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1. INTRODUCTION

The FM1 MOS Calibration was carried out on 15 - 30 January 1998 at the MPE Panter X-Ray facility in Nueried (Munchen), Germany.

The data produced by the MOS instrument was archived by the EST EGSE, together with the housekeeping data of the calibration facility and other derived data.

The Raw Archive were processed by the EST Science Console in order to produce a data set written in the EGSE Reduced Data Format to be analysed by the EPIC Data Analysis Team (CDAT).

This lead to populate an Erdf (Epic Reduced Data Files) Archive containing a set of HK and Science data files for each *exposure* (i.e. for each period among two consecutive idle status of the instrument) and a set of HK data files for each *idle* period.

Each exposure was identified by a *Run ID* number and the related files have been archived in the Erdf/Science/ and Erdf/HK subdirectories, grouped by decade of runs.

A summary of the data taking is given in Annex 2.

1.1. Purpose and scope

The aim of the present document is to describe the test configuration set up and the content of the Erdf DAT Tapes containing all the Erdf data produced during the campaign.

The Erdf DAT tapes content list is given in Annex 1.

1.2. Reference documents

[1] L. Chiappetti, Basic requirements for processing of EPIC science telemetry, EPIC-EST-SP-005, Issue 1

[2] EMCS Electrical I/F Specification, EPIC-EST-SP-001, Issue 3, August 1996

[3] Format of the EPIC GSE Reduced Data Files, EPIC-EST-SP-004, Issue 1.4, February 1997

[4] Format of the Panter HK files in the EGSE Reduced Data (ERDF) Archive, EPIC-EST-SP-012, Issue 1.0, 27 February 1998

1.3. Change Record

[1] First issue accompaining the "*Panter FM1 MOS* " Erdf DAT Tapes, Version 1.

1.4. Definition, acronyms and abbreviations

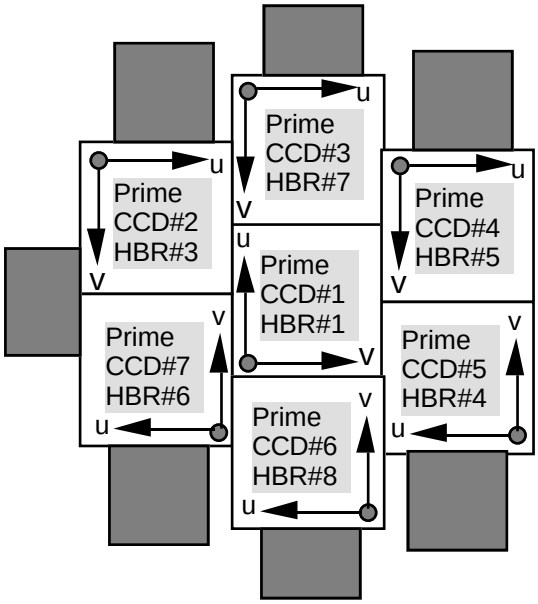
AIV	Assembly, Integration and Verification
APID	Application Process Identifier
CAL-COE	Calibration Check-Out Equipment
CCOE	Central Check-Out Equipment
CDAT	Calibration and Data Team
EMCS	Epic Mos Camera System
EPCS	Epic Pn Camera System

EPIC	European Photon Imaging Camera
ERDF	EGSE Reduced Data Files
ERMS	Epic Radiation Monitor System
ESA/CCS	European Space Agency Central Check-out System
ETE-COE	End-to-End Check Out Equipment
ETOL	European Test Operation Language
EXP-COE	Experimental Check Out Equipment
FDHS EC	Fast Data Handling Simulator Engineering Console
FDHS LU	Fast Data Handling Simulator Local Unit
FITS	Flexible Image Transport System
FTP	File Transfer Protocol
FWHM	Full Width at Half Maximum
HEW	Half Energy Width
HK	Housekeeping
ISU	Interface Simulator Unit
LAN	Local Area Network
NFS	Network File System
OLA	On-Line Analysis
OOL	Out of Limit
MOVCOE	Movement Checkout Equipment
PCF	Primary Calibration File
QLA	Quick Look Analysis
SID	Structure Identifier
SQL	Structured Query Language
TBD	To Be Defined
TBV	To Be Verified
TBW	To Be Written
TM	Telemetry
XDR	eXternal Data Representation format
XMM	X-ray Multi Mirror

