFDU is 52 bytes in length."
END_OBJECT                             = COLUMN

OBJECT                                 = COLUMN
 NAME                                  = ORBIT_NUMBER
 START_BYTE                            = 21
 DATA_TYPE                             = MSB_INTEGER
 BYTES                                 = 4
 UNIT                                  = 'N/A'
 OBJECT                                = ALIAS
  ALIAS_NAME                           = FH_ORB
  USAGE_NOTE                           = 'MAGELLAN STANFORD SCVDR SIS'
```

```
 END_OBJECT                          = ALIAS
 DESCRIPTION                         = "The orbit number for the data
  to be fit."
END_OBJECT                           = COLUMN

OBJECT                               = COLUMN
 NAME                                = ORBIT_VERSION
 START_BYTE                          = 25
 DATA_TYPE                           = MSB_INTEGER
 BYTES                               = 4
 UNIT                                = 'N/A'
 OBJECT                              = ALIAS
  ALIAS_NAME                         = FH_VER
  USAGE_NOTE                         = 'MAGELLAN STANFORD SCVDR SIS'
 END_OBJECT                          = ALIAS
 DESCRIPTION                         = "The version number for the
  altimetry data file used in this processing. Obtained from the
  VERSION_ID keyword of the corresponding ALT-EDR Orbit Header File
  (Note: This turns out not to be a good indicator of the version of the
  data file; the Orbit Header File itself is rarely updated)."
END_OBJECT                           = COLUMN

OBJECT                               = COLUMN
 NAME                                = SSLFIT_MAJOR_VERSION_NUMBER
 START_BYTE                          = 29
 DATA_TYPE                           = MSB_INTEGER
 BYTES                               = 2
 UNIT                                = 'N/A'
 OBJECT                              = ALIAS
  ALIAS_NAME                         = FH_SSLFIT_MAJOR
  USAGE_NOTE                         = 'MAGELLAN STANFORD SCVDR SIS'
 END_OBJECT                          = ALIAS
 DESCRIPTION                         = "The number of the major
  software version of Stanford program SSLFIT used to fit these data."
END_OBJECT                           = COLUMN

OBJECT                               = COLUMN
 NAME                                = SSLFIT_MINOR_VERSION_NUMBER
 START_BYTE                          = 31
 DATA_TYPE                           = MSB_INTEGER
 BYTES                               = 2
 UNIT                                = 'N/A'
 OBJECT                              = ALIAS
  ALIAS_NAME                         = FH_SSLFIT_MINOR
  USAGE_NOTE                         = 'MAGELLAN STANFORD SCVDR SIS'
 END_OBJECT                          = ALIAS
 DESCRIPTION                         = "The number of the minor
  software version of Stanford program SSLFIT used to fit these data."
END_OBJECT                           = COLUMN

OBJECT                               = COLUMN
 NAME                                = ALTINV_MAJOR_VERSION_NUMBER
 START_BYTE                          = 33
 DATA_TYPE                           = MSB_INTEGER
 BYTES                               = 2
```

```
 UNIT                                = 'N/A'
 OBJECT                              = ALIAS
  ALIAS_NAME                         = FH_ALTINV_MAJOR
  USAGE_NOTE                         = 'MAGELLAN STANFORD SCVDR SIS'
 END_OBJECT                          = ALIAS
 DESCRIPTION                         = "The number of the major
  software version of Stanford program ALTINV that produced the
  scattering function solutions."
END_OBJECT                           = COLUMN

OBJECT                               = COLUMN
 NAME                                = ALTINV_MINOR_VERSION_NUMBER
 START_BYTE                          = 35
 DATA_TYPE                           = MSB_INTEGER
 BYTES                               = 2
 UNIT                                = 'N/A'
 OBJECT                              = ALIAS
  ALIAS_NAME                         = FH_ALTINV_MINOR
  USAGE_NOTE                         = 'MAGELLAN STANFORD SCVDR SIS'
 END_OBJECT                          = ALIAS
 DESCRIPTION                         = "The number of the minor
  software version of Stanford program ALTINV that produced the
  scattering function solutions."
END_OBJECT                           = COLUMN

OBJECT                               = COLUMN
 NAME                                = ALT_MAJOR_VERSION_NUMBER
 START_BYTE                          = 37
 DATA_TYPE                           = MSB_INTEGER
 BYTES                               = 2
 UNIT                                = 'N/A'
 OBJECT                              = ALIAS
  ALIAS_NAME                         = FH_ALT_MAJOR
  USAGE_NOTE                         = 'MAGELLAN STANFORD SCVDR SIS'
 END_OBJECT                          = ALIAS
 DESCRIPTION                         = "The number of the major
  software version of Stanford program ALT used to carry out the
  range-Doppler processing on these data."
END_OBJECT                           = COLUMN

OBJECT                               = COLUMN
 NAME                                = ALT_MINOR_VERSION_NUMBER
 START_BYTE                          = 39
 DATA_TYPE                           = MSB_INTEGER
 BYTES                               = 2
 UNIT                                = 'N/A'
 OBJECT                              = ALIAS
  ALIAS_NAME                         = FH_ALT_MINOR
  USAGE_NOTE                         = 'MAGELLAN STANFORD SCVDR SIS'
 END_OBJECT                          = ALIAS
 DESCRIPTION                         = "The number of the minor
  software version of Stanford program ALT used to carry out the
  range-Doppler processing on these data."
END_OBJECT                           = COLUMN
```

```
OBJECT                                  = COLUMN
 NAME                                   = NUMBER_OF_RECORDS_IN_FILE
 START_BYTE                             = 41
 DATA_TYPE                              = MSB_INTEGER
 BYTES                                  = 4
 UNIT                                   = 'N/A'
 OBJECT                                 = ALIAS
  ALIAS_NAME                            = FH_NREC
  USAGE_NOTE                            = 'MAGELLAN STANFORD SCVDR SIS'
 END_OBJECT                             = ALIAS
 DESCRIPTION                            = "The number of inversions
  (solutions for the surface scattering law) and hence, the number of
  fitted result records in this file; equal to NUMBER_OF_DATA_RECORDS."
END_OBJECT                              = COLUMN

OBJECT                                  = COLUMN
 NAME                                   = NUMBER_OF_SYNTHETIC_SCATTERING_LAWS
 START_BYTE                             = 45
 DATA_TYPE                              = MSB_INTEGER
 BYTES                                  = 2
 UNIT                                   = 'N/A'
 OBJECT                                 = ALIAS
  ALIAS_NAME                            = FH_NLAW
  USAGE_NOTE                            = 'MAGELLAN STANFORD SCVDR SIS'
 END_OBJECT                             = ALIAS
 DESCRIPTION                            = "The number of synthetic
  scattering laws compared against the scattering solution; 'synthetic'
  scattering laws can include Hagfors, exponential, Gaussian, Rayleigh,
  and Muhleman."
END_OBJECT                              = COLUMN

OBJECT                                  = COLUMN
 NAME                                   = INVERSION_METHOD_ID
 START_BYTE                             = 47
 DATA_TYPE                              = UNSIGNED_INTEGER
 BYTES                                  = 1
 UNIT                                   = 'N/A'
 OBJECT                                 = ALIAS
  ALIAS_NAME                            = FH_METH_INV
  USAGE_NOTE                            = 'MAGELLAN STANFORD SCVDR SIS'
 END_OBJECT                             = ALIAS
 DESCRIPTION                            = "The identifier for inversion
  method (carried forward from corresponding Altimetry Inversion Header
  Record; see Section 5.4.1 of the SCVDR SIS)."
END_OBJECT                              = COLUMN

OBJECT                                  = COLUMN
 NAME                                   = VARIANCE_ESTIMATION_METHOD_ID
 START_BYTE                             = 48
 DATA_TYPE                              = UNSIGNED_INTEGER
 BYTES                                  = 1
 UNIT                                   = 'N/A'
 OBJECT                                 = ALIAS
  ALIAS_NAME                            = FH_METH_SIG
  USAGE_NOTE                            = 'MAGELLAN STANFORD SCVDR SIS'
```

```
 END_OBJECT                          = ALIAS
 DESCRIPTION                         = "The identifier for variance
  estimation technique (carried forward from the corresponding Altimetry
  Inversion Header Record; see Section 5.4.1 of the SCVDR SIS)."
END_OBJECT                           = COLUMN

OBJECT                               = COLUMN
 NAME                                = CONSTRAINT_VARIANCE_METHOD_ID
 START_BYTE                          = 49
 DATA_TYPE                           = UNSIGNED_INTEGER
 BYTES                               = 1
 UNIT                                = 'N/A'
 OBJECT                              = ALIAS
  ALIAS_NAME                         = FH_METH_GAMSIG
  USAGE_NOTE                         = 'MAGELLAN STANFORD SCVDR SIS'
 END_OBJECT                          = ALIAS
 DESCRIPTION                         = "The identifier for variance
  constraint technique (carried forward from the corresponding Altimetry
  Inversion Header Record; see Section 5.4.1 of the SCVDR SIS)."
END_OBJECT                           = COLUMN

OBJECT                               = COLUMN
 NAME                                = THERMAL_NOISE_METHOD_ID
 START_BYTE                          = 50
 DATA_TYPE                           = UNSIGNED_INTEGER
 BYTES                               = 1
 UNIT                                = 'N/A'
 OBJECT                              = ALIAS
  ALIAS_NAME                         = FH_METH_THERMAL
  USAGE_NOTE                         = 'MAGELLAN STANFORD SCVDR SIS'
 END_OBJECT                          = ALIAS
 DESCRIPTION                         = "The identifier for thermal
  noise estimation technique (carried forward from corresponding
  Altimetry Inversion Header Record; see Section 5.4.1 of the SCVDR SIS)."
END_OBJECT                           = COLUMN

OBJECT                               = COLUMN
 NAME                                = DOPPLER_ROTATION_METHOD_ID
 START_BYTE                          = 51
 DATA_TYPE                           = UNSIGNED_INTEGER
 BYTES                               = 1
 UNIT                                = 'N/A'
 OBJECT                              = ALIAS
  ALIAS_NAME                         = FH_METH_FROT
  USAGE_NOTE                         = 'MAGELLAN STANFORD SCVDR SIS'
 END_OBJECT                          = ALIAS
 DESCRIPTION                         = "The identifier for Doppler
  rotation technique (carried forward from the corresponding Altimetry
  Inversion Header Record; see Section 5.4.1 of the SCVDR SIS)."
END_OBJECT                           = COLUMN

OBJECT                               = COLUMN
 NAME                                = RANGE_ECHO_PROCESSING_ID
 START_BYTE                          = 52
 DATA_TYPE                           = UNSIGNED_INTEGER
```

```
 BYTES                                = 1
 UNIT                                 = 'N/A'
 OBJECT                               = ALIAS
  ALIAS_NAME                          = FH_METH_ECHO
  USAGE_NOTE                          = 'MAGELLAN STANFORD SCVDR SIS'
 END_OBJECT                           = ALIAS
 DESCRIPTION                          = "The identifier for range echo
  processing technique (carried forward from the corresponding Altimetry
  Inversion Header Record; see Section 5.4.1 of the SCVDR SIS)."
END_OBJECT                            = COLUMN

OBJECT                                = COLUMN
 NAME                                 = MAXIMUM_ANGLE_METHOD_ID
 START_BYTE                           = 53
 DATA_TYPE                            = UNSIGNED_INTEGER
 BYTES                                = 1
 UNIT                                 = 'N/A'
 OBJECT                               = ALIAS
  ALIAS_NAME                          = FH_METH_BMAX
  USAGE_NOTE                          = 'MAGELLAN STANFORD SCVDR SIS'
 END_OBJECT                           = ALIAS
 DESCRIPTION                          = "The identifier for technique
  to set maximum incidence angle in solution (carried forward from
  corresponding Altimetry Inversion Header Record; see Section 5.4.1 of
  the SCVDR SIS)."
END_OBJECT                            = COLUMN

OBJECT                                = COLUMN
 NAME                                 = NON_DELTA_SPECTRAL_FILTER_FLAG
 START_BYTE                           = 54
 DATA_TYPE                            = UNSIGNED_INTEGER
 BYTES                                = 1
 UNIT                                 = 'N/A'
 OBJECT                               = ALIAS
  ALIAS_NAME                          = FH_SPECF
  USAGE_NOTE                          = 'MAGELLAN STANFORD SCVDR SIS'
 END_OBJECT                           = ALIAS
 DESCRIPTION                          = "Set if Doppler spectrum was
  filtered before the inversion (carried forward from corresponding
  Altimetry Inversion Header Record; see Section 5.4.1 of the SCVDR SIS)."
END_OBJECT                            = COLUMN

OBJECT                                = COLUMN
 NAME                                 = SPARE
 START_BYTE                           = 55
 BYTES                                = 18
END_OBJECT                            = COLUMN

END
```

B.11. SCVDROHF.FMT Example

```
CCSD3ZF0000100000001NJPL3IF0PDSX00000001

PDS_VERSION_ID                          = PDS3

OBJECT                                  = COLUMN
 NAME                                   = SFDU_LABEL_AND_LENGTH
 START_BYTE                             = 1
 DATA_TYPE                              = CHARACTER
 BYTES                                  = 20
 UNIT                                   = 'N/A'
 OBJECT                                 = ALIAS
  ALIAS_NAME                            = HR_SFDU
  USAGE_NOTE                            = 'MAGELLAN STANFORD SCVDR SIS'
 END_OBJECT                             = ALIAS
 DESCRIPTION                            = "'NJPL1I00000400000260', the
  designator '0004' is registered with the NJPL SFDU authority as the
  'Orbit Header Record'. '00000260' indicates that the remainder of the
  SFDU is 260 bytes in length.."
END_OBJECT                              = COLUMN

OBJECT                                  = COLUMN
 NAME                                   = ORBIT_NUMBER
 START_BYTE                             = 21
 DATA_TYPE                              = MSB_INTEGER
 BYTES                                  = 4
 UNIT                                   = 'N/A'
 OBJECT                                 = ALIAS
  ALIAS_NAME                            = HR_ORB
  USAGE_NOTE                            = 'MAGELLAN STANFORD SCVDR SIS'
 END_OBJECT                             = ALIAS
 DESCRIPTION                            = "The Magellan Orbit Number
  corresponding to the following five files (altimetry inversion,
  inversion fit, sinusoidal image, oblique sinusoidal image, and
  emissivity). An orbit begins at apoapsis, and the number corresponds to
  the input data from the corresponding ALT-EDR and/or C-BIDR or F-BIDR
  tape(s)."
END_OBJECT                              = COLUMN

OBJECT                                  = COLUMN
 NAME                                   = NUMBER_ALTIMETRY_INVERSION_RECS
 START_BYTE                             = 25
 DATA_TYPE                              = MSB_INTEGER
 BYTES                                  = 4
 UNIT                                   = 'N/A'
 OBJECT                                 = ALIAS
  ALIAS_NAME                            = HR_NINV
  USAGE_NOTE                            = 'MAGELLAN STANFORD SCVDR SIS'
 END_OBJECT                             = ALIAS
 DESCRIPTION                            = "The number of NR_REC SFDU's in
  this orbit's Altimetry Inversion File."
END_OBJECT                              = COLUMN

OBJECT                                  = COLUMN
 NAME                                   = NUMBER_INVERSION_FIT_RECS
```

```
 START_BYTE                          = 29
 DATA_TYPE                           = MSB_INTEGER
 BYTES                               = 4
 UNIT                                = 'N/A'
 OBJECT                              = ALIAS
  ALIAS_NAME                         = HR_NFIT
  USAGE_NOTE                         = 'MAGELLAN STANFORD SCVDR SIS'
 END_OBJECT                          = ALIAS
 DESCRIPTION                         = "The number of FR_REC SFDU's in
  this orbit's Inversion Fit File; FR_NREC and NR_NREC should be the same."
END_OBJECT                           = COLUMN

OBJECT                               = COLUMN
 NAME                                = NUMBER_SIN_IMAGE_DATA_RECS
 START_BYTE                          = 33
 DATA_TYPE                           = MSB_INTEGER
 BYTES                               = 4
 UNIT                                = 'N/A'
 OBJECT                              = ALIAS
  ALIAS_NAME                         = HR_NISMG
  USAGE_NOTE                         = 'MAGELLAN STANFORD SCVDR SIS'
 END_OBJECT                          = ALIAS
 DESCRIPTION                         = "The number of IR_REC SFDU's in
  this orbit's Sinusoidal Image Data File."
END_OBJECT                           = COLUMN

OBJECT                               = COLUMN
 NAME                                = NUMBER_OBL_IMAGE_DATA_RECS
 START_BYTE                          = 37
 DATA_TYPE                           = MSB_INTEGER
 BYTES                               = 4
 UNIT                                = 'N/A'
 OBJECT                              = ALIAS
  ALIAS_NAME                         = HR_NIOMG
  USAGE_NOTE                         = 'MAGELLAN STANFORD SCVDR SIS'
 END_OBJECT                          = ALIAS
 DESCRIPTION                         = "The number of IR_REC SFDU's in
  this orbit's Oblique Image Data File."
END_OBJECT                           = COLUMN

