XMM

XMM Interface Control Document: Proposal Handling Subsystem Tools (SSD)

XMM-SOC-ICD-0020-SSD Issue 2.1

Written by: K. Galloway

March 29, 1999

Revision history

Revision number	Date	Revision author	Comments
Draft 1.0	September 9, 1997	K. Galloway	First draft
Draft 2.0	September 29, 1997	K. Galloway	Updated after internal review
Issue 1.0	November 28, 1997	K. Galloway	Updated after external review
Issue 2.0	February 23, 1998	K. Galloway	Updated as a result of Issue 1.0 comments
Issue 2.1	March 29, 1999	K. Galloway	Updated for Issue 2.0 DCP 1

XMM

XMM Interface Control Document: Proposal Handling Subsystem Tools (SSD)

XMM-SOC-ICD-0020-SSD Issue 2.1

Written by: K. Galloway

March 29, 1999

Agreed by K. Galloway: .....

Agreed by D. Lumb: .....

Agreed by J. Riedinger: .....

Agreed by N. Peccia: .....

Agreed by H. Nye: .....

Agreed by Logica: .....

Contents

List of Tables

1 Introduction

1.1 Purpose

The PHS Tools are the scientific analysis tools, developed by ESTEC SSD, which are used by the Proposal Handler when evaluating proposals. There are 3 PHS Tools related interfaces addressed in this document:

1. The interface that exists between the XSCS PHS Proposal Tools [1] and the PHS Tools when initiating the PHS Tools. This principally involves identifying the names and location of the PHS Tools. This interface is subsequently referred to as the XSCS Proposal Tools Interface.
2. The interface that exists between the PHS Tools output and the Proposal Database. The mechanism for the transfer of the data is the PHS Tools Database File. This interface is subsequently referred to as the PHS Tools Database File Interface.
3. The interface that exists between the PHS Tools development environment and the XSCS PHS operational environment and describes the mechanisms involved in a PHS Tools delivery. This interface is subsequently referred to as the PHS Tools Delivery Interface.

1.2 Scope

This document describes the details of the 3 PHS Tools related interfaces described above. The PHS Tools are detailed and the format of the PHS Tools Database File is described.

This document does not define the structure of the Proposal File from which the PHS Tools obtain the majority of their input. This is described in [2]. Also, this document does not describe the format of any other input files used by the PHS Tools or any of the other files generated by the PHS Tools. These will be defined in the relevant PHS Tools design documents and user manuals.

1.3 Documentation

From the following documents the applicable documents are: [1] [2]

From the following documents the reference documents are: [3] [4] [5]

[1] Logica. XMM Combined MCS-SCS Development ADD. 502.EC23404:1.0, Logica, October 1997.

[2] N.White. XMM Interface Control Document: Proposal Handling Subsystem Tools. XMM-SOC-ICD-0018-DPD Issue A5, Logica, June 1998.

[3] ESA. Science Operation Centre User Requirements Document. XMM-SOC-URD-0013-SMD Issue 2 rev. 0, ESA DO/ESOC/MOD/SMD, September 1996.

[4] I.Palmer. XSCS Human-Computer Interface ICD. LOG-XMMS-ICD-IP-1402/97, Logica, October 1997.

[5] I.Palmer. XSCS Technical Meeting 16 PHS Tools Meeting. LOG-XSCS-MOM-IMP-1232-97, Logica, April 1997.

1.4 Acronyms

BPE	Blue Processing Electronics
DIPPV	Default Instrument Programmable Parameter Value
DPU	Digital Processing Unit
ESTEC	European Space Research and Technology Centre
GO	Guest Observer
PGO	Principal Guest Observer
PHS	Proposal Handling Subsystem
SOC	Science Operations Centre
SSD	Space Science Department
XSCS	XMM SOC Control System

1.5 Glossary of Terms

- **Proposal Database:** The database of proposals contained within the XSCS
- **Proposal File:** The file generated by the Logica developed XSCS which contains all of the information about a proposal contained in the proposal database. The PHS Tools will access all proposal information using this file. This file is fully described in [2]
- **PHS Tools Database File:** The file generated by the PHS Tools which contains the data which is to be entered into the Proposal Database.
- **PHS Tools Information File:** The file generated by the PHS Tools which contains all of the data generated by the PHS Tools. This file is used by the Proposal Handler to evaluate the proposal and to decide if the contents of the PHS Tools Database File should be stored in the Proposal Database.

2 Operational Assumptions and Constraints

2.1 Assumptions

The following assumptions are made:

- The PHS Tools run on a Solaris workstation. The development of the PHS Tools will be performed within the Scisim development environment and the operational environment for the PHS Tools will nominally be one of the PHS Solaris workstations.
- The PHS Tools expect the name and location of the Proposal File to be passed as a single command line argument. This will be an absolute path and not relative.

2.2 Constraints

None.

3 Requirements

3.1 Functional Requirements

None.

3.2 On-line Data Delivery Requirements

None.

3.3 Off-line Data Delivery Requirements

None.

4 Interface Characteristics

4.1 Interface Location and Medium

4.1.1 XSCS Proposal Tools Interface

The PHS Tools executables and scripts will reside on the NFS mounted disks on the XSCS Solaris server within the PHS allocated area.