2. TEST SET UP

2.1. MOS Camera Head Configuration

The FM1 MOS under test consisted of 7 CCDs. The view from behind the CCD surface is sketched below.



The u_i,v_i node detector coordinates are in pixel. The u coordinate ranges 0 to 609, as it includes two extra regions of 5 pixels on both sides for overscan. The v coordinate ranges 0 to 601, as it includes an extra region of 2 pixels on top.

The coordinates of an event falling in the central pixel of the 5x5 cell used by the EMCR are returned as the coordinates of the top right corner, including the extra pixels (see ref. [1], sect. 1.3.1.1).

2.2. EGSE configuration and data archiving

The data taking was conducted using the EGSE configuration depicted in fig.1 below.

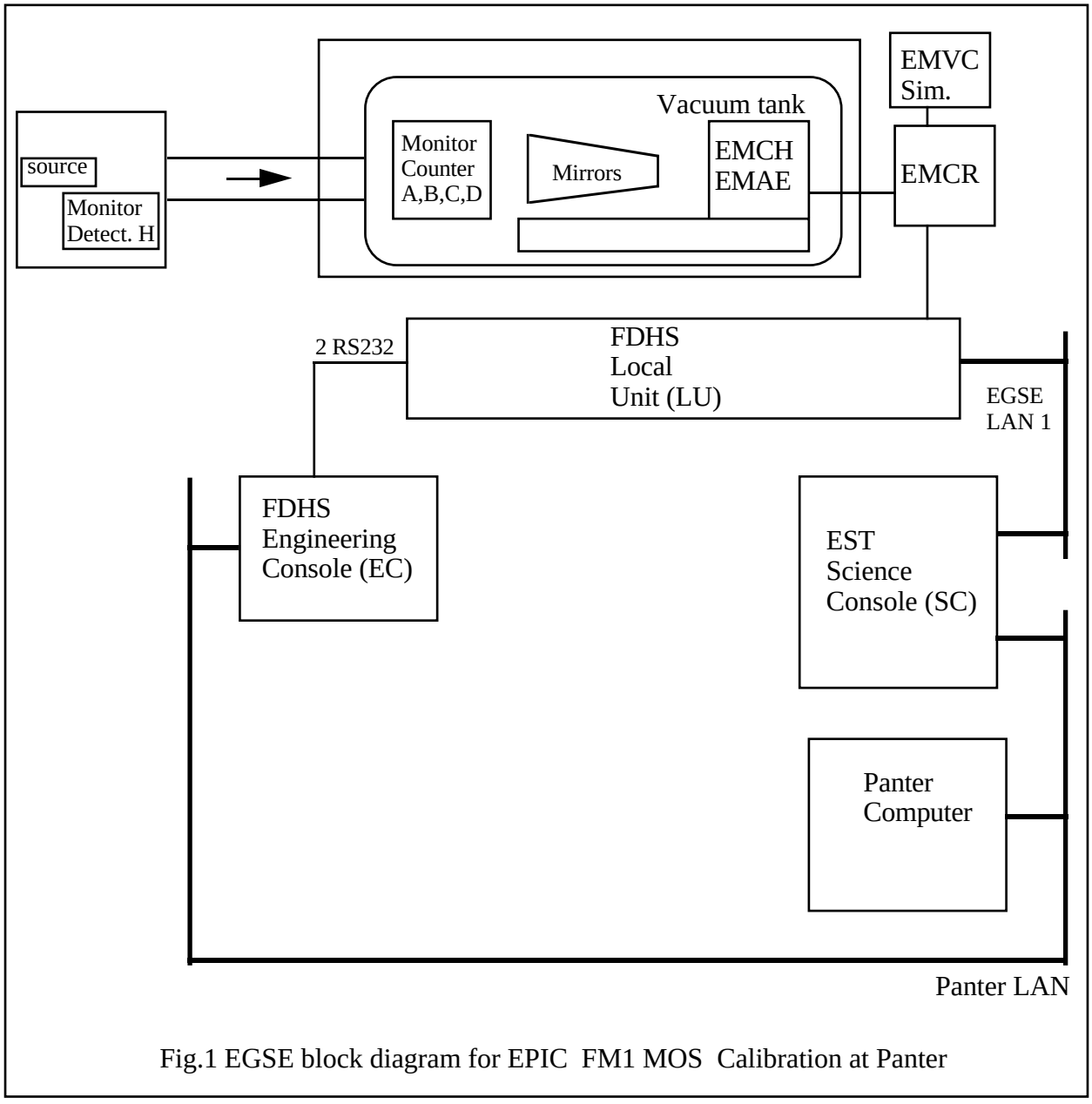
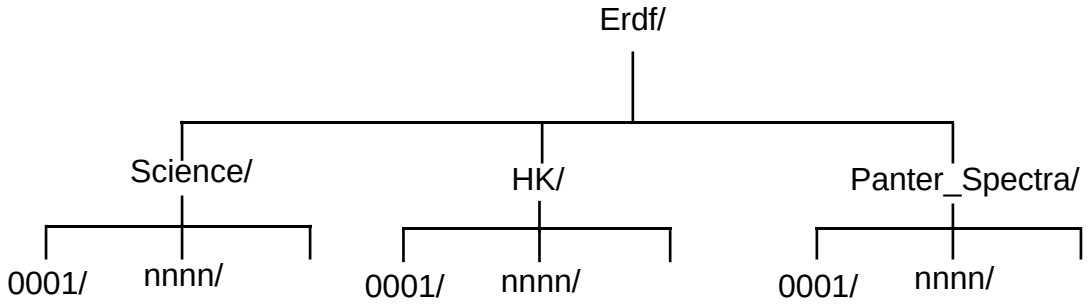