OBJECT                               = COLUMN
 NAME                                = NUMBER_EMISSIVITY_DATA_RECS
 START_BYTE                          = 41
 DATA_TYPE                           = MSB_INTEGER
 BYTES                               = 4
 UNIT                                = 'N/A'
 OBJECT                              = ALIAS
  ALIAS_NAME                         = HR_NEMS
  USAGE_NOTE                         = 'MAGELLAN STANFORD SCVDR SIS'
 END_OBJECT                          = ALIAS
 DESCRIPTION                         = "The number of ER_REC SFDU's in
  this orbit's Emissivity Data File."
END_OBJECT                           = COLUMN

OBJECT                               = COLUMN
```

```
 NAME                                = SPARE
 START_BYTE                          = 45
 BYTES                               = 4
END_OBJECT                           = COLUMN

OBJECT                               = COLUMN
 NAME                                = FIRST_INVERSION_FOOTPRINT_TIME
 START_BYTE                          = 49
 DATA_TYPE                           = IEEE_REAL
 BYTES                               = 8
 UNIT                                = 'SECONDS'
 OBJECT                              = ALIAS
  ALIAS_NAME                         = HR_INV_START
  USAGE_NOTE                         = 'MAGELLAN STANFORD SCVDR SIS'
 END_OBJECT                          = ALIAS
 DESCRIPTION                         = "The S/C ephemeris time
  (seconds of TDB since J2000) that represents the first altimeter
  inversion footprint of this orbit. It is equal to the NR_SCET value in
  the first NR_REC record of this orbit's Altimetry Inversion File."
END_OBJECT                           = COLUMN

OBJECT                               = COLUMN
 NAME                                = LAST_INVERSION_FOOTPRINT_TIME
 START_BYTE                          = 57
 DATA_TYPE                           = IEEE_REAL
 BYTES                               = 8
 UNIT                                = 'SECONDS'
 OBJECT                              = ALIAS
  ALIAS_NAME                         = HR_INV_END
  USAGE_NOTE                         = 'MAGELLAN STANFORD SCVDR SIS'
 END_OBJECT                          = ALIAS
 DESCRIPTION                         = "The S/C ephemeris time
  (seconds of TDB since J2000) that represents the last altimeter
  inversion footprint of this orbit. It is equal to the NR_SCET value in
  the last NR_REC record of this orbit's Altimetry Inversion File."
END_OBJECT                           = COLUMN

OBJECT                               = COLUMN
 NAME                                = FIRST_FIT_FOOTPRINT_TIME
 START_BYTE                          = 65
 DATA_TYPE                           = IEEE_REAL
 BYTES                               = 8
 UNIT                                = 'SECONDS'
 OBJECT                              = ALIAS
  ALIAS_NAME                         = HR_FIT_START
  USAGE_NOTE                         = 'MAGELLAN STANFORD SCVDR SIS'
 END_OBJECT                          = ALIAS
 DESCRIPTION                         = "The S/C ephemeris time
  (seconds of TDB since J2000) that represents the first inversion fit
  footprint of this orbit. It is equal to the NR_SCET value in the first
  NR_REC record of this orbit's Altimetry Inversion File."
END_OBJECT                           = COLUMN

OBJECT                               = COLUMN
 NAME                                = LAST_FIT_FOOTPRINT_TIME
```

```
 START_BYTE                          = 73
 DATA_TYPE                           = IEEE_REAL
 BYTES                               = 8
 UNIT                                = 'SECONDS'
 OBJECT                              = ALIAS
  ALIAS_NAME                         = HR_FIT_END
  USAGE_NOTE                         = 'MAGELLAN STANFORD SCVDR SIS'
 END_OBJECT                          = ALIAS
 DESCRIPTION                         = "The S/C ephemeris time
  (seconds of TDB since J2000) that represents the last inversion fit
  footprint of this orbit. It is equal to the NR_SCET value in the last
  NR_REC record of this orbit's Altimetry Inversion File."
END_OBJECT                           = COLUMN

OBJECT                               = COLUMN
 NAME                                = FIRST_SIN_IMAGE_FOOTPRINT_TIME
 START_BYTE                          = 81
 DATA_TYPE                           = IEEE_REAL
 BYTES                               = 8
 UNIT                                = 'SECONDS'
 OBJECT                              = ALIAS
  ALIAS_NAME                         = HR_SIMG_START
  USAGE_NOTE                         = 'MAGELLAN STANFORD SCVDR SIS'
 END_OBJECT                          = ALIAS
 DESCRIPTION                         = "The S/C ephemeris time
  (seconds of TDB since J2000 that represents the first sinusoidal image
  footprint of this orbit. It is equal to the IR_SCET value in the first
  IR_REC record of this orbit's sinusoidal image data file."
END_OBJECT                           = COLUMN

OBJECT                               = COLUMN
 NAME                                = LAST_SIN_IMAGE_FOOTPRINT_TIME
 START_BYTE                          = 89
 DATA_TYPE                           = IEEE_REAL
 BYTES                               = 8
 UNIT                                = 'SECONDS'
 OBJECT                              = ALIAS
  ALIAS_NAME                         = HR_SIMG_END
  USAGE_NOTE                         = 'MAGELLAN STANFORD SCVDR SIS'
 END_OBJECT                          = ALIAS
 DESCRIPTION                         = "The S/C ephemeris time
  (seconds of TDB since J2000) that represents the last sinusoidal image
  footprint of this orbit. It is equal to the IR_SCET value in the last
  IR_REC record of this orbit's sinusoidal image data file."
END_OBJECT                           = COLUMN

OBJECT                               = COLUMN
 NAME                                = FIRST_OBL_IMAGE_FOOTPRINT_TIME
 START_BYTE                          = 97
 DATA_TYPE                           = IEEE_REAL
 BYTES                               = 8
 UNIT                                = 'SECONDS'
 OBJECT                              = ALIAS
  ALIAS_NAME                         = HR_OIMG_START
  USAGE_NOTE                         = 'MAGELLAN STANFORD SCVDR SIS'
```

```
 END_OBJECT                          = ALIAS
 DESCRIPTION                         = "The S/C ephemeris time
  (seconds of TDB since J2000) that represents the first oblique image
  footprint of this orbit. It is equal to the IR_SCET value in the first
  IR_REC record of this orbit's oblique image data file."
END_OBJECT                           = COLUMN

OBJECT                               = COLUMN
 NAME                                = LAST_OBL_IMAGE_FOOTPRINT_TIME
 START_BYTE                          = 105
 DATA_TYPE                           = IEEE_REAL
 BYTES                               = 8
 UNIT                                = 'SECONDS'
 OBJECT                              = ALIAS
  ALIAS_NAME                         = HR_OIMG_END
  USAGE_NOTE                         = 'MAGELLAN STANFORD SCVDR SIS'
 END_OBJECT                          = ALIAS
 DESCRIPTION                         = "The S/C ephemeris time
  (seconds of TDB since J2000) that represents the last oblique image
  footprint of this orbit. It is equal to the IR_SCET value in the last
  IR_REC record of this orbit's oblique image data file."
END_OBJECT                           = COLUMN

OBJECT                               = COLUMN
 NAME                                = FIRST_EMISSIVITY_FOOTPRINT_TIME
 START_BYTE                          = 113
 DATA_TYPE                           = IEEE_REAL
 BYTES                               = 8
 UNIT                                = 'SECONDS'
 OBJECT                              = ALIAS
  ALIAS_NAME                         = HR_EMS_START
  USAGE_NOTE                         = 'MAGELLAN STANFORD SCVDR SIS'
 END_OBJECT                          = ALIAS
 DESCRIPTION                         = "The S/C ephemeris time
  (seconds of TDB since J2000) of the first emissivity measurement of
  this orbit. It is equal to the ER_SCET value in the first ER_REC record
  of this orbit's emissivity data file."
END_OBJECT                           = COLUMN

OBJECT                               = COLUMN
 NAME                                = LAST_EMISSIVITY_FOOTPRINT_TIME
 START_BYTE                          = 121
 DATA_TYPE                           = IEEE_REAL
 BYTES                               = 8
 UNIT                                = 'SECONDS'
 OBJECT                              = ALIAS
  ALIAS_NAME                         = HR_EMS_END
  USAGE_NOTE                         = 'MAGELLAN STANFORD SCVDR SIS'
 END_OBJECT                          = ALIAS
 DESCRIPTION                         = "The S/C ephemeris time
  (seconds of TDB since J2000) of the last emissivity measurement of this
  orbit. It is equal to the ER_SCET value in the last ER_REC record of
  this orbit's emissivity data file."
END_OBJECT                           = COLUMN
```

```
OBJECT                                  = COLUMN
 NAME                                   = AVERAGE_ORBIT_PERIAPSIS_TIME
 START_BYTE                             = 129
 DATA_TYPE                              = CHARACTER
 BYTES                                  = 15
 UNIT                                   = 'N/A'
 OBJECT                                 = ALIAS
  ALIAS_NAME                            = HR_AVG_SCLK
  USAGE_NOTE                            = 'MAGELLAN STANFORD SCVDR SIS'
 END_OBJECT                             = ALIAS
 DESCRIPTION                            = "The periapsis time of the
  predicted orbit in spacecraft clock units."
END_OBJECT                              = COLUMN

OBJECT                                  = COLUMN
 NAME                                   = AVERAGE_SEMI_MAJOR_AXIS
 START_BYTE                             = 144
 DATA_TYPE                              = CHARACTER
 BYTES                                  = 23
 UNIT                                   = 'KM'
 OBJECT                                 = ALIAS
  ALIAS_NAME                            = HR_AVG_SMA
  USAGE_NOTE                            = 'MAGELLAN STANFORD SCVDR SIS'
 END_OBJECT                             = ALIAS
 DESCRIPTION                            = "The semi-major axis of the
  predicted orbit."
END_OBJECT                              = COLUMN

OBJECT                                  = COLUMN
 NAME                                   = AVERAGE_ECCENTRICITY
 START_BYTE                             = 167
 DATA_TYPE                              = CHARACTER
 BYTES                                  = 23
 UNIT                                   = 'N/A'
 OBJECT                                 = ALIAS
  ALIAS_NAME                            = HR_AVG_ECC
  USAGE_NOTE                            = 'MAGELLAN STANFORD SCVDR SIS'
 END_OBJECT                             = ALIAS
 DESCRIPTION                            = "The eccentricity of the
  predicted orbit."
END_OBJECT                              = COLUMN

OBJECT                                  = COLUMN
 NAME                                   = AVERAGE_INCLINATION
 START_BYTE                             = 190
 DATA_TYPE                              = CHARACTER
 BYTES                                  = 23
 UNIT                                   = 'DEGREES'
 OBJECT                                 = ALIAS
  ALIAS_NAME                            = HR_AVG_INCL
  USAGE_NOTE                            = 'MAGELLAN STANFORD SCVDR SIS'
 END_OBJECT                             = ALIAS
 DESCRIPTION                            = "The inclination of the
  predicted orbit with respect to the xy-plane of the J2000 coordinate
  system."
```

```
END_OBJECT                              = COLUMN

OBJECT                                  = COLUMN
 NAME                                   = AVERAGE_ASCENDING_NODE_LONGITUDE
 START_BYTE                             = 213
 DATA_TYPE                              = CHARACTER
 BYTES                                  = 23
 UNIT                                   = 'DEGREES'
 OBJECT                                 = ALIAS
  ALIAS_NAME                            = HR_AVG_LON
  USAGE_NOTE                            = 'MAGELLAN STANFORD SCVDR SIS'
 END_OBJECT                             = ALIAS
 DESCRIPTION                            = "The angle in the xy-plane of
  the J2000 coordinate system to the ascending node of the predicted
  orbit."
END_OBJECT                              = COLUMN

OBJECT                                  = COLUMN
 NAME                                   = AVERAGE_ARGUMENT_OF_PERIAPSIS
 START_BYTE                             = 236
 DATA_TYPE                              = CHARACTER
 BYTES                                  = 23
 UNIT                                   = 'DEGREES'
 OBJECT                                 = ALIAS
  ALIAS_NAME                            = HR_AVG_ARG
  USAGE_NOTE                            = 'MAGELLAN STANFORD SCVDR SIS'
 END_OBJECT                             = ALIAS
 DESCRIPTION                            = "The angle in the plane of the
  predicted orbit from the ascending node in the xy-plane of the J2000
  coordinate system to the periapsis."
END_OBJECT                              = COLUMN

OBJECT                                  = COLUMN
 NAME                                   = SPARE
 START_BYTE                             = 259
 BYTES                                  = 22
END_OBJECT                              = COLUMN

END
```

APPENDIX C

EXAMPLES OF OTHER FILES

C.1. AAREADME.TXT Example

```
CCSD3ZF0000100000001NJPL3IF0PDSX00000001

PDS_VERSION_ID                  = PDS3
RECORD_TYPE                     = FIXED_LENGTH
RECORD_BYTES                    = 80
SPACECRAFT_NAME                 = MAGELLAN
TARGET_NAME                     = VENUS
OBJECT                          = TEXT
  PUBLICATION_DATE              = 1995-01-01
  NOTE                          = "MAGELLAN SCVDR ARCHIVE CD-WO"
END_OBJECT                      = TEXT
END

                    MAGELLAN SCVDR ARCHIVE CD-WO

1.  Introduction

  This CD-WO contains Magellan SCVDR (Surface Characteristics Vector
  Data Record) products. It also contains documentation files which
  describe the SCVDRs. Each SCVDR data directory contains altimetry,
  oblique backscatter, and radiometry measurements for a single orbit,
  along with the ancillary files necessary to understand the data.

  The SCVDR products archived on this volume are the exact products
  released by the Magellan Project.  However, all data files have been
  suffixed with ASCII carat characters ('^', decimal 94) to make them a
  multiple of 32500 bytes in length (to assist VAX-VMS users).  Errors
  and anomalies are noted where detected.  Supporting documentation and
  label files conform to the Planetary Data System (PDS) Standards,
  Version 3.0, Jet Propulsion Laboratory (JPL) document JPL D-7669.

2.  Disk Format

  The disk has been formatted so that a variety of computer systems
  (e.g.  IBM PC, Macintosh, Sun) may access the data.  Specifically, it
  is formatted according to the ISO 9660 level 1 Interchange Standard.
  For further information, refer to the ISO 9660 Standard Document: RF#
  ISO 9660-1988, 15 April 1988.

3.  File Formats

  Each orbit for which SCVDR data exist is represented by a set of
  up to 6 data files copied from the SCVDR tape product:

    ANFnnnnn.v   - Altimetry Inversion File, generated from the
```

ALT-EDR raw altimetry data records, using the G-Matrices in a GMF file in the [GEOMETRY] directory on this volume.

EDFnnnnn.v - Emissivity File, generated from the radiometric mode of the Magellan radar, either from the ALT-EDR or C-BIDR data records.

NFFnnnnn.v - Altimetry Inversion Fit File, generated from the ANF file of the same orbit and version number.

OHFnnnnn.v - Orbit Header File, describing the other files of this orbit and version number.

OIFnnnnn.v - Oblique Sinusoidal Image File, derived from the polar image file of the C-BIDR (Compressed basic image data record) product by fitting the SAR backscatter values to a polynomial in incidence angle.

SIFnnnnn.v - Sinusoidal Image File, derived from the non-polar image file of the C-BIDR (Compressed basic image data record) product by fitting the SAR backscatter values to a polynomial in incidence angle.

where 'nnnnn' represents the orbit number, and 'v' the numeric version number. The content of each file is described in a detached PDS label, a file with the same 8-letter name and an extension of "LBL". Further information on SCVDR file formats and their contents can be obtained from the Magellan Software Interface Specification document SU-MGN-SCVDR, version 1.0, October 1, 1992.

All document files (*.TXT) and detached label files (*.LBL) contain 80-byte fixed-length records, with a carriage return character (ASCII 13) in the 79th byte and a line feed character (ASCII 10) in the 80th byte. The first two lines are an exception: the first contains a 40-byte SFDU aggregate label, followed by a carriage return and a line feed. The second contains 36 space characters (ASCII 32) followed by a carriage return and a line feed. The first PAIR of lines is therefore 80 bytes long, and all remaining lines are offset from the start of the file by a multiple of 80 bytes. This allows the files to be read by the MacOS, DOS, Unix, and VMS operating systems. The PDS label file has the same name as the data file it describes, with the extension .LBL.

PDS labels are object-oriented. The object to which the label refers (e.g. HEADER, TABLE, etc.) is denoted by a statement of the form:

```
^object = location
```

in which the carat character (^, also called a pointer in this context) indicates that the object starts at the given location. In an embedded label, the location is an integer representing the starting record number of the object (the first record in the file is record 1). In a detached label, the location denotes the name of the file containing the object,

along with the starting record or byte number. For example:

```
^TABLE = ("ANF01000.1",312<BYTES>)
```

indicates that the TABLE object begins at byte 312 of the file ANF01000.1, in the same directory as the detached label file. Below is a list of the possible formats that use the ^object keyword.