4.1.2 PHS Tools Database File Interface

The PHS Tools Database File is an ASCII file which will be created in the same location as the Proposal File [2]. The interface is the NFS mounted disks on the XSCS Solaris server within the PHS allocated area.

4.1.3 PHS Tools Delivery Interface

The interface exists between the Scisim development machine and the XSCS operational environment. The location of the Scisim development machine is TBD. The XSCS will be located at the Villspa ground station in Villafranca, Spain.

The medium for the transfer of the PHS Tools between these 2 environments is TBD.

4.2 Hardware Characteristics and Limitations

4.2.1 XSCS Proposal Tools Interface

The XSCS PHS hardware is the XSCS NT server and the XSCS Solaris workstations. Any limitations are TBD.

4.2.2 PHS Tools Database File Interface

The XSCS PHS hardware is the XSCS NT server and the XSCS Solaris workstations. Any limitations are TBD.

4.2.3 PHS Tools Delivery Interface

The Scisim development machine is an Sun Ultra-2 Solaris workstation.

The XSCS PHS hardware is the XSCS NT server and the XSCS Solaris workstations. Any limitations are TBD.

4.3 Data Source, Destination and Transfer Mechanism

4.3.1 XSCS Proposal Tools Interface

The delivered PHS Tools will reside in a directory identified by the PHS_TOOLS_DIR environmental variable. The PHS Tools executables will reside in a subdirectory named 'executables'. All PHS Tool executables can therefore be accessed using the path 'PHS_TOOLS_DIR/executables'. The PHS Tools scripts will reside in a subdirectory named 'scripts'. All PHS Tool scripts can therefore be accessed using the path 'PHS_TOOLS_DIR/scripts'.

4.3.2 PHS Tools Database File Interface

The PHS Tools Database File will be created by the PHS Tools in the directory identified by the PHS_TOOLS_OP_DIR environmental variable. This directory is on the NFS drives of the XSCS Solaris server.

4.3.3 PHS Tools Delivery Interface

The PHS Tools will be developed within the Scisim development environment. The PHS Tools (including the required star catalogues, look up tables and other input files) will be transferred/ installed on the operational XSCS Solaris workstations. The details of the actual transfer mechanism are TBD.

4.4 Node and Device Addressing

4.4.1 XSCS Proposal Tools Interface

The PHS Tools executables will be accessed using the path defined by 'PHS_TOOLS_DIR/executables'.

The PHS Tools scripts will be accessed using the path defined by 'PHS_TOOLS_DIR/scripts'.

4.4.2 PHS Tools Database File Interface

The PHS Tools Database Files will be created in the directory indicated by the environmental variable 'PHS_TOOLS_OP_DIR.

4.4.3 PHS Tools Delivery Interface

The details of any node and device addressing are TBD.

4.5 Relationships with other Interfaces

4.5.1 XSCS Proposal Tools Interface

The relationship of the PHS Tools with the XSCS Proposal Tools HCI is detailed in [4].

The relationship of the PHS Tools with the Proposal File, and the format of this file, is fully detailed in [2].

4.5.2 PHS Tools Database File Interface

The details of the mechanism for the loading of the data contained in the PHS Tools Database File into the Proposal Database are TBD.

4.5.3 PHS Tools Delivery Interface

As the transfer mechanism is currently unknown the relationship with any other interface is TBD.

5 Access

5.1 Interface Utility Software

None.

5.2 Failure Protection, Detection and Recovery Procedures

5.2.1 XSCS Proposal Tools Interface

The handling of any failure in the execution of the PHS Tools will be in accordance to the procedures specified in the PHS Tools user manual.

5.2.2 PHS Tools Database File Interface

Not applicable.

5.2.3 PHS Tools Delivery Interface

The transfer medium of the PHS Tools from the development environment to the operational environment is TBD. Therefore the failure protection, detection and recovery procedures associated with the transfer medium are TBD.

The PHS Tools will be delivered as a tar file and installation procedures will be defined in the accompanying delivery note. Any failure to install the PHS Tools on the operational environment will be handled according to the defined procedures.

5.3 File Naming Convention

5.3.1 XSCS Proposal Tools Interface

The command line syntax for the invokation of a PHS Tool is:

tool_name proposal_file

where:

- tool_name: The name of the PHS Tools executable or script and has the syntax 'ii_nnnnnn' where
  - 'ii' is an identifier and can take the value:
    - ep: epic instrument executable
    - rg: rgs instrument executable
    - om: om instrument executable
    - gn: general phs tool executable
    - sc: script
  - 'nnnnnn' is a 6 character descriptor of the tool.

The name assigned to each PHS Tool is specified in Section 7.

- proposal_file consists of the absolute path of the directory in which the Proposal File resides and the name of the Proposal File as defined in [2].

5.3.2 PHS Tools Database File Interface

The file naming convention for the PHS Tools Database File is:

proposal_id.dbf

where:

- 'proposal_id' is the 6 digit number of the corresponding Proposal File [2].
- 'dbf' identifies the file as a PHS Tools Database File.

5.3.3 PHS Tools Delivery Interface

The PHS Tools will be delivered to the operational environment as a tar file. The tar file naming convention is:

phs_tools_vvv.tar

where 'vvv' identifies the PHS Tools version contained within the tar file (001 to 999).