Fig.1 EGSE block diagram for EPIC FM1 MOS Calibration at Panter

The EGSE Reduced Data Files to be included in the DAT tape were stored under the following Erdf directory tree:



Science and HK subtrees

These subtrees were devoted, as usual, to the data acquired in near real time from the instrument and from the Panter facility (On-line Data), namely:

Science: Egse Reduced Science Data Files, as derived in near-realtime from the Instrument Raw TLM Science data.

HK: Instrument Raw TLM HK data files related to an exposure, copied from the Instrument Raw HK data

Facility Raw HK data files related to an exposure, copied from the Facility Raw HK data files.

In the HK subtree have been saved also the FITS files created from each of the above Facility Raw HK file at the end of the Campaign.

The Science and HK files are grouped under subdirectories containing the files related to the Run Id of a given decade, e.g.: 0001/ contains all the files related to Run Id 1,2,3, ...,9,10.

The bulk of the data contained in the Science subdirectory were the FITS files with the photon lists and the auxiliary information produced for each CCD when operated in imaging mode. Most of the remaning files contain CCD Transparent mode and Timing Mode data.

The Science subdirectory was available via NFS to the Off-Line Analysis Workstation as soon as the exposure was completed.

The Instrument Raw TLM HK data include all the HK Packets received from the FDHS Eng. Console. The desired class of packet can be extracted on the basis of the Packet Type and the Packet Subtype information contained in the Data Field Header.

At the Panter FM1 MOS Calibration, at least the following class of HK packets were present:

	Packet Type	Packet Subtype
Housekeeping Telemetry	[1]	[2]

Panter_Spectra subtree

As sketched in fig.1 above, in order to monitor the beam flux, four Monitor counters (A, B, C, D) were located close to the Mirrors Module and one Solid-State-Detector was located close to the X-Ray source.