```
^object = n
^object = n<BYTES>
^object = ("filename.ext",n)
^object = ("filename.ext",n<BYTES>)
```

where

n	is the starting record or byte number of the object, counting from the beginning of the file (record 1, byte 1).
<BYTES>	indicates that the number given is in units of bytes.
filename	is the upper-case file name.
ext	is the upper-case file extension.

4. CD-ROM Contents

The files on this CD-ROM are organized in one top-level directory with several subdirectories. The following table shows the structure and content of these directories. In the table, directory names are enclosed in square brackets ([]), upper-case letters indicate an actual directory or file name, and lower-case letters indicate the general form of a set of directory or file names.

FILE	CONTENTS
Top-level directory	
|- AAREADME.TXT	The file you are reading.
|- ERRATA.TXT	Overview of errors on this, and previous, volumes of SCVDRCD products.
|- VOLDESC.CAT	A description of the contents of this CD-ROM volume in a format readable by both human and computers.
|- [CATALOG]	A directory containing information about the Magellan SCVDR dataset.
| |- CATINFO.TXT	Description of contents of the CATALOG directory.
| |- DATASET.CAT	PDS dataset catalog object
| |- INST.CAT	PDS instrument catalog object
| |- INSTHOST.CAT	PDS spacecraft catalog object

```
|   |- MISSION.CAT   PDS mission catalog object
|   |
|   |- PERSONEL.CAT  PDS personnel catalog object
|   |
|   '- REFS.CAT      PDS reference catalog object
|
|- [DOCUMENT]        A directory containing document files relating
|   |                to this disk.
|   |
|   |- SCVDR.ASC     A machine readable version of the SU-MGN-SCVDR
|   |                SIS document describing the format and content of
|   |                the Magellan SCVDR Products.
|   |
|   |- SCVDR.LBL     A detached PDS label file describing SCVDR.ASC
|   |                and SCVDR.PS.
|   |
|   |- SCVDR.PS      A copy of SCVDR.ASC in PostScript format,
|   |                suitable for previewing on a high-resolution
|   |                graphics terminal or direct printing on a
|   |                laser printer or photo-typesetter.
|   |
|   |- SCVDRCD.ASC   A machine readable version of the PDS-GEO-SCVDRCD
|   |                SIS document describing the format of the
|   |                Magellan SCVDRCD Archive CD-WO volumes.
|   |
|   |- SCVDRCD.LBL   A detached PDS label file describing SCVDRCD.ASC
|   |                and SCVDRCD.PS.
|   |
|   |- SCVDRCD.PS    A copy of SCVDRCD.ASC in PostScript format,
|   |                suitable for previewing on a high-resolution
|   |                graphics terminal or direct printing on a
|   |                laser printer or photo-typesetter.
|   |
|   '- DOCINFO.TXT   Description of contents of the DOCUMENT directory.
|
|- [GEOMETRY]        A directory containing the G-Matrix files used to
|   |                generate the ANF data files on this volume.
|   |
|   |- GEOMINFO.TXT  Description of the contents of this directory.
|   |
|   |- GMFnnnnn.v    G-Matrix file used to generate ANF data files.
|   |
|   '- GMFnnnnn.LBL  Description of GMFnnnnn.v.
|
|- [INDEX]           A directory containing information about the
|   |                contents of this CD-WO volume.
|   |
|   |- CUMINDEX.LBL  Description of CUMINDEX.TAB.
|   |
|   |- CUMINDEX.TAB  Cumulative index of all SCVDR archive data files.
|   |
|   |- INDEX.LBL     Description of INDEX.TAB.
|   |
|   |- INDEX.TAB     Index of SCVDR archive data files on this volume.
|   |
```

```
|   '- INDXINFO.TXT  Description of the contents of the INDEX directory.
|
|- [LABEL]           A directory containing information on PDS formats
|   |                beyond what is in individual detached LBL files.
|   |
|   |- SCVDRANF.FMT  Format of ANF data records.
|   |
|   |- SCVDRANH.FMT  Format of the ANF header record.
|   |
|   |- SCVDREDF.FMT  Format of EDF data records.
|   |
|   |- SCVDREDH.FMT  Format of the EDF header record.
|   |
|   |- SCVDRGMF.FMT  Format of GMF data records.
|   |
|   |- SCVDRGMH.FMT  Format of the GMF header record.
|   |
|   |- SCVDRIMF.FMT  Format of SIF and OIF data records.
|   |
|   |- SCVDRIMH.FMT  Format of the SIF and OIF header record.
|   |
|   |- SCVDRNFF.FMT  Format of NFF data records.
|   |
|   |- SCVDRNFH.FMT  Format of the NFF header record.
|   |
|   |- SCVDROHF.FMT  Format of the single OHF data record.
|   |
|   '- LABINFO.TXT  Description of contents of the LABEL directory.
|
|- [SOFTWARE]        A directory containing C-language source code
|   |                for reading SCVDR data files.
|   |
|   |- MAKEFILE.MAK  Script used by the UNIX "make" command to
|   |                generate executables from these source files.
|   |
|   |- SCV_RDR.C     Low level routines to read SCVDR data files into
|   |                the structures defined in SCVDR.H
|   |
|   |- SCV_RDR.I     Function definition skeleton for SCV_RDR.C.
|   |
|   |- SCVDR.H       Definition of SCVDR data structures.
|   |
|   |- SCVDRSCN.PL   Perl script to list contents of SCVDR data files.
|   |
|   |- SCVPARSE.C    Low level routines to parse SFDU structures.
|   |
|   |- SCVPARSE.H    Definition of SFDU header structures.
|   |
|   |- SCVPARSE.I    Function definition skeleton for SCVPARSE.C.
|   |
|   |- SOFTINFO.TXT  Description of contents of the SOFTWARE directory.
|   |
|   |- TESTANF.C     A program that illustrates how to read an
|   |                altimetry inversion file.
|   |
```

```
|   |- TESTEDF.C     A program that illustrates how to read an
|   |                emissivity file.
|   |
|   |- TESTGMF.C     A program that illustrates how to read a
|   |                G-matrix file.
|   |
|   |- TESTIF.C      A program that illustrates how to read an
|   |                image data file.
|   |
|   |- TESTNFF.C     A program that illustrates how to read an
|   |                inversion fit file.
|   |
|   |- TESTOHF.C     A program that illustrates how to read an
|   |                orbit header file.
|   |
|   '- TYPES.H       Miscellaneous SCVDR definitions.
|
'- [Snnnn_vv]        Directories containing SCVDR data files for
    |                orbit 'nnnn', version 'vv'.
    |
    |- ANFnnnnn.v    Altimetry Inversion File
    |- EDFnnnnn.v    Emissivity File
    |- NFFnnnnn.v    Altimetry Inversion Fit File
    |- OHFnnnnn.v    Orbit Header File
    |- OIFnnnnn.v    Oblique Sinusoidal Image File
    |- SIFnnnnn.v    Sinusoidal Image File
    '- tttnnnnn.LBL  PDS labels for the data files
```

5. Whom to Contact for Information

For questions concerning this volume set:

G. Leonard Tyler
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Durand Bldg., Room 213
Stanford, CA 94305-4055

Telephone: 415-723-3535
Datafax: 415-723-9251
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Telephone: 415-723-3525
Datafax: 415-723-9251
Internet: rsimpson@magellan.stanford.edu

6. Cognizant Persons

Magellan Raymond Arvidson

```
      Archive Project        McDonnell Center for the Space Sciences
      Coordinator            Department of Earth and Planetary Sciences
                             Washington University
                             St. Louis, MO 63130

    SCVDR Data,              Richard Simpson
      documentation          Stanford University
                             Center for Radar Astronomy
                             Durand Bldg., Room 232
                             Stanford, CA 94305-4055

    Volume generation,       Peter Ford and Joan Quigley
      validation, labels,    MIT 37-601, Cambridge, MA 02139-4307
      catalog templates      Internet: pds-requests@space.mit.edu

    This disk was produced at MIT by Peter Ford and Joan Quigley.
```

C.2. CATINFO.TXT Example

```
CCSD3ZF0000100000001NJPL3IF0PDSX00000001

PDS_VERSION_ID                  = PDS3
RECORD_TYPE                     = STREAM
SPACECRAFT_NAME                 = MAGELLAN
TARGET_NAME                     = VENUS
OBJECT                          = TEXT
  PUBLICATION_DATE              = 1995-01-01
  NOTE                          = "MAGELLAN SCVDR ARCHIVE CD-WO"
END_OBJECT                      = TEXT
END

                DESCRIPTION OF CATALOG FILES ON THIS VOLUME

  This file describes the files present in the [CATALOG] directory on this
volume.  The files are:

      DATASET.CAT   - PDS dataset catalog object
      INSTHOST.CAT  - PDS spacecraft catalog object
      MISSION.CAT   - PDS mission catalog object
      PERSONEL.CAT  - PDS personnel catalog object
      REFS.CAT      - PDS reference catalog object
      INST.CAT      - PDS instrument catalog object
```

C.3. DATASET.CAT Example

```
CCSD3ZF0000100000001NJPL3IF0PDSX00000001

PDS_VERSION_ID                    = PDS3

RECORD_TYPE                       = FIXED_LENGTH
RECORD_BYTES                      = 80
OBJECT                            = DATA_SET
 DATA_SET_ID                      = "MGN-V-RDRS-5-SCVDR-V1.0"
```

```
OBJECT                          = DATA_SET_INFORMATION
 DATA_SET_NAME                  = "MAGELLAN SURFACE
                                   CHARACTERISTICS VECTOR
                                   DATA RECORD"
 DATA_SET_COLLECTION_MEMBER_FLG = "N"
 START_TIME                     = 1990-09-15T16:22:14
 STOP_TIME                      = 1992-09-14T02:28:41
 DATA_SET_RELEASE_DATE          = 1995-01-01
 PRODUCER_FULL_NAME             = "DR. G. LEONARD TYLER"
 DETAILED_CATALOG_FLAG          = "N"
 DATA_SET_DESC                  = "
```

Data Set Overview
==========

The Surface Characteristics Vector Data Record (SCVDR) is an orbit-by-orbit reduction of Magellan scattering and emission measurements carried out at Stanford University. The SCVDR includes near-nadir scattering functions obtained by numerical inversion from altimetry (ALT) echoes, results (e.g., rms surface slopes and Fresnel reflectivity) from fitting analytic functions to those inversions, scattering function segments at oblique incidence angles derived from synthetic aperture radar (SAR) echoes, and estimates of surface emissivity derived from thermal microwave radiometry (RAD) measurements. The SCVDR is one of several inputs to the Global Vector Data Record (GVDR), a gridded summary of scattering results, also produced at Stanford.

The SCVDR parallels the Altimetry and Radiometry Composite Data Record (ARCDR) produced at the Massachusetts Institute of Technology in its orbit-by-orbit organization. But the SCVDR differs from the ARCDR in that no a priori assumptions are made regarding the form of the scattering function.

The SCVDR was originally recorded on a set of 8 mm Unix 'tar' tapes. Data were blocked typically in groups of 100 orbits, but the coverage in a few cases was as large as several hundred orbits or as few as a dozen depending on mapping activity or mission scheduling. For transfer to CD-WO (the SCVDRCD) blocking was adjusted to match the capacity of the CD media.

Parameters
==========

The Magellan raw data set comprises three basic data types: echoes from the nadir-viewing altimeter (ALT), echoes from the oblique backscatter synthetic aperture radar (SAR) imaging system, and passive radiothermal emission measurements (RAD) made using the SAR high-gain antenna (HGA). The objective in compiling the SCVDR is to obtain an accurate estimate of the surface backscattering function (sometimes called the specific backscatter function or 'sigma-zero') for Venus from these three data types and to show its variation with incidence (polar) angle, azimuthal

angle, and surface location.

The Magellan data have been 'inverted' using techniques described by [TYLER1992]. If a surface is statistically homogeneous and scatters isotropically, the distribution of echo signal can be predicted using the radar equation on small surface elements, then sorting and accumulating the incremental power contributions by time-delay and Doppler frequency. Given a measured radar echo versus range and Doppler, the process may be inverted to yield the specific radar cross section as a function of incidence angle. In the SCVDR the Magellan empirical backscattering function has been obtained from ALT data at nadir to as much as 10 degrees from normal incidence in steps of 0.5 degrees. The empirical backscattering function at oblique angles (15 to 50 degrees from normal incidence) has been obtained over narrow ranges (1-4 degrees) from the SAR data. The emissivity, which in some models is the complement of the Fresnel reflectivity, has been obtained from the RAD measurements.

Processing

ALT and SAR data have been processed at Stanford University using 'inversion' methods, whereby the radar equation is converted to a matrix-vector relationship and that is solved (using least-squares techniques) to obtain an 'empirical' scattering function for each radar echo [TYLER1992]. In the case of ALT data, stability of the solution requires considerable attention; in the case of SAR data, it is the variability of the surface scattering itself that leads to the most uncertainty. Stanford has also independently confirmed the results of the MIT processing of emissivity data but without developing separate algorithms.

At Stanford ALT-EDR tapes were the input for calculation of near-nadir empirical backscattering functions. For oblique backscatter, C-BIDR tapes from the Magellan Project and F-BIDR files obtained via Internet from Washington University were the input products. Emissivity results were calculated from radar burst headers, which are included among both the ALT-EDR and C/F-BIDR files. Output was collected on an orbit-by-orbit basis into the SCVDR.

Data

Each SCVDR includes data from several orbits. For each orbit, there are six files:

(1) Orbit Header File
(2) Altimetry Inversion File (ANF)
(3) Inversion Fit File (NNF)
(4) Sinusoidal Image File (SIF)
(5) Oblique Image File (OIF)

(6) Emissivity Data File (EDF)

The Orbit Header File contains basic information about the Magellan orbit and summary data from the other five files. OHF information includes average Keplerian orbit elements, the number of entries in each of the other files, and starting and ending times for data in the other files.

The Altimetry Inversion file contains the results of the altimetry echo inversion (sigma-zero versus incidence angle at spacings typically of 0.5 degree to a maximum of about 10 degrees from nadir). The ANF also includes uncertainties in sigma-zero, geometry for the ALT observations, parameters of the radar system used in computing the absolute backscatter, and echo timing estimates which could be converted to Venus radius values.

The Inversion Fit File contains results from fitting up to five scattering laws to the experimentally derived near-nadir sigma-zero function (the ANF). The five laws include: Hagfors, exponential, gaussian, Rayleigh, and Muhleman. Free parameters (for example, the roughness parameter C and the Fresnel reflectivity R for the Hagfors law) are also reported, as is an estimate of the rms surface roughness corresponding to each fit. Residuals between the analytic function and the data indicate which function best matches the experimental results.

The Sinusoidal Image File contains the results of fitting a quadratic function to the average SAR pixel values across a sinusoidal equal area image strip. The image strips are from either C-BIDR or F-BIDR files; the best fit quadratic represents the sigma-zero function over a few degrees of incidence angle for a surface area about 20 km across track and about 2 km along track. Geometrical data, uncertainties, and other information is also included in the SIF.

The Oblique Image File contains the results of fitting a quadratic approximation to pixel values stored in the Magellan oblique sinusoidal equal area projection. The OIF and SIF are identical except for the projection of the input pixel data. The OIF contains data for north and south polar regions.

The Emissivity Data File contains results of analysis of Magellan RAD data. Surface emissivities, uncertainties, geometrical data, and system parameter values are included.

Ancillary Data

Inversion of the altimetry data requires use of matrices incorporating information about the geometry of the observations and the relationships of geometry to radar range, Doppler frequency offset, and incidence angle on

the planet's surface. Matrices were computed at approximately one degree increments in spacecraft latitude for orbits on which viewing conditions were distinctly different. These matrices are included with the SCVDR data in the GEOMETRY directory on the CD-WO.

Ancillary data for most processing at Stanford was obtained from the data tapes and files received from the Magellan Project. These included trajectory and pointing information for the spacecraft, clock conversion tables, spacecraft engineering data, and SAR processing parameters. For calibration of the radar instrument itself, Magellan Project reports (including some received from Hughes Aircraft Co. [BARRY1987; CUEVAS1989; SE011]) were used. Documentation on handling of data at the Jet Propulsion Laboratory was also used [BRILL&MEISL1990; SCIEDR; SDPS101].

Coordinate System
==========

Most information about spacecraft positions and velocities is stored using J2000 inertial coordinates. Most information about surface locations is stored using Venus Body Fixed 1985 coordinates [LYONS1988].

Software
========

A special library and several example programs are provided in source code form for reading the SCVDR data files. One main program is provided for each file type (including the geometry files). These are provided to illustrate access to the data using the reader subroutine(s); the main programs themselves do nothing beyond returning diagnostic messages. Source code and include files are in the C language; a Unix makefile (for creating executables) and a Perl script (to list contents of SCVDR files) are also provided.

Media/ Format
==========

The SCVDR will be delivered using compact disc write once (CD-WO) media. Formats will be based on standards for such products established by the Planetary Data System (PDS) [PDSSR1992]. "

CONFIDENCE_LEVEL_NOTE = "

Overview
========

The SCVDR is intended to be a systematic and comprehensive reduction of radar and radio data acquired by the Magellan Mission. It emphasizes extraction of electromagnetic properties of the Venus surface with minimal assumptions

regarding the form of the backscatter function. Limitations implicit in the analysis approach and in the resulting data are summarized below.

Review

The SCVDR has been reviewed internally by the Magellan Project prior to release to the planetary community. The review included compilation of the Global Vector Data Record (GVDR) at Stanford and independent confirmation of formats and values at M.I.T.

Data Coverage and Quality

Because the orbit of Magellan was elliptical during most of its mapping operations, the character of the signal varied considerably over an orbit as well as from place to place on the surface. Although the SCVDR quantifies much of the spatial variation, systematic limitations of both the instrument and the mission mean that some variability was missed or only partially captured.

General Limitations

It is important to remember that, since the SAR and ALT antennas were aimed at different parts of the planet during each orbit, building up a collection of composite scattering data for any single surface region requires that results from several orbits be integrated. In the case of data from polar regions, where only the SAR was able to probe, there will be no ALT data. When scheduling or other factors interrupted the systematic collection of data, there may be ALT data for some regions but no comparable SAR or radiometry data (or vice versa).

Outages played an important role in determining coverage for all Cycles. For example, although a goal of Cycle 3 radar mapping was radar stereo, early orbits were used to collect data at nominal incidence angles that had been missed during Cycle 1 because of thermal problems with the spacecraft. A transmitter failure during Cycle 3 caused a further loss of data. It is not within the scope of this description to provide detailed information on data coverage.

Leading Edge: Identification of the echo leading edge is critical for both topographic analysis and extraction of the near-nadir scattering function from ALT data. For topography, a timing error translates directly into an error in planetary radius. For calculation of the scattering function, both the inferred echo dispersion and the inferred echo amplitude will be in error if the

initial rise of the echo is improperly identified. This limitation applies most commonly when the spacecraft ALT antenna was aimed away from nadir and the surface was rough (e.g., during Cycle 1 over Aphrodite Terra).

Inversion Stability: Although the ALT inversions require no assumptions about the form of the backscatter function, inversion processes are unstable in the presence of noise. Second differences were constrained during ALT inversions to improve stability. The quantitative constraint was varied from periapsis to the poles based on whether the 'noise' was radar echo speckle or speckle plus thermal system noise in the receiver. Instabilities affect primarily the inversion results at the largest incidence angles.

Noise Baseline: During ALT inversion, an estimate of 'thermal' noise was derived from the data. At low spacecraft altitudes noise was primarily radar clutter (for example, aliased signal from frequencies outside the nominal Doppler window). At high spacecraft altitudes, both range aliasing and real system thermal noise contributed. The erroneous inclusion of high-angle scattered signal in the 'noise' estimate leads to the following consequences:

(1) the derived scattering function amplitude will be underestimated (inferred reflectivity will be too small);
(2) the echo decay rate with incidence angle will be overestimated (inferred rms surface slope will be too small);
(3) uncertainty in the derived scattering function will be too small (especially at the largest angles).

Orbit Eccentricity: Periapsis throughout the radar mapping mission was near 10 degrees N latitude at altitudes of approximately 300 km. The altitude near the poles, on the other hand, was on the order of 3000 km. For all data types this means lower confidence in results obtained at the poles than near the equator.

Dynamic Antenna Pointing: The spacecraft attitude varied during each orbit to compensate partially for the changing SAR range to the surface and to provide scattering at higher incidence angles when the echo signal was expected to be strongest. The SAR antenna was pointed at about 45 degrees from nadir near periapsis; this was reduced to about 15 degrees at the poles. The ALT antenna, at a constant 25 degree offset from the SAR antenna, followed in tandem but at angles which were not optimized for obtaining the best altimetry echo.

Footprints: A nominal nadir footprint can be assigned to altimetry results, but this footprint is biased near periapsis because the ALT antenna is rotated about 20

degrees from nadir (during Cycle 1). Over polar regions in Cycle 1, the ALT antenna is rotated about 10 degrees to the opposite side of nadir. A more important consideration in polar regions is that the area illuminated by the ALT antenna is approximately 100 times as large as near periapsis because of the higher spacecraft altitude. The region contributing to echoes in polar regions -- and therefore the region over which estimates of Fresnel reflectivity and rms surface tilts apply -- is much larger than at periapsis.

Cycle 1 Mapping

During Mapping Cycle 1 almost half the orbits provided SAR images of the north pole; because of the orbit inclination, ALT data never extended beyond about 85N latitude in the north and 85S in the south. No SAR images of the south pole were acquired during Mapping Cycle 1 because the SAR antenna was always pointed to the left of the ground track; Cycle 1 SAR image strips near the south pole were at latitudes equatorward of 85S.

Beginning at approximately orbit 600 and extending until nearly orbit 1100, onboard recording of radar data slowly degraded. Most of these data were subsequently reprocessed, with some improvement in data quality. Where available, the reprocessed data have been included in the SCVDR.

Cycle 2 Mapping

During much of Mapping Cycle 2, the spacecraft was flown 'backwards' so as to provide SAR images of the same terrain but with 'opposite side' illumination. This adjustment also meant that the SAR could image near the Venus south pole (but not near the north pole). The ALT data continued to be limited to latitudes equatorward of 85N and 85S.

SCVDR processing of image data within about two degrees of the south pole suffers from errors. This apparently resulted from reprojection of the oblique sinusoidal pixels but the precise cause of the problem was never isolated and corrected. This problem potentially affects all south pole OIF data, including any obtained in Cycle 3 as well as the larger volume from Cycle 2.

Cycle 3 Mapping

During Mapping Cycle 3 the emphasis was on obtaining SAR data at the same viewing azimuth as in Cycle 1 but at different incidence angles (for radar stereo). In fact, most data were acquired at an incidence angle of about 25 degrees, which meant that the ALT antenna was usually aimed