5.4 Storage and File Detection Requirements

5.4.1 XSCS Proposal Tools Interface

Storage is required for the following PHS Tools output:

- PHS Tools Database File: Contains the PHS Tool output to be subsequently loaded into the Proposal Database. Only 1 database file will exist for each Proposal File.
- PHS Tools Information File: Contains the complete output of the PHS Tools and will be used by the Proposal Handler to evaluate the proposal and to decide whether the information contained within the PHS Tools Database File is to be stored in the Proposal Database. Only 1 information file will exist for each Proposal File.
- PHS Tools Log File: Contains a log of the PHS Tools applied to a Proposal File. Only 1 log file will exist for each Proposal File.

These files are generated in the directory indicated by the PHS_TOOLS_OP_DIR environmental variable.

In [2] the storage requirements are identified for the simultaneous storage of 20 Proposal Files. These storage requirements need to be extended to include the PHS Tools Database, Information and Log Files associated with each Proposal File.

The file detection requirements are such that the identified PHS Tools output files can be deleted in the same manner as the Proposal Files, namely from the PHS Proposal Tools component [2]. Note: The file naming convention for the PHS Tools Database, Information and Log Files is:

proposal_id.fff

where:

- 'proposal_id' is the 6 digit number of the corresponding Proposal File [2].
- 'fff' identifies the file type and can take the values:
  - dbf: PHS Tools Database File
  - inf: PHS Tools Information File
  - log: PHS Tools Log File

5.4.2 PHS Tools Database File Interface

Covered in previous section.

5.4.3 PHS Tools Delivery Interface

The PHS Tools will be installed as executables and scripts along with any associated control, input and configuration files on the XSCS Solaris server within the PHS allocated area. The PHS Tools will reside on disk in the following directory structure:

A top level directory named 'phs_tools' will contain the following subdirectories:

- executables: directory containing the PHS Tools executables
- scripts: directory containing the PHS Tools scripts
- data: directory containing the PHS Tools configuration and data files
- catalogues: directory containing the star catalogues to be accessed by the PHS Tools.

5.5 Security Requirements

5.5.1 XSCS Proposal Tools Interface

Access to the PHS Tools is via the XSCS PHS. The security features implemented for the XSCS PHS are sufficient.

5.5.2 PHS Tools Database File Interface

The PHS Tools Database Files reside within the XSCS PHS environment. The security features implemented for the XSCS PHS are sufficient.

5.5.3 PHS Tools Delivery Interface

As the transfer medium for the PHS Tools from the development environment to the operational environment is unknown then the security requirements needed during the transfer of the data are TBD.

5.6 Data Integrity Checks

5.6.1 XSCS Proposal Tools Interface

Any data integrity checks performed by the PHS Tools when executing will be described in the relevant PHS Tools design documents. These data integrity checks will place no additional requirements on the Logica developed XSCS.

5.6.2 PHS Tools Database File Interface

Not applicable.

5.6.3 PHS Tools Delivery Interface

As the transfer medium for the PHS Tools from the development environment to the operational environment is unknown then the data integrity checks required during the transfer of the data are TBD.

5.7 Backup Requirements

5.7.1 XSCS Proposal Tools Interface

The backup procedures implemented for the XSCS PHS are sufficient.

5.7.2 PHS Tools Database File Interface

The backup procedures implemented for the XSCS PHS are sufficient.

5.7.3 PHS Tools Delivery Interface

The backup procedures implemented in the Scisim development environment are sufficient.

The backup procedures implemented for the XSCS PHS are sufficient.

5.8 Error Handling

5.8.1 XSCS Proposal Tools Interface

The error handling performed by the PHS tools will be described in the relevant design documents. The error handling mechanism of the PHS Tools will place no additional requirements on the Logica developed XSCS.

5.8.2 PHS Tools Database File Interface

Not applicable.

5.8.3 PHS Tools Delivery Interface

As the transfer medium for the PHS Tools from the development environment to the operational environment is unknown then the error handling required during the transfer of the data is TBD.

5.9 Application Layer

Not applicable.

6 Detailed Interface Specifications

6.1 Data Structure

6.1.1 XSCS Proposal Tools Interface

The PHS Tools are identified in Section 7.

6.1.2 PHS Tools Database File Interface

The format of a PHS Tools Database File is defined in Section 8.

6.1.3 PHS Tools Delivery Interface

The data structure transferred across the interface is the PHS Tools tar file. The contents of this tar file will be described in the delivery note which accompanies a PHS Tools delivery.

6.2 Generation Method

6.2.1 XSCS Proposal Tools Interface

The PHS Tools executables and scripts are generated on the PHS Tools development machine and delivered to the operational environment as components of a PHS Tools delivery.

6.2.2 PHS Tools Database File Interface

A PHS Tools Database File is generated by the PHS Tools. It is generated only once when the first PHS Tool is applied to a specified Proposal File. Any subsequent application of PHS Tools to that Proposal File results in the old PHS Tools Database File being updated.

6.2.3 PHS Tools Delivery Interface

The generation of the PHS Tools tar file will be performed using a script executed on the PHS Tools development machine.