Care of the Panter Facility computer system, the spectra data from these detectors have been accumulated during each EPIC instrument observation and saved at the end of each observation producing one data file and one auxiliary file for each detector.

Starting from this Campaign, the Panter_Spectra subtree has been added to the Erdf tree in order to specifically host these spectra data files.

Also in this case, the files are grouped under subdirectories containing the files related to the Panter Run Id of a given decade.

It is noted that this Run Id numbering is not the same used by the Science Console for the Science and HK data above. When noted in the logbook, the Panter Run Id corresponding to the SC Run ID have been reported in Annex 2; the missing ones can be derived using the time stamps given in summary files included in the Erdf tapes (see section 3.1 below).

It is noted also that, as all the Panter Spectra data files have been provided in one shot at the end of the Campaign (including also the data collected in the first week of March during the tests carried out with the EMDH unit and the standard EGSE), they have been saved in just one Erdf Tape (Tape # 001).

2.3. File Naming

Science and HK subtrees

The following file naming was used under the HK tree for the HK data produced during the exposure having Run id nnnnn:

PANnnnnn_YYMMDD_HHMMSS.rhk for the MOS Instrument HK

PANnnnnn_YYMMDD_HHMMSS.phk for the Panter (Facility) HK

where nnnnn is the Run ID and YYMMDD and HHMMSS are the time and the date of creation, respectively.

The HK data (either MOS Instrument HK or Panter Facility HK) produced before exposure n was started (IDLE period among n-1 and n) were identified by adding an "_" in their file name. A double "_" in the name, identified the first IDLE period of a measurement session (i.e. started just after the connection with the FDHS).

For each of the above .phk file which was not empty, the Science Console created a FITS binary table file with name:

nnnnn_YYMMDD_HHMMSS.panterhk

The file naming under the Science tree for the Imaging/Timing/Transparent modes is described in [3].

When required, Offset data files have been produced offline by a PC and saved in the same Science decade of the related Transparent Data using the following naming:

PANnnnnn_YYMMDD.off

In addition, for each event list file, an ASCII file with extension '*.dump'* contains additional information which allows to trace how the frame have been reconstructed from the Raw data stream. Namely:

- first column: the index in the tlm buffer of the word pertaining to the format identified by the second column: H = header, T = Trailer, E = Event, U = unknown
- column 3-12: the format content in exadecimal format
- column 13-14: *tlm#* is the frame number found in the header/trailer
- column 15-16: *asf#* is the frame number derived accumulating the tlm# and archived in the asf file

  or:

  discarded, in case the trailer was discarded together with the previous events, as its tlm# was different from the tlm# found in the last header
- column 17-18 *t* is the reference time derived from the trailer

In order to verify whether at the start of the exposure any tlm buffer is lost, for the first 10 buffers read from the LAN, a line with a letter *B* in the second column gives the counter incremented by the Science Console every time a new buffer is read from the LAN (*buffer#)* and the counter inserted in the tlm buffer by the FDHS Local Unit (*tlm buffer#*).

Panter_Spectra subtree

The naming for the Monitor Detectors spectra data file and the auxiliary data file corresponding to the Panter Run ID *nnn* is, respectively,:

*X*MOS_nnn.ASC

*X*MOS_nnn.4LP

where *X is* A, B, C, D, H for the different detectors.

2.4. Data Format

Science and HK subtrees

The Erdf/Science files have been produced following the FITS format given in [3].

The instrument HK are in the TLM format specified in [2].

The Panter Facility HK format (Raw and FITS) is given in [4]. It is noted that the FHEADER and the FVERSION keywords are meaningful in the ERDF Tape #001 only (in the remaining they are empty).

Panter_Spectra subtree

A short description of the meaningful ASCII lines contained in the .4LP files is given in the table below.