```
      directly at nadir instead of drifting from side to side,
      as had been the case in Cycles 1 and 2.  These Cycle 3 data,
      therefore, may be among the best from the altimeter.
      Dynamic range in SAR data was larger than in Cycles 1 and 2
      because the incidence angle was fixed rather than varying to
      compensate for the changing spacecraft altitude.


   Other Comments
   ==============
     Although information on radar echo timing is included in the
     ANF, a thorough analysis for topography was not attempted in
     the SCVDR.  Comparison of the preliminary SCVDR results with
     results in the ARCDR showed consistency in the altitude
     estimates.  Systematic errors were more carefully addressed
     in the ARCDR.  ARCDR topography was carried forward to the
     GVDR.

     Likewise, the EDF results in the SCVDR are consistent with
     emissivity data in the ARCDR.  The ARCDR emissivity results
     were carried forward to the GVDR."

END_OBJECT                      = DATA_SET_INFORMATION

OBJECT                          = DATA_SET_TARGET
 TARGET_NAME                    = VENUS
END_OBJECT                      = DATA_SET_TARGET

OBJECT                          = DATA_SET_HOST
 INSTRUMENT_HOST_ID             = MGN
 INSTRUMENT_ID                  = RDRS
END_OBJECT                      = DATA_SET_HOST

OBJECT                          = DATA_SET_REFERENCE_INFORMATION
 REFERENCE_KEY_ID               = "BARRY1987"
END_OBJECT                      = DATA_SET_REFERENCE_INFORMATION

OBJECT                          = DATA_SET_REFERENCE_INFORMATION
 REFERENCE_KEY_ID               = "BRILL&MEISL1990"
END_OBJECT                      = DATA_SET_REFERENCE_INFORMATION

OBJECT                          = DATA_SET_REFERENCE_INFORMATION
 REFERENCE_KEY_ID               = "CUEVAS1989"
END_OBJECT                      = DATA_SET_REFERENCE_INFORMATION

OBJECT                          = DATA_SET_REFERENCE_INFORMATION
 REFERENCE_KEY_ID               = "LYONS1988"
END_OBJECT                      = DATA_SET_REFERENCE_INFORMATION

OBJECT                          = DATA_SET_REFERENCE_INFORMATION
 REFERENCE_KEY_ID               = "PDSSR1992"
END_OBJECT                      = DATA_SET_REFERENCE_INFORMATION

OBJECT                          = DATA_SET_REFERENCE_INFORMATION
 REFERENCE_KEY_ID               = "SCIEDR"
```

```
 END_OBJECT                      = DATA_SET_REFERENCE_INFORMATION

 OBJECT                          = DATA_SET_REFERENCE_INFORMATION
  REFERENCE_KEY_ID               = "SDPS101"
 END_OBJECT                      = DATA_SET_REFERENCE_INFORMATION

 OBJECT                          = DATA_SET_REFERENCE_INFORMATION
  REFERENCE_KEY_ID               = "SE011"
 END_OBJECT                      = DATA_SET_REFERENCE_INFORMATION

 OBJECT                          = DATA_SET_REFERENCE_INFORMATION
  REFERENCE_KEY_ID               = "TYLER1992"
 END_OBJECT                      = DATA_SET_REFERENCE_INFORMATION

END_OBJECT                       = DATA_SET
END
```

C.4. DOCINFO.TXT Example

```
CCSD3ZF0000100000001NJPL3IF0PDSX00000001

PDS_VERSION_ID                   = PDS3
RECORD_TYPE                      = STREAM
SPACECRAFT_NAME                  = MAGELLAN
TARGET_NAME                      = VENUS
OBJECT                           = TEXT
  PUBLICATION_DATE               = 1995-01-01
  NOTE                           = "MAGELLAN SCVDR ARCHIVE CD-WO"
END_OBJECT                       = TEXT
END

              DESCRIPTION OF DOCUMENTATION FILES ON THIS VOLUME

  This file describes the files present in the [DOCUMENT] directory on
this volume.  The files are:

      SCVDR.ASC     - Software Interface Specification for the Magellan
                      Surface Characteristics Vector Data Record (SCVDR)
                      products, from which the SCVDRCD disks are made.
                      Formatted for display or printing at 66 lines per
                      page with up to 78 constant-width characters per
                      line.

      SCVDR.LBL     - PDS detached label file describing SCVDR.ASC and
                      SCVDR.PS.

      SCVDR.PS      - Software Interface Specification for the Magellan
                      Surface Characteristics Vector Data Record (SCVDR)
                      products, from which the SCVDRCD disks are made.
                      Formatted in Adobe PostScript.

      SCVDRCD.ASC   - Software Interface Specification for the Magellan
                      Surface Characteristics Vector Data Record on
                      Compact Disk Read-Only Memory (SCVDRCD) Product.
                      Formatted for display or printing at 66 lines per
                      page with up to 78 constant-width characters per
```

```
                line.

     SCVDRCD.LBL   - PDS detached label file describing SCVDRCD.ASC and
                     SCVDRCD.PS.

     SCVDRCD.PS    - Software Interface Specification for the Magellan
                     Surface Characteristics Vector Data Record on
                     Compact Disk Read-Only Memory (SCVDRCD) Product.
                     Formatted in Adobe PostScript.
```

C.5. GEOMINFO.TXT Example

```
CCSD3ZF0000100000001NJPL3IF0PDSX00000001

PDS_VERSION_ID                  = PDS3
RECORD_TYPE                     = STREAM
SPACECRAFT_NAME                 = MAGELLAN
TARGET_NAME                     = VENUS
OBJECT                          = TEXT
  PUBLICATION_DATE              = 1995-01-01
  NOTE                          = "MAGELLAN SCVDR GEOMETRY FILES"
END_OBJECT                      = TEXT
END

               DESCRIPTION OF GEOMETRY FILES IN THIS DIRECTORY

  The files in this directory contain the inversion matrices used to
generate the ANF and NFF files in the data directories on this volume.
Each GMF file is accompanied by a detached PDS label file with the same
name and 'LBL' extension.  Refer to file SCVDRCD.TXT in the DOCUMENT
directory for further details.
```

C.6. INDEX.TAB Example

```
0376,01,"ANF00376.1","S0376_01","SCVDR.00376-00399;1","GMF00376.1","MG_2101"
0376,01,"EDF00376.1","S0376_01","SCVDR.00376-00399;1","           ","MG_2101"
0376,01,"GMF00376.1","GEOMETRY","SCVDR.00376-00399;1","           ","MG_2101"
0376,01,"NFF00376.1","S0376_01","SCVDR.00376-00399;1","           ","MG_2101"
0376,01,"OHF00376.1","S0376_01","SCVDR.00376-00399;1","           ","MG_2101"
0376,01,"OIF00376.1","S0376_01","SCVDR.00376-00399;1","           ","MG_2101"
0376,01,"SIF00376.1","S0376_01","SCVDR.00376-00399;1","           ","MG_2101"
0377,01,"ANF00377.1","S0377_01","SCVDR.00376-00399;1","GMF00376.1","MG_2101"
0377,01,"EDF00377.1","S0377_01","SCVDR.00376-00399;1","           ","MG_2101"
0377,01,"NFF00377.1","S0377_01","SCVDR.00376-00399;1","           ","MG_2101"
0377,01,"OHF00377.1","S0377_01","SCVDR.00376-00399;1","           ","MG_2101"
0377,01,"OIF00377.1","S0377_01","SCVDR.00376-00399;1","           ","MG_2101"
0377,01,"SIF00377.1","S0377_01","SCVDR.00376-00399;1","           ","MG_2101"
```

C.7. INDXINFO.TXT Example

```
CCSD3ZF0000100000001NJPL3IF0PDSX00000001

PDS_VERSION_ID                  = PDS3
RECORD_TYPE                     = STREAM
SPACECRAFT_NAME                 = MAGELLAN
TARGET_NAME                     = VENUS
```

```
OBJECT                          = TEXT
 PUBLICATION_DATE               = 1995-01-01
 NOTE                           = "MAGELLAN SCVDR ARCHIVE CD-WO"
END_OBJECT                      = TEXT
END
```

DESCRIPTION OF INDEX FILES ON THIS VOLUME

This file describes the files present in the [INDEX] directory on this volume. The files are:

INDEX.LBL - PDS label for the volume index (INDEX.TAB). It identifies the volume index and describes the structure (columns) of the index table.

INDEX.TAB - Volume index in tabular format.

CUMINDEX.LBL - PDS label for the cumulative volume index (CUMINDEX.TAB).

CUMINDEX.TAB - Cumulative volume index in tabular format.

C.8. INST.CAT Example

```
CCSD3ZF0000100000001NJPL3IF0PDSX00000001

PDS_VERSION_ID                  = PDS3

RECORD_TYPE                     = FIXED_LENGTH
RECORD_BYTES                    = 80
OBJECT                          = INSTRUMENT
 INSTRUMENT_HOST_ID             = "MGN"
 INSTRUMENT_ID                  = "RDRS"

 OBJECT                         = INSTRUMENT_INFORMATION
  INSTRUMENT_NAME               = "RADAR SYSTEM"
  INSTRUMENT_TYPE               = "RADAR"
  INSTRUMENT_DESC               = "

    Instrument Specifications
    =========================
      The radar was manufactured by Hughes Aircraft Company and the
      'build date' is taken to be 1989-01-01.  The radar dimensions
      were 0.304 by 1.35 by 0.902 (height by length by width in
      meters) and the mass was 126.1 kg.