6.3 Data Passed Across the Interface and Their Direction

6.3.1 XSCS Proposal Tools Interface

Not applicable

6.3.2 PHS Tools Database File Interface

Not applicable

6.3.3 PHS Tools Delivery Interface

A PHS Tools tar file is passed from the PHS Tools development machine to the XSCS PHS workstations.

6.4 Size and Frequency of Transfers

6.4.1 XSCS Proposal Tools Interface

Not applicable.

6.4.2 PHS Tools Database File Interface

Storage is required for the following PHS Tools output:

- PHS Tools Database File: Maximum size of this file is 50 Kbytes.
- PHS Tools Information File: Maximum size of this file is 150 Kbytes
- PHS Tools Log File: Maximum size of this file is 50 Kbytes

In [2] the resource requirements are produced for the simultaneous storage of 20 proposal files. Using this figure then 5 Mbytes of disk space is required for the PHS Tools output files.

6.4.3 PHS Tools Delivery Interface

The disk space required for the files contained within a PHS Tools delivery is estimated to be 750 Mbytes for the star catalogues and 100 Mbytes for all of the other files associated with the PHS Tools. The tar file containing these files will be transferred whenever a new delivery of the PHS Tools is made.

6.5 Timing and Synchronisation Requirements

Not applicable.

7 PHS Tools Definition

7.1 Overview

It is necessary for the Proposal Handler to perform a technical evaluation of the XMM proposals [3]. The Logica developed PHS performs much of the routine proposal consistency checking but that technical evaluation which is of a scientific nature is to be performed by the ESTEC SSD developed PHS Tools. The PHS Tools allow the Proposal Handler to evaluate and supplement the information associated with a proposal. The proposal information is made available to the PHS Tools via a Proposal File generated by the Logica developed PHS [2].

The PHS Tools are designed to run individually but due to severe constraints in terms of the time available to the Proposal Handler to evaluate a proposal the PHS Tools will also be able to run as a simple scripted pipeline [5]. Each script will consist of a sequence of PHS Tools executables. A script is considered here to also be a PHS Tool in that it can be invoked from the Proposal Tools Interface in the same manner as a PHS Tools executable.

A PHS Tool is started using the Proposal Tools HCI [4]. The user enters the identifier of the proposal to be processed using the Proposal ID dialogue. The user is then presented with the Tools menu bar. Using this the user can select the required PHS Tool from a drop down menu. The interface consists of launching the relevant tool passing the name of the Proposal File (with its full directory structure).

The subsequent sections identify each PHS Tool, briefly outline its function, identify the name assigned to it (see Section 5.3) and the outputs written by the tool to the PHS Tools Database File.

7.2 EPIC PHS Tools

7.2.1 Overview of the EPIC PHS Tools

Five EPIC PHS Tools have been identified. They are:

- EPIC expected X-ray count rate tool
- EPIC expected optical count rate tool
- EPIC telemetry bandwidth calculation tool
- EPIC signal to noise ratio tool
- EPIC science parameter calculator tool

Details of these tools are provided in subsequent sections. First however, a summary of the outputs of these tools to the PHS Tools Database File is provided (Table 1).

Table 1: PHS Tools Database File: EPIC PHS Tools Fields

Parameter	EPIC PHS Tool	No of Instances per EPIC Instr.	Notes
Per Exposure			
Expected x-ray counts	X-ray count rate tool	1	1
Signal to noise ratio	Signal to noise ratio	1	1
Expected pile-up	Science parameter calculator	1	1
Fraction of smeared photons	Science parameter calculator	1	1
Duty cycle	Science parameter calculator	1	1
Total number of counts	Science parameter calculator	1	1
Total area of chosen fov	Science parameter calculator	1	1
Counts per frame	Science parameter calculator	1	1

1. A field is required in the PHS Tools Database File for each exposure of an EPIC instrument.

7.2.2 EPIC Expected X-ray Count Rate Tool

7.2.2.1 Function

For each EPIC exposure the EPIC expected X-ray count rate tool will calculate the expected X-ray count rate, in events/ second, incident on the focal plane.

7.2.2.2 Executable Name

ep_xcount

7.2.2.3 PHS Tools Database File Outputs

For each EPIC instrument (MOS-1, MOS-2 and p-n) exposure the expected count rates will be specified in the PHS Tools Database File.

7.2.3 EPIC Expected Optical Count Rate Tool

7.2.3.1 Function

For each EPIC instrument the EPIC expected optical count rate tool will calculate the expected optical count rate, in events/ second, incident on the focal plane.

7.2.3.2 Executable Name

ep_ocount

7.2.3.3 PHS Tools Database File Outputs

None. The information output from this tool is written to the PHS Tools Information File only.

7.2.4 EPIC Telemetry Bandwidth Calculation Tool

7.2.4.1 Function

For each EPIC (MOS-1, MOS-2 and p-n) exposure identified in the Proposal File the EPIC telemetry bandwidth calculation tool will estimate the required telemetry bandwidth.

7.2.4.2 Executable Name

ep_tmband

7.2.4.3 PHS Tools Database File Outputs

None. The information output from this tool is written to the PHS Tools Information File only.

7.2.5 EPIC Signal to Noise Ratio Tool

7.2.5.1 Function

For each EPIC exposure identified in the Proposal File the EPIC signal to noise ratio tool will estimate the SNR.