Line	Description
1	start and stop time
3	Realtime
5	Livetime
7	Total sum
9	Sum in the ROI
19	(Range) number of channels
34-35	borders of ROI
41-46	parameter for calibration (only used at Monitor H), equation: [8]=caloff +x*calfact + x^2*calfact2+x^3*calfact3

The .ASC file contains one ASCII line for each spectra channel.

3. THE ERDF DAT TAPES

A procedure has been used in order to produce the Erdf DAT Tape containing the Erdf/ subdirectories related to a given set of decades.

As detailed in the following sections, the procedure analyses all the files contained in the selected decades in order to produce the related summary and log files and to create a tape directory which will be saved in the DAT as the first tar file which summaries the content of the tape itself.

The usual procedure has been customised for the Panter Campaign in order to include the Panter_Spectra subdirectory, if any, as the second tar file in the tape.

3.1. The summary and log files

As a first step, the procedure takes care of adding into each decade subdirectory of the Erdf/Science and Erdf/HK, the summary and log decade files, namely:

Science/nnnn/instr_sc.sum; Science/nnnn/instr_sc.log

HK/nnnn/instr_hk.sum; HK/nnnn/instr_hk.log

HK/nnnn/facil_hk.sum; HK/nnnn/facil_hk.log.

HK/nnnn/facil_spectra.sum.

The *.sum are tabular ASCII files containing summary data separated by Tabs. The *.log contains the list of the files which have been removed, together with the reason of the removal.

The instr_sc.sum file

The procedure searches in the decade subdirectory for all the files related to a given exposure. Hence, from the files pertaining to a given CCD, the procedure extracts and writes in this file the values of the following FITS keywords:

FILENAME, DATATYPE DATE-OBS, TIME-OBS, DATE-END, TIME-END, FRMTIME, WINDOWX0, WINDOWY0, WINDOWDX, WINDOWDY, NFRAME, NEVENT

where:

FILENAME = base file name (e.g. 00541_970424_180503.m1*)

NFRAME = number of frame as given by the NAXIS2 keyword of the *asf file

NEVENT = number of event as given by the NAXIS2 keyword of the *elf file

For the meaning of the remaining keyword refer to [3].

The instr_sc.log files

In case one of the following values is found:

NFRAME = 0 in *elf

NEVENT = 0 in *asf

FRTIME = .000000E+00 in the *diag

the related files are removed and an antry is written in this file.

The instr_hk.sum and facil_hk.sum files

These files list the name and the size (in bytes) of each HK file contained in the decade related to the instrument and to the calibration facility (Orsay, Panter) respectively.

The instr_hk.log and facil_hk.log files

These files list the names of the HK files which have been removed as they were empty.

The facil_spectra.sum files

The procedure extracts the start and stop date and time from the line 1 of each the AMOS_nnn.4LP file contained in the decade and writes these values into the facil_spectra.sum file, e.g.:

FILENAME	DATE-START	TIME-START	DATE-END	TIME-END
MOS_001	01/15/98	14:46:44	01/15/98	15:23:42
MOS_002	01/15/98	15:23:47	01/15/98	20:16:00
MOS_003	01/16/98	10:24:26	01/16/98	11:39:33
MOS_004	01/16/98	11:39:40	01/16/98	18:16:04
MOS_005	01/16/98	18:16:24	01/16/98	18:18:55
MOS_006	01/16/98	18:21:24	01/16/98	18:21:41
MOS_007	01/16/98	18:22:25	01/16/98	18:25:45
……	……	……	……	……

3.2. The tape directory

As second step, the procedure creates the Tapes/Tape.nnn directory, where nnn is the number assigned to the Erdf tape to be produced.

At the time tape production, this directory will be stored in the first tar file of the Erdf DAT Tape in order to allow the user to have a summary on the tape content without having to inspect all the tape.

In this subdirectory, the procedure creates the following files.