      Instrument Id                 : RDRS
      Instrument Host Id            : MGN
      Pi Pds User Id                : GPETTENGILL
      Instrument Name               : RADAR SYSTEM
      Instrument Type               : RADAR
      Build Date                    : 1989-01-01
      Instrument Mass               : 126.100000
      Instrument Length             : 1.350000
      Instrument Width              : 0.902000
      Instrument Height             : 0.304000
```

Instrument Manufacturer Name : HUGHES AIRCRAFT

For more information on the radar system see the papers by [JOHNSON1990] and [SAUNDERSETAL1990].

Instrument Overview

The Magellan radar system included a 3.7 m diameter high gain antenna (HGA) for SAR and radiometry and a smaller fan-beam antenna (ALTA) for altimetry. The system operated at 12.6 cm wavelength. Common electronics were used in SAR, altimetry, and radiometry modes. The SAR operated in a burst mode; altimetry and radiometry observations were interleaved with the SAR bursts.

Between SAR bursts (typically several times a second) groups of altimeter pulses were transmitted from a dedicated fan-beam altimeter antenna directed toward the spacecraft's nadir. The altimeter pulses were identical in waveform and bandwidth to the SAR pulses, resulting in a range accuracy of better than 15 m. The pulse-repetition rate and burst duration differed between the two modes.

Radiometry data were obtained by spending a portion of the time between SAR bursts and after altimeter operation in a passive (receive-only) mode, with the HGA antenna capturing the microwave thermal emission from the planet. Noise power within the 10-MHz receiver bandwidth was detected and accumulated for 50 ms. To reduce the sensitivity to receiver gain changes in this mode, the receiver was connected on alternate bursts first to a comparison dummy load at a known physical temperature and then to the HGA. The short-term temperature resolution was about 2 K; the long-term absolute accuracy after calibration was about 20 K.

Science Objectives

See MISSION_OBJECTIVES_SUMMARY under MISSION.

Operational Considerations

The Magellan radar system was used to acquire radar back-scatter (SAR) images, altimetry, and radiometry when the spacecraft was close to the planet. Nominal operation extended from about 20 minutes before periapsis until about 20 minutes after periapsis. In the SAR mode output from the radar receiver was sampled, blocks of samples were quantized using an adaptive procedure, and the results were stored on tape. In the altimetry mode samples were recorded directly, without quantization. Radiometry measurements were stored in the radar header records. During most of the remainder of each orbit, the HGA was pointed toward Earth and the contents of the tape recorder were

transmitted to a station of the DSN at approximately 270 kilobits/ second. SAR, altimetry, and radiometry data were then processed using ground software into images, altimetry profiles, estimates of backscatter coefficient, emissivity, and other quantities.

Calibration Description

The radar was calibrated before flight using an active electronic target simulator [CUEVAS1989].

Platform Mounting Descriptions

The spacecraft +Z axis vector was in the nominal direction of the HGA boresight. The +X axis vector was parallel to the nominal rotation axis of the solar panels. The +Y axis vector formed a right-handed coordinate system and was in the nominal direction of the star scanner boresight. The spacecraft velocity vector was in approximately the -Y direction when the spacecraft was oriented for left-looking SAR operation. The nominal HGA polarization was linear in the y-direction.

Cone Offset Angle	: 0.00
Cross Cone Offset Angle	: 0.00
Twist Offset Angle	: 0.00

The altimetry antenna boresight was in the x-z plane 25 degrees from the +Z direction and 65 degrees from the +X direction. The altimetry antenna was aimed approximately toward nadir during nominal radar operation. The altimetry antenna polarization was linear in the y-direction.

The medium gain antenna boresight was 70 degrees from the +Z direction and 20 degrees from the -Y direction. The low gain antenna was mounted on the back of the HGA feed; it’s boresight was in the +Z direction and it had a hemispherical radiation pattern.

Principal Investigator

The Principal Investigator for the radar instrument was Gordon H. Pettengill.

Instrument Section / Operating Mode Descriptions

The Magellan radar system consisted of the following sections, each of which operated in the following modes:

Section	Mode
SAR	Synthetic Aperture Radar (SAR)

ALT Altimetry
RAD Radiometry

(1) SAR Characteristics

In the Synthetic Aperture Radar mode, the radar transmitted bursts of phase-modulated pulses through its high gain antenna. Echo signals were captured by the antenna, sampled at the receiver output, and stored on tape after being quantized to reduce data volume. Pulse repetition rate and incidence angle were chosen to meet a minimum signal-to-noise ratio requirement (8 dB) for image pixels after ground processing. Multiple looks were used in processing to reduce speckle noise. Incidence angles varied from about 13 degrees at the pole to about 44 degrees at periapsis during normal mapping operations (e.g., Cycle 1); but other 'look angle profiles' were used during the mission.

Peak transmit power	: 350 watts
Transmitted pulse length	: 26.5 microsecs
Pulse repetition frequency	: 4400-5800 per sec
Time bandwidth product	: 60
Inverse baud width	: 2.26 MHz
Data quantization (I and Q)	: 2 bits each
Recorded data rate	: 750 kilobits/ sec
Polarization (nominal)	: linear horizontal
HGA half-power full beam width	: 2.2 deg (azimuth)
	: 2.5 deg (elev)
one-way gain (from SAR RF port)	: 35.7 dBi
System temperature (viewing Venus)	: 1250 K
Surface resolution (range)	: 120-360 m
(along track)	: 120-150 m
Number of looks	: 4 or more
Swath width	: 25 km (approx)
Antenna look angle	: 13-47 deg
Incidence angle on surface	: 18-50 deg
Data Path Type	: RECORDED DATA PLAYBACK
Instrument Power Consumption	: UNK

(2) ALT Characteristics

After SAR bursts (typically several times a second) groups of altimeter pulses were transmitted from a dedicated fan beam altimeter antenna (ALTA) directed toward the spacecraft's nadir. Output from the radar receiver was sampled, and the samples were stored on tape for transmission to Earth. During nominal left-looking SAR operation the ALTA pointed approximately 20 deg to the left of the spacecraft ground track at periapsis and about 10 deg to the right of the ground track near the north and south pole.

```
  Data quantization (I and Q)          : 4 bits each
  Recorded data rate                   : 35 kbs
  Polarization                         : linear
  ALTA half-power full beamwidth
                          (along track): 11 deg
                          (cross track): 31 deg
       one-way gain referenced to
                           ALT RF port : 18.9 dBi
  ALTA offset from HGA                 : 25 deg
  Burst interval                       : 0.5-1.0 sec
        duration                       : 1.0 millisec
  Dynamic range                        : 30 dB (or more)

  Data Path Type                       : RECORDED DATA
                                           PLAYBACK
  Instrument Power Consumption         : UNK


(3) RAD Characteristics
-----------------------
  Radiometry measurements were made by the radar receiver and
  HGA in a receive-only mode that was activated after the
  altimetry mode to record the level of microwave radiothermal
  emission from the planet.  Noise power within the 10-MHz
  receiver bandwidth was detected and accumulated for 50 ms.  To
  reduce the sensitivity to receiver gain changes in this mode,
  the receiver was connected on alternate bursts first to a
  comparison dummy load at a known physical temperature and then
  to the HGA.  The short-term temperature resolution was about 2
  K; the long-term absolute accuracy after calibration was about
  20 K.  At several times during the mission, radiometry
  measurements were carried out using known cosmic radio
  sources.

  Receiver Bandwidth                 : 10 MHz
  Integration Time                   : 50 millisecs
  Polarization (nominal)             : linear horizontal
  Data Quantization                  : 12 bits
  Data Rate                          : 10-48 bits/ sec
  HGA half-power full beam width     : 2.2 deg
  System temperature (viewing Venus) : 1250 K
  Antenna look angle                 : 13-47 deg
  Incidence angle on surface         : 18-50 deg
  Surface resolution (along track)   : 15-120 km
                     (cross track)   : 20-125 km

  Data Path Type               : RECORDED DATA PLAYBACK
  Instrument Power Consumption : UNK "

END_OBJECT                     = INSTRUMENT_INFORMATION

OBJECT                         = INSTRUMENT_REFERENCE_INFO
 REFERENCE_KEY_ID              = "CUEVAS1989"
END_OBJECT                     = INSTRUMENT_REFERENCE_INFO
```

```
 OBJECT                          = INSTRUMENT_REFERENCE_INFO
  REFERENCE_KEY_ID               = "JOHNSON1990"
 END_OBJECT                      = INSTRUMENT_REFERENCE_INFO

 OBJECT                          = INSTRUMENT_REFERENCE_INFO
  REFERENCE_KEY_ID               = "SAUNDERSETAL1990"
 END_OBJECT                      = INSTRUMENT_REFERENCE_INFO

END_OBJECT                        = INSTRUMENT

END
```

C.9. INSTHOST.CAT Example

```
CCSD3ZF0000100000001NJPL3IF0PDSX00000001

PDS_VERSION_ID                    = PDS3

RECORD_TYPE                       = FIXED_LENGTH
RECORD_BYTES                      = 80
OBJECT                            = INSTRUMENT_HOST
INSTRUMENT_HOST_ID                = "MGN"

 OBJECT                           = INSTRUMENT_HOST_INFORMATION
  INSTRUMENT_HOST_NAME            = "MAGELLAN"
  INSTRUMENT_HOST_TYPE            = "SPACECRAFT"
  INSTRUMENT_HOST_DESC            = "

    Spacecraft Overview
    ===================
      The Magellan spacecraft was built by the Martin Marietta
      Corporation.  The spacecraft structure included four major
      sections: High-Gain Antenna (HGA), Forward Equipment Module
      (FEM), Spacecraft Bus (including the solar array), and the Orbit
      Insertion Stage.  Spacecraft subsystems included those for
      thermal control, power, attitude control, propulsion, command
      data and data storage, and telecommunications.

      Design of the Magellan spacecraft was driven by the need for a
      low-cost, high-performance vehicle.  Protoflight units that had
      been built for preflight tests or were spares from the Voyager
      spacecraft were available from storage at no cost.  These
      included the 3.7 meter diameter high-gain antenna (HGA), the
      spacecraft bus, propulsion system components, thermal control
      louvers, and much of the radio subsystem.  The stockpile of
      flight spares for the Galileo spacecraft provided Magellan's
      command and data system, tape recorders, attitude control
      processor, power subsystem and propulsion components.  Further
      elements were drawn from other projects and from NASA standard
      designs.  Only about 30% (by mass) of the Magellan spacecraft --
      primarily the radar electronics and the solar panels -- was
      especially designed for the mission.

      The high-gain antenna (HGA) was used as the antenna for the
      synthetic aperture radar (SAR) and as the primary antenna for
      the telecommunications system.  The HGA boresight was defined to
```

be the +Z axis for the spacecraft-fixed coordinate system.

The spacecraft bus was a ten sided structure containing the star scanner, medium-gain antenna (MGA), rocket engine modules (REMs), command data and data storage (CDDS) subsystem, attitude control monopropellant tank, and a nitrogen tank for providing propellant pressurization. The solar panel array was attached to the bus; its rotation axis defined the +X axis for the spacecraft-fixed coordinate system. The +Y axis of the coordinate system was in the nominal direction of the star scanner boresight, forming a right-hand coordinate system.

The radar electronics, the reaction wheels, and various other spacecraft subsystem components were contained within the Forward Equipment Module, located between the bus and HGA.

The orbit insertion stage contained a STAR-48 solid rocket motor (SRM) that was used to provide the impulse required to perform the Venus Orbit Insertion (VOI) maneuver.

Thermal control of the spacecraft was accomplished by a combination of louvers, thermal blankets, passive coatings, and heat dissipating elements. The nominal operating temperature for the spacecraft components was between -5 and +40 degrees Celsius. The thermal control subsystem maintained these components at the appropriate temperatures for all orientations of the spacecraft orbit and sun-line and for all spacecraft operating modes. Electrical power was supplied by two large solar panels with a total area of 12.6 square meters. This array was capable of producing a minimum power of 1029 W at the end of the nominal mission; it could rotate about its axis to allow tracking of the Sun despite the changing Earth-Sun-spacecraft geometry during the mission. A dedicated sun sensor optimized power production. Bus voltage regulation was controlled by the power control unit (PCU) with a shunt regulator for diverting excess power from the solar arrays to maintain power as raw power (28-35 v), regulated power at 28 vDC +/ -0.56 vDC, and as AC at 2.4 kHz through an inverter. Two 30 amp-hour, 26-cell nickel cadmium batteries provided power during times of solar occultation and allowed normal spacecraft operations independent of real-time solar illumination. These batteries were sized to allow a degraded mission in the event that one of them failed.

The attitude of the Magellan spacecraft was controlled through the use of reaction wheels, with monopropellant rocket motors being used to desaturate the reaction wheels periodically. During both the interplanetary cruise and the orbital portions of the mission, attitude reference was provided by an inertial reference unit (IRU), updated each orbit using celestial references. During the mapping part of each orbit, the spacecraft was initially oriented with the HGA pointing down toward Venus, with the exact attitude being a function of the spacecraft altitude and the SAR mapping objectives. During the downlink transmission part of the orbit, the spacecraft was

oriented with the HGA slightly off the Earth-line. The low gain antenna (LGA) was mounted coaxially with the HGA and did not require pointing since it had an omnidirectional beam pattern. The altimeter horn (ALTA) was mounted so that a portion of the fan-shaped beam nominally pointed in the nadir direction during the mapping part of an orbit.

The Magellan propulsion subsystem consisted of two parts. The first, a Star 48 SRM, provided the impulse for VOI. Following that maneuver, the empty casing and parts of its support structure were ejected from the spacecraft. The second part consisted of monopropellant hydrazine thrusters that were used for trajectory correction maneuvers (TCMs) during inter-planetary cruise, thrust vector control (TVC) during VOI, orbit trim maneuvers during the mapping mission, and attitude control when the reaction wheels were being desaturated. The rocket motors were clustered in modules located on the end of outrigger booms in order to increase their moment arms and thus decrease attitude control propellant requirements.

Twelve 0.9-N (Newton) and four 22-N rocket motors were used for attitude control, with thrust being provided by eight 445-N rocket motors or by the 0.9-N motors for small TCMs. All engines pointed in the -Z direction, with the exception of the roll motors.

The 0.9-N motors were used for tip-off control following separation of the inertial upper stage (IUS), reaction wheel desaturation, roll control for all times other than VOI, to back up any failed reaction wheels, and for small TCMs or orbit trim maneuvers (OTMs). The 22-N motors were used for roll control during VOI. The 445-N motors were used for controlling the spacecraft rotational axis during VOI, and to provide impulses during all propulsive maneuvers. The monopropellant motors also provided the impulses needed to trim the VOI maneuver.

The command, data and data storage (CDDS) system received uplink commands via the radio frequency subsystem (RFS) and controlled the spacecraft in response to those commands. It also controlled the acquisition and storage of scientific data and sending that data, along with supplemental engineering data, to the RFS for downlink transmission to Earth. The commands were sent to the spacecraft as time-event pairs for storage and later execution, and also in the form of blocks which the CDDS later expanded into spacecraft executable commands. In the Venus orbit phase, commands for up to three days of radar operation were stored. There was also a provision for receiving and executing discrete commands sent from the ground. SAR data were stored on two multi-track digital tape records (DTRs) for later playback over the high-rate X-band link; there was no provision for real-time transmission of the SAR data. Data storage capacity of the two DTRs was approximately 1.8 billion bits. Engineering data were normally transmitted to Earth over a real-time S-band link. During those times when a real-time link was not possible, the engineering data were recorded on a DTR

```
      and played back via the X-band high-rate link with the SAR data.
      The recorded data stream was alternately switched between the
      two DTRs so that the data would not be lost during the DTR track
      change.

      The Magellan telecommunications subsystem contained all the
      hardware necessary to maintain communications between Earth and
      the spacecraft.  The subsystem contained the radio frequency
      subsystem, the LGA, MGA, and HGA.  The RFS performed the
      functions of carrier transponding, command detection and
      decoding, and telemetry modulation.  The spacecraft was capable
      of simultaneous X-band and S-band uplink and downlink
      operations.  The S-band operated at a transmitter power of 5 W,
      while the X-band operated at a power of 22 W.  Uplink data rates
      were 31.25 and 62.5 bps (bits per second) with downlink data
      rates of 40 bps (emergency only), 1200 bps (real-time
      engineering rate), 115.2 kbps (kilobits per second) (radar
      downlink backup), and 268.8 kbps (nominal).

      For more information on the Magellan spacecraft see the papers
      by [SAUNDERSETAL1990] and [SAUNDERSETAL1992].  "

 END_OBJECT                      = INSTRUMENT_HOST_INFORMATION

 OBJECT                          = INSTRUMENT_HOST_REFERENCE_INFO
  REFERENCE_KEY_ID               = "SAUNDERSETAL1990"
 END_OBJECT                      = INSTRUMENT_HOST_REFERENCE_INFO

 OBJECT                          = INSTRUMENT_HOST_REFERENCE_INFO
  REFERENCE_KEY_ID               = "SAUNDERSETAL1992"
 END_OBJECT                      = INSTRUMENT_HOST_REFERENCE_INFO

END_OBJECT                       = INSTRUMENT_HOST

END
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C.10. LABINFO.TXT Example

```
CCSD3ZF0000100000001NJPL3IF0PDSX00000001

PDS_VERSION_ID                   = PDS3
RECORD_TYPE                      = STREAM
SPACECRAFT_NAME                  = MAGELLAN
TARGET_NAME                      = VENUS
OBJECT                           = TEXT
  PUBLICATION_DATE               = 1995-01-01
  NOTE                           = "MAGELLAN SCVDR FORMAT FILES"
END_OBJECT                       = TEXT
END
```

```
              DESCRIPTION OF PDS LABEL FILES ON THIS VOLUME

  This file describes the files present in the [LABEL] directory on
this volume.  The files are:

    SCVDRANF.FMT  - PDS detached object format file describing the
```

structure of the binary data records in the ANFs (Altimeter Inversion Files) in the data directories of this volume.

SCVDRANH.FMT - PDS detached object format file describing the structure of the single binary header record in the ANFs (Altimeter Inversion Files) in the data directories of this volume.

SCVDREDF.FMT - PDS detached object format file describing the structure of the binary data records in the EDFs (Emissivity Data Files) in the data directories of this volume.

SCVDREDH.FMT - PDS detached object format file describing the structure of the single binary header record in the EDFs (Emissivity Data Files) in the data directories of this volume.

SCVDRGMF.FMT - PDS detached object format file describing the structure of the binary data records in the GMFs (Geometry Matrix Files) in the GEOMETRY directory of this volume.

SCVDRGMH.FMT - PDS detached object format file describing the structure of the single binary header record in the GMFs (Geometry Matrix Files) in the GEOMETRY directory of this volume.

SCVDRIMF.FMT - PDS detached object format file describing the structure of the binary data records in the SIFs (Sinusoidal Image Files) and OIFs (Oblique Sinusoidal Image Files) in the data directories of this volume.

SCVDRIMH.FMT - PDS detached object format file describing the structure of the single binary header record in the SIFs (Sinusoidal Image Files) and OIFs (Oblique Sinusoidal Image Files) in the data directories of this volume.

SCVDRNFF.FMT - PDS detached object format file describing the structure of the binary data records in the NFFs (Altimeter Inversion Fit Files) in the data directories of this volume.

SCVDRNFH.FMT - PDS detached object format file describing the structure of the single binary header record in the NFFs (Altimeter Inversion Fit Files) in the data directories of this volume.

SCVDROHF.FMT - PDS detached object format file describing the structure of the single binary data record in the OHFs (Orbit Header Files) in the data directories of this volume.

The remaining PDS label files on this volume are located in the several data directories. Their names end with 'LBL' and they describe the corresponding data files.

The keywords in all PDS label files are described in "Planetary Science Data Dictionary", JPL D-7116, Rev. C, 20 November 1992.