7.2.5.2 Executable Name

ep_sn_rat

7.2.5.3 PHS Tools Database File Outputs

For each EPIC instrument (MOS-1, MOS-2 and p-n) exposure the expected signal to noise ratio will be specified in the PHS Tools Database File.

7.2.6 EPIC Science Parameter Calculator Tool

7.2.6.1 Function

For each EPIC exposure identified in the Proposal File the EPIC science parameter calculator tool will estimate the following science parameters:

- Expected pile-up
- Fraction of smeared photons
- Duty cycle
- Total number of counts
- Total area of chosen field of view
- Counts per frame

7.2.6.2 Executable Name

ep_scipar

7.2.6.3 PHS Tools Database File Outputs

For each EPIC instrument (MOS-1, MOS-2 and p-n) exposure the expected pile-up, fraction of smeared photons, duty cycle, total counts, the total FOV area and the counts per frame will be specified in the PHS Tools Database File.

7.3 RGS PHS Tools

7.3.1 Overview of the RGS PHS Tools

Four RGS PHS Tools have been identified. They are:

- RGS expected X-ray count rate estimation tool
- RGS expected optical count rate estimation tool
- RGS telemetry bandwidth calculation tool
- RGS diagnostic downlink time estimation tool

Details of these tools are provided in subsequent sections. First however, a summary of the outputs of these tools to the PHS Tools Database File is provided (Table 2).

Table 2: PHS Tools Database File: RGS PHS Tools Fields

Parameter	RGS PHS Tool	No of Instances per RGS Instr.	Notes
Per Observation			
Expected x-ray counts	X-ray count rate tool	1	1
Expected optical counts	Optical count rate tool	1	1
Per Exposure			
Diagnostic downlink time	Diagnostic downlink time tool	1	2

1. For each observation a field is required in the PHS Tools Database File for both the expected x-ray counts and the expected optical counts for each RGS instrument.
2. For each RGS exposure in which the queue memory is generated in parallel to spectroscopy data the expected downlink time of this diagnostic data is calculated and written to the PHS Tools Database File.

7.3.2 RGS Expected X-ray Count Rate Tool

7.3.2.1 Function

For each RGS instrument the RGS expected X-ray count rate tool will calculate the expected X-ray count rate, in events/ second, incident on the focal plane.

7.3.2.2 Executable Name

rg_xcount

7.3.2.3 PHS Tools Database File Outputs

For each RGS instrument the expected X-ray counts are calculated for each observation and stored in the PHS Tools Database File.

7.3.3 RGS Expected Optical Count Rate Tool

7.3.3.1 Function

For each RGS instrument the RGS expected optical count rate tool will calculate the expected optical count rate, in events/ second, incident on the focal plane.

7.3.3.2 Executable Name

rg_ocount

7.3.3.3 PHS Tools Database File Outputs

For each RGS instrument the expected optical counts are calculated for each observation and stored in the PHS Tools Database File.

7.3.4 RGS Telemetry Bandwidth Calculation Tool

7.3.4.1 Function

For each RGS exposure identified in the Proposal File the RGS telemetry bandwidth calculation tool will estimate the required telemetry bandwidth.

7.3.4.2 Executable Name

rg_tmband

7.3.4.3 PHS Tools Database File Outputs

None. The information output from this tool is written to the PHS Tools Information File only.

7.3.5 RGS Diagnostic Downlink Time Estimation Tool

7.3.5.1 Function

When an RGS instrument is operating in a scientific mode with queue memory processing enabled it is necessary to determine how long it will take to downlink diagnostic data.

7.3.5.2 Executable Name

rg_diagdl

7.3.5.3 PHS Tools Database File Outputs

For each science exposure involving queue memory data the expected downlink time, in seconds, is calculated and stored in the PHS Tools Database File.

7.4 OM PHS Tools

7.4.1 Overview of the OM PHS Tools

The following eight OM PHS Tools have been identified:

- OM image mode background count rate estimation tool
- OM fast mode count rate estimation tool
- OM tracking frame time estimation tool
- OM fast mode time slice estimation tool
- OM science windows tool
- OM telemetry bandwidth calculation tool
- OM bright object and guide star tool
- OM science parameter calculator tool

Details of these tools are provided in subsequent sections. First however, a summary of the outputs of these tools to the PHS Tools Database File is provided (Table 3).

Table 3: PHS Tools Database File: OM PHS Tools Fields

Parameter	OM PHS Tool	Number of Instances	Notes
Per Observation			
No. of guide stars	Bright object and guide star tool	1	1
Guide star right ascension	Bright object and guide star tool	n	2
Guide star declination	Bright object and guide star tool	n	2
Lower position angle	Bright object and guide star tool	1	3
Upper position angle	Bright object and guide star tool	1	3
Per Exposure			
No of memory windows	Science windows tool	1	4
Memory window right ascension	Science windows tool	m	5
Memory window declination	Science windows tool	m	5
Memory window X0	Science windows tool	m	5
Memory window Y0	Science windows tool	m	5
Memory window deltaX	Science windows tool	m	5
Memory window deltaY	Science windows tool	m	5
Tracking frame time	Tracking frame time estimation tool	1	6
Exposure duration	Tracking frame time estimation tool	1	7
Total count rate	Science parameter calculator	1	8
Source count rate	Science parameter calculator	1	8
Signal to noise ratio	Science parameter calculator	1	8
Per Science Window			
Expected count rate	Image mode count rate estimation tool Fast mode count rate estimation tool	1	9
Sampling Time	Fast mode time slice estimation	1	10
Fast memory area	Science windows tool	1	10
Science window deltaX	Science windows tool	1	11

continued on next page

continued from previous page			
Parameter	OM PHS Tool	Number of Instances	Notes
Science window deltaY	Science windows tool	1	11