The tape_id file

This file contains the ASCII string "TAPEID = nnn" identifying the tape, e.g.:

TAPEID = 001

The tape_files file

The procedure writes into this file one entry for each Erdf subdirectory. Each entry, gives the id of the tape to be created and the sequential number of the tar file where the subdirectory will be saved. The following table shows the case where the Panter_Spectra subdirectory is present:

TAPEID	FILE #	Tar Dir
001	001	Tapes/Tape.001/
001	002	Panter_Spectra/

001	003	HK/0112/
001	003	Science/0112/
001	004	HK/0113/
001	004	Science/0113/
001	005	HK/0114/
001	005	Science/0114/
….	….	….

The summary and log files

All the summary and log files contained in each decade are merged and stored in the Tapes/Tape.nnn directory in a file having the same name, i.e.:

instr_sc.sum; instr_sc.log

instr_hk.sum; instr_hk.log

facil_hk.sum; facil_hk.log

facil_spectra.sum

contain the information related to the whole tape.

4. DATA DISTRIBUTION

Five Erdf DAT tapes have been produced in order to contain all the data saved in the Erdf/ data tree during the Panter FM1 MOS Calibration, namely:

TAPE	FROM		TO	
	RUNID	DATE	RUNID	DATE
1	1120	15/01/1998	1231	20/01/1998
2	1232	20/01/1998	1275	23/01/1998
3	1276	23/01/1998	1322	26/01/1998
4	1323	26/01/1998	1366	28/01/1998
5	1367	28/01/1998	1434	30/01/1998

The file location of each decade is given Annex 1, were the content of the tape_files files, mentioned in 3 above, is presented.

4.1. How to inspect the Erdf DAT tape and restore the files

The tape can be positioned to the desired tar file using the "*mt*" command and the subdirectory can be extracted using the "*tar*" command.

Some examples (on an DEC OSF Platform) follow (note: the "*no-rewind*" device is specified).

[1] skip the first three End Of File marks :

> mt -f /dev/nrmt0m fsf 3

[2] list the content of the next tar file (file # 4 in the DAT Tape):

> tar tvf /dev/nrmt0m

```
drwxr-xr-x  203/650      0 Dec 23 17:52:29 1996 12/
-rwxr-x---  203/650  28800 Dec  4 13:12:34 1996 12/00111_041296_131157.m1ima1elf
-rwxr-x---  203/650  11520 Dec 23 12:06:01 1996 12/00111_041296_131157.m1imaasf
-rwxr-x---  203/650  11520 Dec  4 13:12:41 1996 12/00111_041296_131157.m3ima1elf
-rwxr-x---  203/650  11520 Dec  4 13:12:41 1996 12/00111_041296_131157.m3imaasf
-rwxr-x---  203/650   8640 Dec  4 13:11:57 1996 12/00111_041296_131157.m6ima1elf
-rwxr-x---  203/650   8640 Dec  4 13:11:57 1996 12/00111_041296_131157.m6imaasf
……
```

[3] skip the End Of File mark of the current file (the file just listed above) and one more End Of File mark in order to position the tape at the beginning of the tar file # 6:

> mt -f /dev/nrmt0m fsf 2

[4] list the content of the next tar file (file # 4 in the DAT Tape):

> tar tvf /dev/nrmt0m

```
drwxr-xr-x  203/650      0 Dec 23 18:06:04 1996 14/
-rwxr-xr-x  203/650  31680 Dec  4 17:03:46 1996 14/00131_041296_165727.m6ima1elf
-rwxr-xr-x  203/650  11520 Dec  4 17:03:46 1996 14/00131_041296_165727.m6imaasf
-rwxr-xr-x  203/650 192960 Dec  4 17:03:41 1996 14/00131_041296_165727.m1ima1elf
-rwxr-xr-x  203/650  11520 Dec  4 17:03:41 1996 14/00131_041296_165727.m1imaasf
-rwxr-xr-x  203/650  40320 Dec  4 17:03:51 1996 14/00131_041296_165727.m3ima1elf
-rwxr-xr-x  203/650  14400 Dec  4 17:03:51 1996 14/00131_041296_165727.m3imaasf
-rwxr-xr-x  203/650  40320 Dec  4 17:11:06 1996 14/00131_041296_171028.m3ima1elf
……
```