C.11. MISSION.CAT Example

```
CCSD3ZF0000100000001NJPL3IF0PDSX00000001

PDS_VERSION_ID                    = PDS3

RECORD_TYPE                       = FIXED_LENGTH
RECORD_BYTES                      = 80
OBJECT                            = MISSION
 MISSION_NAME                     = "MAGELLAN"

 OBJECT                           = MISSION_INFORMATION
  MISSION_START_DATE              = 1989-05-04
  MISSION_STOP_DATE               = 1994-10-12
  MISSION_ALIAS_NAME              = "VENUS RADAR MAPPER (VRM)"
  MISSION_DESC                    = "

    Mission Overview
    ================
      The Magellan spacecraft was launched from the Kennedy Space
      Center on 4 May 1989.  The spacecraft was deployed from the
      Shuttle cargo bay after the Shuttle achieved parking orbit.
      Magellan, using an inertial upper stage rocket, was then placed
      into a Type IV transfer orbit to Venus where it carried out
      radar mapping and gravity studies starting in August 1990.  The
      Mission has been described in many papers including two special
      issues of the Journal of Geophysical Research [VRMPP1983;
      SAUNDERSETAL1990; JGRMGN1992].  The radar system is also
      described in [JOHNSON1990].

      Magellan was powered by single degree of freedom, sun-tracking,
      solar panels.  The spacecraft was 3-axis stabilized by reaction
      wheels using gyros and a star sensor for attitude reference.
      The spacecraft carried a solid rocket motor for Venus orbit
      insertion.  A small hydrazine system was used for trajectory
      corrections and certain attitude control functions.  Earth
      communication with the Deep Space Network (DSN) was by means of
      S- and X-band channels.  The high-gain antenna also functioned
      as the SAR mapping antenna during orbital operations.

      The interplanetary cruise phase lasted until 10 August 1990.
      During the cruise phase there were small trajectory correction
      maneuvers to ensure proper approach geometry.  Using the solid
      rocket motor, the spacecraft was placed into an elliptical orbit
      around the planet, with a periapsis latitude of approximately 10
      degrees north, a periapsis altitude of 295 km, a period of 3.263
      hours, and an apoapsis altitude of approximately 7762 km.
```

After orbit insertion, the radar system acquired test data. Then, unexpectedly, the signal from the spacecraft was lost twice. Following an intense recovery process, commands were sent to avoid further communication interruptions, and the spacecraft resumed mapping operations on 15 September 1990.

Each mapping cycle lasted 243 days, which was the time required for Venus to make one rotation under the spacecraft orbit. The first mapping cycle ended on 15 May 1991. Typical activities during a single mapping pass on Cycle 1 were as follows. As the spacecraft neared periapsis, it was oriented so the high-gain antenna pointed slightly to the side of the ground track. At a true anomaly of -59 degrees, the radar was commanded on. The radar continued to take data to a true anomaly of 80 degrees and then the radar was commanded off. On the next pass the swath started at -80 degrees and went to 59 degrees. Alternating north and south swaths were repeated throughout Cycle 1.

The range of latitudes covered by the synthetic aperture radar (SAR) during Cycle 1 was 67 degrees S to 90 degrees N. The range of SAR incidence angles was from just under 20 to just over 40 degrees. The SAR data were taken at a data rate of 750 kilobits/second and were stored in the spacecraft tape recorder. Altimeter and radiometer data were also taken when SAR data were acquired. The altimeter data were taken using a small fan beam antenna at a data rate of 30 kb/s. As the spacecraft moved away from the planet toward apoapsis, the spacecraft reoriented the high-gain antenna towards Earth and the stored radar data were transmitted to DSN stations. This data taking- and transmitting-cycle was repeated for every orbit. By 15 May 1991, the planet had been completely mapped except for the area near the South Pole and a few regions which had been missed because of temporary equipment failures.

Cycle 2 observations focused on filling the gaps in Cycle 1 coverage (including the south pole area), acquiring SAR data at a constant incidence angle (25 degrees), and conducting a suite of ad hoc experiments, including high resolution imaging and radar stereo. To observe the south pole the spacecraft was rotated 180 degrees about its nadir-pointing axis so as to conduct right-looking SAR observations. Gaps in the Cycle 1 coverage were filled by rotating the spacecraft back to its initial left-looking direction. The orbit plane was adjusted slightly at the beginning of Cycle 2 so that altimetry tracks would be offset by about 10 km at the equator, bisecting the orbit-to-orbit offset of altimetry tracks in Cycle 1. The spacecraft was rotated 90 deg about the HGA boresight on orbits 3716-3719 to obtain SAR and radiometry data with VV polarization. Radio occultation measurements were made on orbits 3212-3214.

The principal objective of Cycle 3 was to perform radar stereo mapping of the Venusian surface. About 30 percent of the Cycle 1 coverage was remapped in this cycle with a different, left-looking incidence angle on the surface. Gravity data were

collected over Artemis Chasma. In addition, high resolution altimetry data were collected by pointing the high gain antenna straight down during orbits 4919 to 4921. Transmission of acquired radar data to Earth became nearly impossible after spacecraft equipment failures late in Cycle 3, and the radar was not used for science purposes after that.

Cycle 4 was used for full (360 degree) longitudinal collection of gravity data because of favorable planetary and spacecraft geometry. The cycle was extended by about ten days to compensate for passage of the radio ray through the Venus atmosphere during the first ten days. To improve sensitivity to gravity features, orbit periapsis was lowered on orbit 5752. Radio occultation measurements were made on orbits 6369, 6370, 6471, and 6472.

The aerobraking phase of the mission was designed to change the Magellan orbit from eccentric to nearly circular. This was accomplished by dropping periapsis to less than 150 km above the surface and using atmospheric drag to reduce the energy in the orbit. Aerobraking ended on 3 August 1993, and periapsis was boosted above the atmosphere leaving the spacecraft in an orbit that was 540 km above the surface at apoapsis and 197 km above the surface at periapsis. The orbit period was 94 minutes. The spacecraft remained on its medium-gain antenna in this orbit until Cycle 5 began officially on 16 August 1993.

During Cycles 5 and 6 the orbit was low and approximately circular. The emphasis was on collecting high-resolution gravity data. Two bistatic surface scattering experiments were conducted, one on 6 October (orbits 9331, 9335, and 9336) and the second on 9 November (orbits 9846-9848).

Mission Phases

Mission phases were defined for significant spacecraft activity periods. During orbital operations a 'cycle' was approximately the time required for Venus to rotate once under the spacecraft (about 243 days). But there were orbit adjustments and other activities that made some mapping cycles not strictly contiguous and slightly longer or shorter than the rotation period.

PRELAUNCH

The prelaunch phase extended from delivery of the spacecraft to Kennedy Space Center until the start of the launch countdown.

Spacecraft Id	: MGN
Target Name	: VENUS
Mission Phase Start Time	: 1988-09-01
Mission Phase Stop Time	: 1989-05-04
Spacecraft Operations Type	: ORBITER

```
LAUNCH
------
  The launch phase extended from the start of launch countdown
  until completion of the injection into the Earth-Venus
  trajectory.

  Spacecraft Id                 : MGN
  Target Name                   : VENUS
  Mission Phase Start Time      : 1989-05-04
  Mission Phase Stop Time       : 1989-05-04
  Spacecraft Operations Type    : ORBITER


CRUISE
------
  The cruise phase extended from injection into the Earth-Venus
  trajectory until 10 days before Venus orbit insertion.

  Spacecraft Id                 : MGN
  Target Name                   : VENUS
  Mission Phase Start Time      : 1989-05-04
  Mission Phase Stop Time       : 1990-08-01
  Spacecraft Operations Type    : ORBITER


ORBIT INSERTION
---------------
  The Venus orbit insertion phase extended from 10 days before
  Venus orbit insertion until burnout of the solid rocket
  injection motor.

  Spacecraft Id                 : MGN
  Target Name                   : VENUS
  Mission Phase Start Time      : 1990-08-01
  Mission Phase Stop Time       : 1990-08-10
  Spacecraft Operations Type    : ORBITER


ORBIT CHECKOUT
--------------
  The orbit trim and checkout phase extended from burnout of the
  solid rocket injection motor until the beginning of radar
  mapping.

  Spacecraft Id                 : MGN
  Target Name                   : VENUS
  Mission Phase Start Time      : 1990-08-10
  Mission Phase Stop Time       : 1990-09-15
  Spacecraft Operations Type    : ORBITER


MAPPING CYCLE 1
---------------
  The first mapping cycle extended from completion of the orbit
  trim and checkout phase until completion of one cycle of radar
```

mapping (approximately 243 days). Mapping orbits included in the first cycle were 373 through 2165. Orbits 2159-2171 were used for an interferometry test, and orbits 2172-2175 were used to conduct an orbit trim maneuver (OTM).

Spacecraft Id	: MGN
Target Name	: VENUS
Mission Phase Start Time	: 1990-09-15
Mission Phase Stop Time	: 1991-05-15
Spacecraft Operations Type	: ORBITER

MAPPING CYCLE 2

The second mapping cycle extended from completion of the first mapping cycle through an additional cycle of mapping. Acquisition of 'right-looking' SAR data was emphasized. Orbits included in the second cycle were 2176 through 3976. Radio occultation measurements were first carried out on orbits 3212-3214. A period of battery reconditioning followed completion of Cycle 2.

Spacecraft Id	: MGN
Target Name	: VENUS
Mission Phase Start Time	: 1991-05-16
Mission Phase Stop Time	: 1992-01-17
Spacecraft Operations Type	: ORBITER

MAPPING CYCLE 3

The third mapping cycle extended from completion of battery reconditioning through an additional cycle of mapping (approximately 243 days). Acquisition of 'stereo' SAR data was emphasized. Orbits included in the third cycle were 4031 through 5747.

Spacecraft Id	: MGN
Target Name	: VENUS
Mission Phase Start Time	: 1992-01-24
Mission Phase Stop Time	: 1992-09-14
Spacecraft Operations Type	: ORBITER

MAPPING CYCLE 4

The fourth mapping cycle extended from completion of the third mapping cycle through an additional cycle of mapping. Acquisition of radio tracking data for gravity studies was emphasized. Radio occultation measurements were carried out on orbits 6369, 6370, 6471, and 6472. Because of poor observing geometry for gravity data collection at the beginning of the cycle, this cycle was extended 10 days beyond the nominal 243 days. Orbits included within the fourth cycle were 5748 through 7626. Periapsis was lowered on orbit 5752

to improve sensitivity to gravity features in Cycle 4.

Spacecraft Id : MGN
Target Name : VENUS
Mission Phase Start Time : 1992-09-14
Mission Phase Stop Time : 1993-05-25
Spacecraft Operations Type : ORBITER

AEROBRAKING

The aerobraking phase extended from completion of the fourth mapping cycle through achievement of a near-circular orbit. Circularization was achieved more quickly than expected; the first gravity data collection in the circular orbit was not scheduled until 11 days later. Orbits included within the aerobraking phase were 7627 through 8392.

Spacecraft Id : MGN
Target Name : VENUS
Mission Phase Start Time : 1993-05-26
Mission Phase Stop Time : 1993-08-05
Spacecraft Operations Type : ORBITER

MAPPING CYCLE 5

The fifth mapping cycle extended from completion of the aerobraking phase through an additional cycle of mapping (approximately 243 days). Acquisition of radio tracking data for gravity studies was emphasized. The first orbit in the fifth cycle was orbit 8393, and the last was orbit 12248.

Spacecraft Id : MGN
Target Name : VENUS
Mission Phase Start Time : 1993-08-16
Mission Phase Stop Time : 1994-04-15
Spacecraft Operations Type : ORBITER

MAPPING CYCLE 6

The sixth mapping cycle extended from completion of the fifth mapping cycle through an additional cycle of mapping (approximately 180 days). Acquisition of radio tracking data for gravity studies was emphasized. The first orbit in the sixth cycle was orbit 12249, and the last was orbit 15032. The sixth cycle ended when radio contact was lost as the spacecraft entered the atmosphere and was destroyed in a 'terminal windmill' experiment.

Spacecraft Id : MGN
Target Name : VENUS
Mission Phase Start Time : 1994-04-16
Mission Phase Stop Time : 1994-10-12

```
      Spacecraft Operations Type     : ORBITER "

MISSION_OBJECTIVES_SUMMARY      = "

  Volcanic and Tectonic Processes
  ===============================
    Magellan images of the Venus surface show widespread evidence
    for volcanic activity.  A major goal of the Magellan mission was
    to provide a detailed global characterization of volcanic
    landforms on Venus and an understanding of the mechanics of
    volcanism in the Venus context.  Of particular interest was the
    role of volcanism in transporting heat through the lithosphere.
    While this goal will largely be accomplished by a careful
    analysis of images of volcanic features and of the geological
    relationships of these features to tectonic and impact
    structures, an essential aspect of characterization will be an
    integration of image data with altimetry and other measurements
    of surface properties.

    Explosive pyroclastic volcanism should not occur in the present
    Venus environment, unless the magma contains amounts of
    volatiles that are large by terrestrial experience.  Thus,
    evidence for extensive pyroclastic deposits would imply the
    presence of large amounts of volatiles or, if the deposits are
    old, may suggest historic changes in atmospheric density.  Such
    ideas can be tested using SAR and altimetry data, combined with
    knowledge of the local geopotential field and may shed light on
    magma dynamics.  Measurements of longitudinal and transverse
    slope, flow margin relief, and flow surface relief also provide
    powerful constraints on flow models, as well as on the
    rheological properties and physical state of the lava.

    A parallel goal was the global characterization of tectonic
    features on Venus and an appreciation of the tectonic evolution
    of the planet.  This goal addressed issues on several scales.
    On the scale of individual tectonic features is the mechanical
    nature of the faulting process, the documentation of geometry
    and sense of fault slip, and the relationship between mechanical
    and thermal properties of the lithosphere.  On a somewhat
    broader scale is linking groups of features to specific
    processes (e.g., uplift, orogeny, gravity sliding, flexure,
    compression or extension of the lithosphere) and testing
    quantitative models for these processes with SAR images and
    supporting topographic, gravitational, and surface compositional
    data.  On a global scale is the question of whether spatially
    coherent, large-scale patterns in tectonic behavior are
    discernible, patterns that might be related to an organized
    system of plates or to mantle convective flow

    For more information on volcanic and tectonic investigations see
    papers by [HEADETAL1992] and [SOLOMONETAL1992], respectively.


  Impact Processes
```

==========

The final physical form of an impact crater has meaning only when the effects of the cratering event and any subsequent modification of the crater can be distinguished. To this end, a careful search of the SAR images can identify and characterize both relatively pristine and degraded impact craters, together with their ejecta deposits (in each size range) as well as distinguishing impact craters from those of volcanic origin. The topographic measures of depth-to-diameter ratio, ejecta thickness distribution as a function of distance from the crater, and the relief of central peaks contribute to this documentation.

It is expected that several time-dependent processes influence the change in appearance of craters with increasing crater age, including continued bombardment of the surface, variations in the mechanical properties of the lithosphere (as a result of cooling or loss of near-surface volatiles), horizontal deformation of the lithosphere, possible variations in the mass of the atmosphere, volcanism, and finally, surface erosion and deposition. Distinguishing and understanding these processes constitute important components of the study of crater morphology.

Beyond their intrinsic interest in providing a record of impact and deformational processes, craters provide a tool for the relative dating of surface geological units. Relative ages can be established from a comparison of the variations in the areal density of craters of a given size as well as from a comparison of the maximum extent to which different craters are degraded. Together with superpositional relationships (a lava flow that covers an older fault) and transectional relationships (a graben that cuts through an older volcano), the relative temporal evolution of large areas of the Venus surface can be reconstructed.

For more information on investigations of impact processes see [SCHABERETAL1992].

Erosional, Depositional, and Chemical Processes

The nature of erosional and depositional processes on Venus is poorly known, primarily because the diagnostic landforms typically occur at a scale too small to have been resolved in Earth-based or Venera 15/16 radar images. Magellan images show wind eroded terrains, landforms produced by deposition (dune fields), possible landslides and other down slope movements, as well as aeolian features such as radar bright or dark streaks 'downwind' from prominent topographic anomalies. One measure of weathering, erosion, and deposition is provided by the extent to which soil covers the surface (for Venus, the term soil is used for porous material, as implied by its relatively low value of bulk dielectric constant). The existence of such material, and its dependence on elevation and geologic setting, provide

important insights into the interactions that have taken place between the atmosphere and the lithosphere.

Because of the inference drawn from the deuterium-to-hydrogen ratio of the present atmosphere for the past existence of substantial amounts of water on Venus, radar images continue to be searched for evidence of past episodes of fluvial activity (drainage systems) and for lake beds and coastal signatures (strandlines).

The existence of a thick and cloudy atmosphere precludes infrared, visual, ultraviolet, x-ray, or gamma-ray observation of the Venus surface from orbit. Thus it is impossible to obtain information on a global basis about the surface composition or mineralogy using remote-sensing techniques at these wavelengths. Pioneer Venus and Magellan have disclosed that very often the surfaces of elevated regions possess both anomalously high values of normal-incidence radar reflectivity, occasionally exceeding 0.43, and associated low values of radio emissivity, reaching as low as 0.50. In the absence of liquid water, which is known from a variety of evidence not to be present today on Venus, it is necessary to assume a surface composition that would be unusual in terrestrial experience to explain values of dielectric constant implied by these observations. The most acceptable of the current hypotheses requires a significant number of electrically conducting elements in surface materials. If these are iron sulfides, as some chemical evidence suggests, they may possibly be brought to the surface by volcanic activity. The good spatial resolution of the Magellan instrumentation, both in determining the surface reflectivity from the altimetric observations and in measuring the emissivity from radiometric observations, promises to outline the structure of these regions and may shed light on their origin. Results will be applied to testing hypotheses for regional and global buffering of atmospheric composition by reactions with crustal materials.