1. The number of potential guide stars in the FOV (n $\leq$ 32).
2. The right ascension and declination of each potential guide star.
3. The position angle constraints necessary to ensure the avoidance of any bright objects.
4. The number of memory windows required for the specified science windows (m $\leq$ 5).
5. If a memory window contains a science window that was specified in celestial coordinates then the centre of that memory window is calculated in celestial coordinates (memory window right ascension and declination) and the size of the window is calculated in pixels (memory window deltaX, deltaY). If a memory window contains only science windows that were specified in detector coordinates (pixels) then the coordinates of the memory window, in pixels, are calculated (memory window X0, Y0, detltaX, deltaY).
6. The tracking frame time in units of the DPU cycle.
7. The exposure duration in units of the tracking frame time.
8. The total count rate, the source count rate and the signal to noise ratio are specified for each exposure.
9. The expected count rate for each science window.
10. For each fast mode window the time slice duration, in units of the MIC CCD frame time, and the allocated fast memory area are specified. The time slice duration, expressed in units of the MIC CCD frame time, is referred to as the sampling time in this document to ensure distinction from the PGO supplied time slice duration (specified in milliseconds).
11. If a science window is specified in celestial coordinates then the size of the science window is converted from arcseconds to detector pixels.

7.4.2 OM Image Mode Count Rate Estimation Tool

7.4.2.1 Function

For each OM exposure this tool calculates the expected count rate for each imaging mode window.

7.4.2.2 Executable Name

om_icount

7.4.2.3 PHS Tools Database File Outputs

For each OM image mode window the expected optical counts, in photons/ second, are calculated and stored in the PHS Tools Database File.

7.4.3 OM Fast Mode Count Rate Estimation Tool

7.4.3.1 Function

For each OM exposure this tool calculates the expected count rate for each fast mode window.

7.4.3.2 Executable Name

om_fcount

7.4.3.3 PHS Tools Database File Outputs

For each OM fast mode window the expected optical counts, in photons/ second, are calculated and stored in the PHS Tools Database File.

7.4.4 OM Fast Mode Time Slice Estimation Tool

7.4.4.1 Function

This tool estimates the MIC CCD frame time. Using this calculated frame time and the fast mode time slice durations specified in the Proposal File in units of milliseconds the tool calculates the time slice durations as integer multiples of the MIC CCD frame time.

7.4.4.2 Executable Name

om_tslice

7.4.4.3 PHS Tools Database File Outputs

For each OM exposure the time slice duration, in units of the MIC CCD frame time, of each fast mode window will be calculated and stored in the PHS Tools Database File. The time slice duration, expressed in units of the MIC CCD frame time, is referred to as the sampling time in this document to ensure distinction from the PGO supplied time slice duration (specified in milliseconds).

Note: There are a maximum of 2 fast mode areas to which the fast mode windows will be allocated. The calculated time slice durations are, strictly speaking, associated with these areas and not with the fast mode windows. However, the relevant sampling time will be associated with each fast mode window.

7.4.5 OM Tracking Frame Time Estimation Tool

7.4.5.1 Function

This tool calculates the OM tracking frame time, in units of the DPU cycle, for each exposure. The exposure duration, originally specified by the proposal submitter in seconds, is then calculated as an integer multiple of this tracking frame time.

7.4.5.2 Executable Name

om_tframe

7.4.5.3 PHS Tools Database File Outputs

For each OM exposure the estimated tracking frame time will be calculated as an integer multiple of the DPU cycle and stored in the PHS Tools Database File.

For each OM exposure the estimated exposure duration will be calculated as an integer number of tracking frames and stored in the PHS Tools Database File.

7.4.6 OM Science Windows Tool

7.4.6.1 Function

This tool ensures that the specified windows satisfy the various constraints imposed on them, namely:

- Memory resource constraints
- Window size constraints
- Window overlap constraints
- Window location constraints

The tool additionally allocates blue fast memory areas to the fast mode science windows and calculates the required memory windows to be associated with the science windows.

The requirements regarding the calculation of window coordinates by this PHS Tool are as follows:

1. Science window defined in terms of celestial coordinates: If the science window is defined in terms of a window center (right ascension and declination) and window widths (deltaX and deltaY in arcseconds) this tool will calculate:
   - The width of the science window is pixels.
   - The centre of the corresponding memory windows in right ascension and declination.
   - The width of the memory window in pixels.
2. Science window defined in terms of detector coordinates (pixels): If the science window is defined completely in terms of detector pixels (Xlow, YLow, deltaX, deltaY) this tool will calculate:
   - The Xlow, Ylow of the memory window in detector pixels
   - The width, deltaX and deltaY, of the memory window in detector pixels.

7.4.6.2 Executable Name

om_sciwin

7.4.6.3 PHS Tools Database File Outputs

For each science window specified in celestial coordinates the size of the window, in detector pixels, is calculated and stored in the PHS Tools Database File.