[5] skip the End Of File mark of the current file (the file just listed above) in order to position the tape at the beginning of the tar file # 7:

> mt -f /dev/nrmt0m fsf

[6] extract the content of the next tar file (file # 7 in the DAT Tape) restoring all the files in the current directory (i.e. creating the subdirectory 15/):

tar xvf /dev/nrmt0m

tar: blocksize = 20

x 15/

x 15/00141_051296_091856.m1ima1elf, 8640 bytes, 17 tape blocks

x 15/00141_051296_091856.m1imaasf, 8640 bytes, 17 tape blocks

x 15/00141_051296_091856.m3ima1elf, 8640 bytes, 17 tape blocks

x 15/00141_051296_091856.m3imaasf, 8640 bytes, 17 tape blocks

x 15/00141_051296_091857.m6ima1elf, 8640 bytes, 17 tape blocks

x 15/00141_051296_091857.m6imaasf, 8640 bytes, 17 tape blocks

x 15/00142_051296_094544.m3ima1elf, 9993600 bytes, 19519 tape blocks

x 15/00142_051296_094544.m3imaasf, 72000 bytes, 141 tape blocks

…….

ANNEX 1 Erdf DAT TAPE Content List

TAPEID	FILE #	Tar Dir
001	001	Tapes/Tape.001/
001	002	Panter_Spectra/
001	003	HK/0112/
001	003	Science/0112/
001	004	HK/0113/
001	004	Science/0113/
001	005	HK/0114/
001	005	Science/0114/
001	006	HK/0115/
001	006	Science/0115/
001	007	HK/0116/
001	007	Science/0116/
001	008	HK/0117/
001	008	Science/0117/
001	009	HK/0118/
001	009	Science/0118/
001	010	HK/0119/
001	010	Science/0119/
001	011	HK/0120/
001	011	Science/0120/
001	012	HK/0121/
001	012	Science/0121/
001	013	HK/0122/
001	013	Science/0122/
001	014	HK/0123/
001	014	Science/0123/
001	015	HK/0124/
001	015	Science/0124/
002	001	Tapes/Tape.002/
002	002	HK/0124/
002	002	Science/0124/

002	003	HK/0125/
002	003	Science/0125/
002	004	HK/0126/
002	004	Science/0126/
002	005	HK/0127/
002	005	Science/0127/
002	006	HK/0128/
002	006	Science/0128/
003	001	Tapes/Tape.003/
003	002	HK/0128/
003	002	Science/0128/
003	003	HK/0129/
003	003	Science/0129/
003	004	HK/0130/
003	004	Science/0130/
003	005	HK/0131/
003	005	Science/0131/
003	006	HK/0132/
003	006	Science/0132/
003	007	HK/0133/
003	007	Science/0133/
004	001	Tapes/Tape.004/
004	002	HK/0133/
004	002	Science/0133/
004	003	HK/0134/
004	003	Science/0134/
004	004	HK/0135/
004	004	Science/0135/
004	005	HK/0136/
004	005	Science/0136/
004	006	HK/0137/
004	006	Science/0137/
005	001	Tapes/Tape.005/
005	002	HK/0137/

005	002	Science/0137/
005	003	HK/0138/
005	003	Science/0138/
005	004	HK/0139/
005	004	Science/0139/
005	005	HK/0140/
005	005	Science/0140/
005	006	HK/0141/
005	006	Science/0141/
005	007	HK/0142/
005	007	Science/0142/
005	008	HK/0143/
005	008	Science/0143/
005	009	HK/0144/
005	009	Science/0144/