For more information on erosional, depositional, and chemical processes see papers by [ARVIDSONETAL1992], [GREELEYETAL1992], and [GREELEYETAL1994].

Isostatic and Convective Processes

Topography and gravity are intimately and inextricably related, and must be jointly examined when undertaking geophysical investigations of the interior of a planet, where isostatic and convective processes dominate. Topography provides a surface boundary condition for modeling the interior density of Venus.

Modeling of the interior density using gravity data is, of course, nonunique. Meaningful interpretation rests on integrating other data sets and/or incorporating specific mechanical models of the interior. For example, a single density interface underlying the known topography can be found

```
     that exactly matches any observed gravity field.  The interface
     can be at any depth; the greater the depth, the larger the
     density contrast needed.

     The thickness of the elastic lithosphere of Venus, i.e., the
     outer region of the planet that behaves elastically over
     geologically long periods of time, is of special interest.  The
     base of this zone is likely to be defined by a specific isotherm
     whose location depends on the particular temperature-dependent
     flow or creep properties of the material underneath.  If this
     isotherm can be mapped in space and time, then models for the
     thermal evolution of the planet can be developed.

     The key to determining lithospheric thickness variations in
     space and time is through flexure studies.  If a mass load,
     e.g., a shield volcano or a mascon, is placed on the planetary
     surface, then the elastic lithosphere will flex under the load.
     The controlling parameter is the flexural rigidity, which is
     dependent on the elastic constants and lithospheric thickness.

     Crucial to applying estimates of flexural rigidity to the task
     of unraveling the thermal history is an estimate of when the
     load was emplaced.  Thus age determinations derived by various
     geologic techniques are essential to this scheme.

     For more information on topography and gravity see papers by
     [FORD&PETTENGILL1992], [ICARUSMGN1994], [KONOPLIVETAL1993],
     and [MCNAMEEETAL1993].  "

END_OBJECT                      = MISSION_INFORMATION

OBJECT                          = MISSION_HOST
 INSTRUMENT_HOST_ID             = "MGN"

 OBJECT                         = MISSION_TARGET
 TARGET_NAME                    = "VENUS"
 END_OBJECT                     = MISSION_TARGET
END_OBJECT                      = MISSION_HOST

OBJECT                          = MISSION_REFERENCE_INFORMATION
 REFERENCE_KEY_ID               = "ARVIDSON1991"
END_OBJECT                      = MISSION_REFERENCE_INFORMATION

OBJECT                          = MISSION_REFERENCE_INFORMATION
 REFERENCE_KEY_ID               = "ARVIDSONETAL1992"
END_OBJECT                      = MISSION_REFERENCE_INFORMATION

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 REFERENCE_KEY_ID               = "CAMPBELLETAL1992"
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 REFERENCE_KEY_ID               = "CAMPBELLETAL1992B"
END_OBJECT                      = MISSION_REFERENCE_INFORMATION
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 OBJECT                         = MISSION_REFERENCE_INFORMATION
  REFERENCE_KEY_ID              = "DAVIESETAL1992"
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 OBJECT                         = MISSION_REFERENCE_INFORMATION
  REFERENCE_KEY_ID              = "FORD&PETTENGILL1992"
 END_OBJECT                     = MISSION_REFERENCE_INFORMATION

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  REFERENCE_KEY_ID              = "GREELEYETAL1992"
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 OBJECT                         = MISSION_REFERENCE_INFORMATION
  REFERENCE_KEY_ID              = "GREELEYETAL1994"
 END_OBJECT                     = MISSION_REFERENCE_INFORMATION

 OBJECT                         = MISSION_REFERENCE_INFORMATION
  REFERENCE_KEY_ID              = "HEAD1991"
 END_OBJECT                     = MISSION_REFERENCE_INFORMATION

 OBJECT                         = MISSION_REFERENCE_INFORMATION
  REFERENCE_KEY_ID              = "HEADETAL1992"
 END_OBJECT                     = MISSION_REFERENCE_INFORMATION

 OBJECT                         = MISSION_REFERENCE_INFORMATION
  REFERENCE_KEY_ID              = "ICARUSMGN1994"
 END_OBJECT                     = MISSION_REFERENCE_INFORMATION

OBJECT                          = MISSION_REFERENCE_INFORMATION
  REFERENCE_KEY_ID              = "JGRMGN1992"
 END_OBJECT                     = MISSION_REFERENCE_INFORMATION

 OBJECT                         = MISSION_REFERENCE_INFORMATION
  REFERENCE_KEY_ID              = "JOHNSON1990"
 END_OBJECT                     = MISSION_REFERENCE_INFORMATION

 OBJECT                         = MISSION_REFERENCE_INFORMATION
  REFERENCE_KEY_ID              = "KONOPLIVETAL1993"
 END_OBJECT                     = MISSION_REFERENCE_INFORMATION

 OBJECT                         = MISSION_REFERENCE_INFORMATION
  REFERENCE_KEY_ID              = "MCNAMEEETAL1993"
 END_OBJECT                     = MISSION_REFERENCE_INFORMATION

 OBJECT                         = MISSION_REFERENCE_INFORMATION
  REFERENCE_KEY_ID              = "PETTENGILL1988"
 END_OBJECT                     = MISSION_REFERENCE_INFORMATION

 OBJECT                         = MISSION_REFERENCE_INFORMATION
  REFERENCE_KEY_ID              = "PETTENGILL1991"
 END_OBJECT                     = MISSION_REFERENCE_INFORMATION

 OBJECT                         = MISSION_REFERENCE_INFORMATION
  REFERENCE_KEY_ID              = "PETTENGILLETAL1992"
 END_OBJECT                     = MISSION_REFERENCE_INFORMATION
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 OBJECT                         = MISSION_REFERENCE_INFORMATION
  REFERENCE_KEY_ID              = "PHILLIPS1991"
 END_OBJECT                     = MISSION_REFERENCE_INFORMATION

 OBJECT                         = MISSION_REFERENCE_INFORMATION
  REFERENCE_KEY_ID              = "PLAUT&ARVIDSON1992"
 END_OBJECT                     = MISSION_REFERENCE_INFORMATION

 OBJECT                         = MISSION_REFERENCE_INFORMATION
  REFERENCE_KEY_ID              = "SAUNDERSETAL1990"
 END_OBJECT                     = MISSION_REFERENCE_INFORMATION

 OBJECT                         = MISSION_REFERENCE_INFORMATION
  REFERENCE_KEY_ID              = "SAUNDERS1991A"
 END_OBJECT                     = MISSION_REFERENCE_INFORMATION

 OBJECT                         = MISSION_REFERENCE_INFORMATION
  REFERENCE_KEY_ID              = "SAUNDERS1991B"
 END_OBJECT                     = MISSION_REFERENCE_INFORMATION

 OBJECT                         = MISSION_REFERENCE_INFORMATION
  REFERENCE_KEY_ID              = "SAUNDERSETAL1992"
 END_OBJECT                     = MISSION_REFERENCE_INFORMATION

 OBJECT                         = MISSION_REFERENCE_INFORMATION
  REFERENCE_KEY_ID              = "SCHABERETAL1992"
 END_OBJECT                     = MISSION_REFERENCE_INFORMATION

 OBJECT                         = MISSION_REFERENCE_INFORMATION
  REFERENCE_KEY_ID              = "SOLOMON1991A"
 END_OBJECT                     = MISSION_REFERENCE_INFORMATION

 OBJECT                         = MISSION_REFERENCE_INFORMATION
  REFERENCE_KEY_ID              = "SOLOMON1991B"
 END_OBJECT                     = MISSION_REFERENCE_INFORMATION

 OBJECT                         = MISSION_REFERENCE_INFORMATION
  REFERENCE_KEY_ID              = "SOLOMONETAL1992"
 END_OBJECT                     = MISSION_REFERENCE_INFORMATION

 OBJECT                         = MISSION_REFERENCE_INFORMATION
  REFERENCE_KEY_ID              = "TYLER1991"
 END_OBJECT                     = MISSION_REFERENCE_INFORMATION

 OBJECT                         = MISSION_REFERENCE_INFORMATION
  REFERENCE_KEY_ID              = "TYLER1992"
 END_OBJECT                     = MISSION_REFERENCE_INFORMATION

 OBJECT                         = MISSION_REFERENCE_INFORMATION
  REFERENCE_KEY_ID              = "VRMPP1983"
 END_OBJECT                     = MISSION_REFERENCE_INFORMATION

END_OBJECT                      = MISSION
END
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C.12. PERSONEL.CAT Example

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CCSD3ZF0000100000001NJPL3IF0PDSX00000001

PDS_VERSION_ID                    = PDS3

RECORD_TYPE                       = FIXED_LENGTH
RECORD_BYTES                      = 80
OBJECT                            = PERSONNEL
 PDS_USER_ID                      = PFORD

 OBJECT                           = PERSONNEL_INFORMATION
  FULL_NAME                       = "PETER G. FORD"
  LAST_NAME                       = FORD
  TELEPHONE_NUMBER                = "6172536485"
  ALTERNATE_TELEPHONE_NUMBER      = "6172534287"
  FAX_NUMBER                      = "6172530861"
  INSTITUTION_NAME                = "MASSACHUSETTS INSTITUTE OF TECHNOLOGY"
  NODE_ID                         = "GEOSCIENCE"
  PDS_AFFILIATION                 = "NODE OPERATIONS MANAGER"
  REGISTRATION_DATE               = 1990-02-06
  ADDRESS_TEXT                    = "Massachusetts Institute of Technology
                                     Center for Space Research
                                     Building 37, Room 601
                                     Cambridge, MA  02139-4307"
 END_OBJECT                       = PERSONNEL_INFORMATION

 OBJECT                           = PERSONNEL_ELECTRONIC_MAIL
  ELECTRONIC_MAIL_ID              = "pgf@space.mit.edu"
  ELECTRONIC_MAIL_TYPE            = "INTERNET"
  PREFERENCE_ID                   = 1
 END_OBJECT                       = PERSONNEL_ELECTRONIC_MAIL

 OBJECT                           = PERSONNEL_ELECTRONIC_MAIL
  ELECTRONIC_MAIL_ID              = "JPLPDS::PFORD"
  ELECTRONIC_MAIL_TYPE            = "NSI/DECNET"
  PREFERENCE_ID                   = 2
 END_OBJECT                       = PERSONNEL_ELECTRONIC_MAIL

END_OBJECT                        = PERSONNEL

OBJECT                            = PERSONNEL
 PDS_USER_ID                      = MMAURER

 OBJECT                           = PERSONNEL_INFORMATION
  FULL_NAME                       = "MICHAEL J. MAURER"
  LAST_NAME                       = MAURER
  TELEPHONE_NUMBER                = "4157231024"
  ALTERNATE_TELEPHONE_NUMBER      = "N/A"
  FAX_NUMBER                      = "4157239251"
  INSTITUTION_NAME                = "STANFORD UNIVERSITY"
  NODE_ID                         = "N/A"
  PDS_AFFILIATION                 = "N/A"
  REGISTRATION_DATE               = 1994-01-18
  ADDRESS_TEXT                    = "Stanford University
                                     Center for Radar Astronomy
```

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                                   Durand Bldg, Room 232
                                   Stanford, CA  94305-4055"
 END_OBJECT                      = PERSONNEL_INFORMATION

 OBJECT                          = PERSONNEL_ELECTRONIC_MAIL
  ELECTRONIC_MAIL_ID             = "maurer@nova.stanford.edu"
  ELECTRONIC_MAIL_TYPE           = "INTERNET"
  PREFERENCE_ID                  = 1
 END_OBJECT                      = PERSONNEL_ELECTRONIC_MAIL

END_OBJECT                       = PERSONNEL

OBJECT                           = PERSONNEL
 PDS_USER_ID                     = GPETTENGILL

 OBJECT                          = PERSONNEL_INFORMATION
  FULL_NAME                      = "GORDON H. PETTENGILL"
  LAST_NAME                      = PETTENGILL
  TELEPHONE_NUMBER               = "6172534281"
  ALTERNATE_TELEPHONE_NUMBER     = "N/A"
  FAX_NUMBER                     = "6172530861"
  INSTITUTION_NAME               = "MASSACHUSETTS INSTITUTE OF TECHNOLOGY"
  NODE_ID                        = "GEOSCIENCE"
  PDS_AFFILIATION                = "N/A"
  REGISTRATION_DATE              = 1991-02-27
  ADDRESS_TEXT                   = "Massachusetts Institute of Technology
                                   Center for Space Research
                                   Building 37, Room 641
                                   Cambridge, MA  02139-4307"
 END_OBJECT                      = PERSONNEL_INFORMATION

 OBJECT                          = PERSONNEL_ELECTRONIC_MAIL
  ELECTRONIC_MAIL_ID             = "ghp@space.mit.edu"
  ELECTRONIC_MAIL_TYPE           = "INTERNET"
  PREFERENCE_ID                  = 1
 END_OBJECT                      = PERSONNEL_ELECTRONIC_MAIL

END_OBJECT                       = PERSONNEL

OBJECT                           = PERSONNEL
 PDS_USER_ID                     = RSIMPSON

 OBJECT                          = PERSONNEL_INFORMATION
  FULL_NAME                      = "RICHARD A. SIMPSON"
  LAST_NAME                      = SIMPSON
  TELEPHONE_NUMBER               = "4157233525"
  ALTERNATE_TELEPHONE_NUMBER     = "N/A"
  FAX_NUMBER                     = "4157239251"
  INSTITUTION_NAME               = "STANFORD UNIVERSITY"
  NODE_ID                        = "N/A"
  PDS_AFFILIATION                = "N/A"
  REGISTRATION_DATE              = 1994-01-21
  ADDRESS_TEXT                   = "Stanford University
                                   Center for Radar Astronomy
                                   Durand Bldg, Room 232
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                                   Stanford, CA  94305-4055"
 END_OBJECT                      = PERSONNEL_INFORMATION

 OBJECT                          = PERSONNEL_ELECTRONIC_MAIL
  ELECTRONIC_MAIL_ID             = "rsimpson@magellan.stanford.edu"
  ELECTRONIC_MAIL_TYPE           = "INTERNET"
  PREFERENCE_ID                  = 1
 END_OBJECT                      = PERSONNEL_ELECTRONIC_MAIL

 OBJECT                          = PERSONNEL_ELECTRONIC_MAIL
  ELECTRONIC_MAIL_ID             = "rsimpson@nova.stanford.edu"
  ELECTRONIC_MAIL_TYPE           = "INTERNET"
  PREFERENCE_ID                  = 2
 END_OBJECT                      = PERSONNEL_ELECTRONIC_MAIL

END_OBJECT                       = PERSONNEL

OBJECT                           = PERSONNEL
 PDS_USER_ID                     = LTYLER

 OBJECT                          = PERSONNEL_INFORMATION
  FULL_NAME                      = "G. LEONARD TYLER"
  LAST_NAME                      = TYLER
  TELEPHONE_NUMBER               = "4157233535"
  ALTERNATE_TELEPHONE_NUMBER     = "N/A"
  FAX_NUMBER                     = "4157239251"
  INSTITUTION_NAME               = "STANFORD UNIVERSITY"
  NODE_ID                        = "RINGS"
  PDS_AFFILIATION                = "NODE ADVISOR"
  REGISTRATION_DATE              = 1990-02-09
  ADDRESS_TEXT                   = "Stanford University
                                   Center for Radar Astronomy
                                   Durand Bldg, Room 213
                                   Stanford, CA  94305-4055"
 END_OBJECT                      = PERSONNEL_INFORMATION

 OBJECT                          = PERSONNEL_ELECTRONIC_MAIL
  ELECTRONIC_MAIL_ID             = "len@nova.stanford.edu"
  ELECTRONIC_MAIL_TYPE           = "INTERNET"
  PREFERENCE_ID                  = 1
 END_OBJECT                      = PERSONNEL_ELECTRONIC_MAIL

END_OBJECT                       = PERSONNEL

END
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C.13. REFS.CAT Example

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PDS_VERSION_ID                   = PDS3

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RECORD_BYTES                     = 80
OBJECT                           = REFERENCE
 REFERENCE_KEY_ID                = "ARVIDSON1991"
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 REFERENCE_DESC                = "Arvidson, R. E., V.R. Baker,
C. Elachi, R.S. Saunders, J.A. Wood, Magellan: Initial Analysis
of Venus Surface Modification, Science, V. 252, pp. 270 - 275,
1991"
END_OBJECT                     = REFERENCE

OBJECT                         = REFERENCE
 REFERENCE_KEY_ID              = "ARVIDSONETAL1992"
 REFERENCE_DESC                = "Arvidson, R. E., R. Greeley,
M.C. Malin, R.S. Saunders, N. Izenberg, J.J. Plaut, E.R.
Stofan, and M.K. Shepard, Surface Modification of Venus as
Inferred from Magellan Observations of Plains, Journal of
Geophysical Research, 97, 13303-13317, 1992"
END_OBJECT                     = REFERENCE