For each OM fast mode window a blue fast mode area (1 or 2) is allocated and stored in the PHS Tools Database File.

For each OM exposure the number of memory windows required to enclose the specified science windows and their details are calculated and stored in the PHS Tools Database File.

7.4.7 OM Telemetry Bandwidth Calculation Tool

7.4.7.1 Function

For each OM exposure identified in the Proposal File the OM telemetry bandwidth calculation tool will estimate the required telemetry bandwidth.

7.4.7.2 Executable Name

om_tmband

7.4.7.3 PHS Tools Database File Outputs

None. The information output from this tool is written to the PHS Tools Information File only.

7.4.8 OM Bright Object and Guide Star Tool

7.4.8.1 Function

For each observation this tool will identify:

- the potential bright stars in the defined fov.
- the position angle constraints required to avoid the bright stars.
- a list of possible guide stars.

7.4.8.2 Executable Name

om_gstars

7.4.8.3 PHS Tools Database File Outputs

For each observation the pointing angle constraints are checked and if it is necessary, updated to ensure the avoidance of bright objects. These values are written to the PHS Tools Database File in units of degrees (TBD as not clearly defined in [1]).

For each observation the tool will identify the right ascension and declination of n (n $\leq$ 32) potential guide stars. It writes the value of n and the right ascension and declination of the guide stars to the PHS Tools Database File. The right ascension will be expressed in hours and the declination in degrees [1].

7.4.9 OM Science Parameter Calculator Tool

7.4.9.1 Function

For each OM exposure identified in the Proposal File the OM science parameter calculator tool will estimate the following science parameters:

1. The total countrate (source plus background) for the target (cts/sec/pixel).
2. The source count rate in units of cts/sec/pixel.
3. The estimated signal to noise ratio.

7.4.9.2 Executable Name

om_scipar

7.4.9.3 PHS Tools Database File Outputs

For each OM exposure the total count rate, the source count rate and the estimated signal to noise ratio expected will be specified in the PHS Tools Database File.

7.5 General and Scripted PHS Tools

7.5.1 View PHS Tools Information File Tool

7.5.1.1 Function

This tool allows the Proposal Handler to view a PHS Tools Information File. It is emphasized that the command line input to this tool is still the name of the Proposal File.

7.5.1.2 Executable Name

gn_infovw

7.5.1.3 PHS Tools Database File Outputs

None. This tool does not produce any output.

7.5.2 Assign Telemetry Lookup Table Tool

7.5.2.1 Function

This tool checks the required telemetry bandwidths for each instrument (previously calculated by the instrument specific PHS Tools) and assigns a suitable telemetry allocation table.

7.5.2.2 Executable Name

gn_tmlook

7.5.2.3 PHS Tools Database File Outputs

For each observation the appropriate telemetry allocation table is identified and written to the PHS Tools Database File.

7.5.3 Scripts

7.5.3.1 Function

There will be 3 PHS Tool Scripts defined. These scripts will specify a sequence of PHS tools to be performed.

7.5.3.2 Script Name

sc_scrpt1, sc_scrpt2, sc_scrpt3

7.5.3.3 PHS Tools Database File Outputs

Not applicable. PHS Tools defined within a script will write to the Proposal Database File but the script itself does not.

8 PHS Tools Database File Definition

8.1 PHS Tools Database File Characteristics

Each PHS Tools Database File is an ASCII file which consists of a number of records. All records consist of an integer multiple of 80 character lines, each line being terminated by a carraige return. All lines will be space (ASCII 32) filled.

The following records types are defined within a PHS Tools Database File:

- Proposal Record
- General Observation Record
- Instrument Specific (EPIC, RGS, OM) Observation Records
- Instrument Specific (EPIC, RGS, OM) Exposure Records
- OM Window Record

and will be present in the file in the following order:

- A proposal record
- There while be a general observation record for each observation identified in the Proposal File. Each general observation record will be followed by (in the order given):
  - An EPIC specific observation record for the EPIC MOS-1 instrument
  - nm1 EPIC exposure records
  - An EPIC specific observation record for the EPIC MOS-2 instrument
  - nm2 EPIC exposure records
  - An EPIC specific observation record for the EPIC p-n instrument
  - np EPIC exposure records
  - An RGS specific observation record for the RGS-1 instrument
  - nr1 RGS exposure records
  - An RGS specific observation record for the RGS-2 instrument
  - nr2 RGS exposure records
  - An OM specific observation record
  - nom OM exposure records Each OM exposure record will be followed by:
    - nsw OM science window records

Where nm1, nm2, np, nr1, nr2 and nom represent the number of exposures associated with the instrument in this observation and nsw is the number of science windows associated with each OM exposure (the value can be different for each exposure).

In all of the subsequent tables 'An' indicates n characters, 'In' indicates an integer of size n characters, 'Fm.n' indicates a real number of total width m characters with n decimal places (for example, F10.7 would represent a number of the form '11.2345678') and 'Em.n' indicates a real number, in engineering format, of total width m characters and n decimal places (for example E10.4 would represent a number of the form ' 1.2345E+24').