OBJECT                         = REFERENCE
 REFERENCE_KEY_ID              = "BARRY1987"
 REFERENCE_DESC                = "Barry, S., Magellan Mission
Operations System: Radar System Interface Requirements, Hughes
Aircraft Co. Report HS513-823-3, May 1987"
END_OBJECT                     = REFERENCE

OBJECT                         = REFERENCE
 REFERENCE_KEY_ID              = "BRILL&MEISL1990"
 REFERENCE_DESC                = "Brill, R., C. and Meisl,
Magellan Altimeter Processing: Algorithms and Constants, Jet
Propulsion Laboratory Document D-6143, 15 February 1990"
END_OBJECT                     = REFERENCE

OBJECT                         = REFERENCE
 REFERENCE_KEY_ID              = "CAMPBELLETAL1992"
 REFERENCE_DESC                = "Campbell, D. B., N.J.S.
Stacy, W.I. Newman, R.E. Arvidson, E.M. Jones, G.S. Musser,
A.Y. Roper, and C. Schaller, Magellan Observations of Extended
Impact Crater Related Features on the Surface of Venus, Journal
of Geophysical Research, 97, 16249-16277, 1992"
END_OBJECT                     = REFERENCE

OBJECT                         = REFERENCE
 REFERENCE_KEY_ID              = "CAMPBELLETAL1992B"
 REFERENCE_DESC                = "Campbell, B. A., and D.B.
Campbell, Analysis of Volcanic Surface Morphology on Venus from
Comparison of Arecibo, Magellan, and Terrestrial Airborne Radar
Data, Journal of Geophysical Research, 97, 16293-16314, 1992"
END_OBJECT                     = REFERENCE

OBJECT                         = REFERENCE
 REFERENCE_KEY_ID              = "CUEVAS1989"
 REFERENCE_DESC                = "Cuevas, C., Magellan Radar
Sensor Compensation Report, Hughes Aircraft Co. Report HS513-
5029, 18 August 1989"
END_OBJECT                     = REFERENCE

OBJECT                         = REFERENCE
 REFERENCE_KEY_ID              = "DAVIESETAL1992"
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 REFERENCE_DESC                = "Davies, M.E., T.R. Colvin,
P.G. Rogers, P.W. Chodas, W.L. Sjogren, E.L. Akim, V.A.
Stepanyantz, Z.P. Vlasova, and A.I. Zakharov, The Rotation
Period, Direction of the North Pole, and Geodetic Control
Network of Venus, Journal of Geophysical Research, 97, 13141-
13151, 1992."
END_OBJECT                     = REFERENCE

OBJECT                         = REFERENCE
 REFERENCE_KEY_ID              = "FORD&PETTENGILL1992"
 REFERENCE_DESC                = "Ford, P. G., and G.H.
Pettengill, Venus Topography and Kilometer-Scale Slopes,
Journal of Geophysical Research, 97, 13103-13114, 1992"
END_OBJECT                     = REFERENCE

OBJECT                         = REFERENCE
 REFERENCE_KEY_ID              = "GREELEYETAL1992"
 REFERENCE_DESC                = "Greeley, R., R.E. Arvidson,
C. Elachi, M.A. Geringer, J.J. Plaut, R.S. Saunders, G.
Schubert, E.R. Stofan, E.J.P. Thouvenot, S.D. Wall, C.M. and
Weitz, Aeolian Features on Venus: Preliminary Magellan Results,
Journal of Geophysical Research, 97, 13319-13345, 1992"
END_OBJECT                     = REFERENCE

OBJECT                         = REFERENCE
 REFERENCE_KEY_ID              = "GREELEYETAL1994"
 REFERENCE_DESC                = "Greeley, R., G. Schubert
D. Limonadi, K.C. Bender, W.I. Newman, P.E. Thomas, C.M. Weitz,
and S.D. Wall, Wind Streaks on Venus: Clues to Atmospheric
Circulation, Science, 263, 358-361, 1994"
END_OBJECT                     = REFERENCE

OBJECT                         = REFERENCE
 REFERENCE_KEY_ID              = "HEAD1991"
 REFERENCE_DESC                = "Head, J. W., D.B. Campbell,
C. Elachi, J.E. Guest, D.P. McKenzie, R.S. Saunders, G.G.
Schaber, G. Schubert, Venus Volcanism: Initial Analysis from
Magellan Data, Science, V. 252, pp. 276 - 288, 1991"
END_OBJECT                     = REFERENCE

OBJECT                         = REFERENCE
 REFERENCE_KEY_ID              = "HEADETAL1992"
 REFERENCE_DESC                = "Head, J.W., L.S. Crumpler,
J.C. Aubele, J.E. Guest, and R.S Saunders, Venus Volcanism:
Classification of Volcanic Features and Structures,
Associations, and Global Distribution from Magellan Data,
Journal of Geophysical Research, 97, 13153-13197, 1992."
END_OBJECT                     = REFERENCE

OBJECT                         = REFERENCE
 REFERENCE_KEY_ID              = "JGRMGN1992"
 REFERENCE_DESC                = "Magellan at Venus special
issues, Journal of Geophysical Research, 97, Nos. E8 and E10,
13063-13689 and 15921-16382, 1992."
END_OBJECT                     = REFERENCE
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OBJECT                          = REFERENCE
 REFERENCE_KEY_ID               = "JOHNSON1990"
 REFERENCE_DESC                 = "W.T.K. Johnson, Magellan
Imaging Radar to unveil Venus, Microwave System News, vol. 20,
no. 3, pp. 25-31, 1990."
END_OBJECT                      = REFERENCE

OBJECT                          = REFERENCE
 REFERENCE_KEY_ID               = "KONOPLIVETAL1993"
 REFERENCE_DESC                 = "Konopliv, A.S., N.J.
Borderies, P.W. Chodas, E.J. Christensen, W.L. Sjogren, and B.G.
Williams, Venus Gravity and Topography: 60th Degree and Order
Model, Geophysical Research Letters, 20, 2403-2406, 1993."
END_OBJECT                      = REFERENCE

OBJECT                          = REFERENCE
 REFERENCE_KEY_ID               = "LYONS1988"
 REFERENCE_DESC                 = "Lyons, D.T., Magellan
Planetary Constants and Models, JPL D-2300, Jet Propulsion
Laboratory, Pasadena, Calif., 1988."
END_OBJECT                      = REFERENCE

OBJECT                          = REFERENCE
 REFERENCE_KEY_ID               = "MCNAMEEETAL1993"
 REFERENCE_DESC                 = "McNamee, J.B., N.J.
Borderies, and W.L. Sjogren, Venus: Global Gravity and
Topography, Journal of Geophysical Research, 98, 9113-9128,
1993."
END_OBJECT                      = REFERENCE

OBJECT                          = REFERENCE
 REFERENCE_KEY_ID               = "PDSSR1992"
 REFERENCE_DESC                 = "Planetary Data System
Standards Reference, Jet Propulsion Laboratory Document D-7669,
Part 2, 20 November 1992"
END_OBJECT                      = REFERENCE

OBJECT                          = REFERENCE
 REFERENCE_KEY_ID               = "PETTENGILL1988"
 REFERENCE_DESC                 = "Pettengill, G. H., Magellan
Venus Radar Mapper Science Experiment Plan of the Radar
Investigation Group (RADIG), MIT/ JPL, 1988."
END_OBJECT                      = REFERENCE

OBJECT                          = REFERENCE
 REFERENCE_KEY_ID               = "PETTENGILL1991"
 REFERENCE_DESC                 = "Pettengill, G. H., P.G.
Ford, W.T.K. Johnson, R.K. Raney, L.A. Soderblom, Magellan:
Radar Performance and Data Products, Science, V. 252, pp. 260 -
265, 1991"
END_OBJECT                      = REFERENCE

OBJECT                          = REFERENCE
 REFERENCE_KEY_ID               = "PETTENGILLETAL1992"
 REFERENCE_DESC                 = "Pettengill, G. H., P.G.
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Ford, and R.J. Wilt, Venus Surface Radiothermal Emission as
Observed by Magellan, Journal of Geophysical Research, 13091-
13102, 1992."
END_OBJECT                      = REFERENCE

OBJECT                          = REFERENCE
 REFERENCE_KEY_ID               = "PHILLIPS1991"
 REFERENCE_DESC                 = "Phillips, R. J., R.E.
Arvidson, J.M. Boyce, D.B. Campbell, J.E. Guest, G.G. Schaber,
L.A. Soderblom, Impact craters on Venus: Initial Analysis from
Magellan, Science, V. 252, pp. 288 - 297, 1991"
END_OBJECT                      = REFERENCE

OBJECT                          = REFERENCE
 REFERENCE_KEY_ID               = "PLAUT&ARVIDSON1992"
 REFERENCE_DESC                 = "Plaut, J. J., and R.E.
Arvidson,  Comparison of Goldstone and Magellan Radar Data in
the Equatorial Plains of Venus, Journal of Geophysical
Research, 97, 16279-16291, 1992"
END_OBJECT                      = REFERENCE

OBJECT                          = REFERENCE
 REFERENCE_KEY_ID               = "SAUNDERSETAL1990"
 REFERENCE_DESC                 = "Saunders, R.S., G.H.
Pettengill, R.E. Arvidson, W.L. Sjogren, W.T.K. Johnson, L.
Pieri, The Magellan Venus Radar Mapping Mission, Journal of
Geophysical Research, 95, 8339-8355, 1990."
END_OBJECT                      = REFERENCE

OBJECT                          = REFERENCE
 REFERENCE_KEY_ID               = "SAUNDERS1991A"
 REFERENCE_DESC                 = "Saunders, R. S., R.E.
Arvidson, J.W. Head III, G.G. Schaber, E.R. Stofan, and S.C.
Solomon, An Overview of Venus Geology, Science, V. 252, pp. 249
- 252, 1991"
END_OBJECT                      = REFERENCE

OBJECT                          = REFERENCE
 REFERENCE_KEY_ID               = "SAUNDERS1991B"
 REFERENCE_DESC                 = "Saunders, R. S., G.H.
Pettengill, Magellan: Mission Summary, Science, V. 252, pp. 247
- 249, 1991"
END_OBJECT                      = REFERENCE

OBJECT                          = REFERENCE
 REFERENCE_KEY_ID               = "SAUNDERSETAL1992"
 REFERENCE_DESC                 = "Saunders, R. S., A.J. Spear,
P.C. Allin, R.S. Austin, A.L. Berman, R.C. Chandlee, J. Clark,
A.V. deCharon, E.M. DeJong, D.G. Griffith, J.M. Gunn, S.
Hensley, W.T.K. Johnson, C.E. Kirby, K.S. Leung, D.T. Lyons,
G.A. Michaels, J. Miller, R.B. Morris, A.D. Morrison, R.G.
Piereson, J.F. Scott, S.J. Shaffer, J.P. Slonski, E.R. Stofan,
T.W. Thompson, and S.D. Wall, Magellan Mission Summary, Journal
of Geophysical Research, 97, 13067-13090, 1992."
END_OBJECT                      = REFERENCE
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OBJECT                         = REFERENCE
 REFERENCE_KEY_ID              = "SCHABERETAL1992"
 REFERENCE_DESC                = "Schaber, G.G., R.G. Strom,
H.J. Moore, L.A. Soderblom, R.L. Kirk, D.J. Chadwick, D.D.
Dawson, L.R. Gaddis, J.M. Boyce, and J. Russell, Geology and
Distribution of Impact Craters on Venus: What Are They Telling
Us?  Journal of Geophysical Research, 97, 13257-13301, 1992."
END_OBJECT                     = REFERENCE

OBJECT                         = REFERENCE
 REFERENCE_KEY_ID              = "SCIEDR"
 REFERENCE_DESC                = "Project Magellan Software
Interface Specification: Magellan Science EDR (TPS-101), 30
January 1991"
END_OBJECT                     = REFERENCE

OBJECT                         = REFERENCE
 REFERENCE_KEY_ID              = "SDPS101"
 REFERENCE_DESC                = "Project Magellan Software
Interface Specification: Full-Resolution Basic Image Data
Record, Revision E, 31 August 1992"
END_OBJECT                     = REFERENCE

OBJECT                         = REFERENCE
 REFERENCE_KEY_ID              = "SE011"
 REFERENCE_DESC                = "Magellan Project Radar
System: Analysis Methods and Performance Estimates, Hughes
Aircraft Co. Report HS513-062-49, July 1989"
END_OBJECT                     = REFERENCE

OBJECT                         = REFERENCE
 REFERENCE_KEY_ID              = "SOLOMON1991A"
 REFERENCE_DESC                = "Solomon, S. C., J.W. Head,
W.M. Kaula, D. McKenzie, B. Parsons, R.J. Phillips, G.
Schubert, and M. Talwani, Venus Tectonics: Initial Analysis
from Magellan, Science, V. 252, pp. 297 - 312, 1991"
END_OBJECT                     = REFERENCE

OBJECT                         = REFERENCE
 REFERENCE_KEY_ID              = "SOLOMON1991B"
 REFERENCE_DESC                = "Solomon, S. C., J.W. Head,
Fundamental Issues in the Geology of Venus, Science, V. 252,
pp. 252 - 260, 1991"
END_OBJECT                     = REFERENCE

OBJECT                         = REFERENCE
 REFERENCE_KEY_ID              = "SOLOMONETAL1992"
 REFERENCE_DESC                = "Solomon, S.C., S.E. Smrekar,
D.L. Bindschadler, R.E. Grimm, W.M. Kaula, G.E. McGill, R.J.
Phillips, R.S. Saunders, G. Schubert, S.W. Squyres, and E.R.
Stofan, Venus Tectonics: An Overview of Magellan Observations,
Journal of Geophysical Research, 97, 13199-13255, 1992, and
Journal of Geophysical Research, 97, 16381, 1992."
END_OBJECT                     = REFERENCE
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OBJECT                          = REFERENCE
 REFERENCE_KEY_ID               = "TYLER1991"
 REFERENCE_DESC                 = "Tyler, G. L., P.G. Ford,
D.B. Campbell, C. Elachi, G.H. Pettengill, R.A. Simpson,
Magellan: Electrical and Physical Properties of Venus' Surface,
Science, V. 252, pp. 265 - 270, 1991"
END_OBJECT                      = REFERENCE

OBJECT                          = REFERENCE
 REFERENCE_KEY_ID               = "TYLER1992"
 REFERENCE_DESC                 = "Tyler, G. L., R.A. Simpson,
M.J. Maurer, and E. Holmann, Scattering Properties of the
Venusian Surface: Preliminary Results from Magellan, Journal of
Geophysical Research, 97, 13115-13139, 1992"
END_OBJECT                      = REFERENCE

OBJECT                          = REFERENCE
 REFERENCE_KEY_ID               = "VRMPP1983"
 REFERENCE_DESC                 = "Venus Radar Mapper Project
Plan, Document 630-1, JPL D-814, 157 pp., Jet Propulsion
Laboratory, Pasadena, Calif., 1983."
END_OBJECT                      = REFERENCE

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C.14. VOLDESC.CAT Example

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CCSD3ZF0000100000001NJPL3IF0PDSX00000001

PDS_VERSION_ID              = PDS3
RECORD_TYPE                 = FIXED_LENGTH
RECORD_BYTES                = 80
OBJECT                      = VOLUME
 VOLUME_SERIES_NAME         = "MISSION TO VENUS"
 VOLUME_SET_NAME            = "MAGELLAN SURFACE CHARACTERISTICS VECTOR
                               DATA RECORD"
 VOLUME_SET_ID              = "USA_NASA_PDS_MG_2101_TO_MG_2149"
 VOLUMES                    = 49
 VOLUME_NAME                = "SCVDR CD Volume 1"
 VOLUME_ID                  = "MG_2101"
 VOLUME_VERSION_ID          = "VERSION 1"
 PUBLICATION_DATE           = 1995-01-01
 DATA_SET_ID                = "MGN-V-RDRS-5-SCVDR-V1.0"
 VOLUME_FORMAT              = "ISO-9660"
 MEDIUM_TYPE                = "CD-WO"
 DESCRIPTION                = "This volume contains Magellan SCVDR
   (Surface Characteristics Vector Data Record) products. It also
   contains documentation files that describe the SCVDRs."
 MISSION_NAME               = "MAGELLAN"
 SPACECRAFT_NAME            = "MAGELLAN"
 SPACECRAFT_ID              = MGN
 OBJECT                     = DATA_PRODUCER
  INSTITUTION_NAME          = "STANFORD UNIVERSITY"
  FACILITY_NAME             = "CENTER FOR RADAR ASTRONOMY"
  FULL_NAME                 = "DR. G. LEONARD TYLER"
  ADDRESS_TEXT              = "STARLAB DURAND BLDG, ROOM 232
```

```
                                STANFORD, CALIFORNIA, 94305-4055, USA"
 END_OBJECT                  = DATA_PRODUCER
 OBJECT                      = CATALOG
  ^DATA_SET_CATALOG          = "DATASET.CAT"
  ^INSTRUMENT_CATALOG        = "INST.CAT"
  ^INSTRUMENT_HOST_CATALOG   = "INSTHOST.CAT"
  ^MISSION_CATALOG           = "MISSION.CAT"
  ^PERSONNEL_CATALOG         = "PERSONEL.CAT"
  ^REFERENCE_CATALOG         = "REFS.CAT"
 END_OBJECT                  = CATALOG
END_OBJECT                   = VOLUME
END
```