8.1.1 Proposal Record

Table 4: PHS Tools Database File: Proposal Record

Line No.	Offset	Type	Description	Note
1	0	A8	'PROPOSAL'	Note 1
2	0	A6	Proposal Id.	Note 2

1. Identifies the record as a Proposal Record
2. The syntax is pppppp

8.1.2 General Observation Record

Table 5: PHS Tools Database File: General Observation Record

Line No.	Offset	Type	Description	Note
1	0	A11	'OBSERVATION'	Note 1
2	0	A10	Observation Id.	Note 2
3	0	I3	Telemetry Allocation Table Pointer	Note 3

1. Identifies the record as an Observation Record
2. The syntax is ppppppooll
3. This number is a pointer to the telemetry allocation table to be used for the observation. A value of '0' (zero) is used to indicate that the field is undefined.

8.1.3 EPIC Observation Record

Table 6: PHS Tools Database File: EPIC Observation Record

Line No.	Offset	Type	Description	Note
1	0	A20	'EPIC OBSERVATION'	Note 1
2	0	I1	EPIC Instrument Id.	Note 2
3	0	I2	No. of exposures	Note 3

1. Identifies the record as an EPIC Observation Record
2. Identifies the EPIC instrument as either EPIC MOS-1 (1), EPIC MOS-2 (2) or EPIC p-n (3).
3. Identifies the number of exposures associated with this instrument for this observation (0-99)

8.1.4 EPIC Exposure Record

Table 7: PHS Tools Database File: EPIC Exposure Record

Line No.	Offset	Type	Description	Note
1	0	A17	'EPIC EXPOSURE'	Note 1
2	0	A13	Exposure Id.	Note 2
3	0	E13.7	Expected x-ray counts	Note 3
4	0	E13.7	Signal to noise ratio	Note 3
5	0	E13.7	Expected pile-up	Note 3
6	0	E13.7	Fraction of smeared photons	Note 3
7	0	E13.7	Duty cycle	Note 3
8	0	E13.7	Total number of counts	Note 3
9	0	E13.7	Total area of chosen fov	Note 3
10	0	E13.7	Counts per frame	Note 3

1. Identifies the record as an EPIC Exposure Record
2. The exposure identifier has the syntax ppppppoolleee.
3. A negative value is used to indicate that the field is undefined.

8.1.5 RGS Observation Record

Table 8: PHS Tools Database File: RGS Observation Record

Line No.	Offset	Type	Description	Note
1	0	A15	'RGS OBSERVATION'	Note 1
2	0	I1	RGS Instrument Id.	Note 2
3	0	E13.7	Expected x-ray counts	Note 4
4	0	E13.7	Expected optical counts	Note 4
5	0	I2	No. of exposures	Note 3

1. Identifies the record as an RGS Observation Record
2. Identifies the RGS instrument as either RGS-1 (1) or RGS-2 (2).
3. Identifies the number of exposures associated with this instrument for this observation (0-99)
4. A negative value is used to indicate that the field is undefined.

8.1.6 RGS Exposure Record

Table 9: PHS Tools Database File: RGS Exposure Record

Line No.	Offset	Type	Description	Note
1	0	A12	'RGS EXPOSURE'	Note 1
2	0	A13	Exposure Id.	Note 2
3	0	I5	Diagnostic downlink time	Note 3

1. Identifies the record as an RGS Exposure Record
2. The exposure identifier has the syntax ppppppoolleee.
3. The value '0' (zero) is used to indicate that the field is undefined or is not applicable.

8.1.7 OM Observation Record

Table 10: PHS Tools Database File: OM Observation Record

Line No.	Offset	Type	Description	Note
1	0	A14	'OM OBSERVATION'	Note 1
2	0	I3	Lower pointing angle constraint	Note 5
3	0	I3	Upper pointing angle constraint	Note 5
4	0	I2	No. of guide stars	Note 4
5	0	A11	guide star 1 right ascension	Note 2
6	0	A11	guide star 1 declination	Note 2
...	...	...	...	...
68	0	A11	guide star n right ascension	Note 2
69	0	A11	guide star n declination	Note 2
70	0	I2	No. of exposures	Note 3

1. Identifies the record as an OM Observation Record
2. The right ascension of the guide stars is expresseed as hours, minutes and seconds of arc in the form HH:MM:SS.SS. The declination of the guide stars is expressed as degrees, minutes and seconds of arc in the form ±DD:MM:SS.S. If the fields are not applicable then the value 'XXXXXXXXXXX' is placed in the fields.
3. Identifies the number of exposures associated with this instrument for this observation (0-99).
4. The number of guide stars which have been identified. The value '0' (zero) is used to indicate that no guide stars have been calculated (or found). In this case all of the guide star details fields would set to 'XXXXXXXXXXX'.
5. The pointing angle constraints will always be defined. They will be either the PGO supplied values or those calculated by the PHS Tool.

8.1.8 OM Exposure Record

Table 11: PHS Tools Database File: OM Exposure Record (*Updated for DCP 1*)

Line No.	Offset	Type	Description	Note
1	0	A11	'OM EXPOSURE'	Note 1
2	0	A13	Exposure Id.	Note 2
3	0	I1	No. of memory windows	Note 4
4	0	A11	Memory window 1 right ascension	Note 5
5	0	A11	Memory window 1 declination	Note 5
6	0	I4	Memory window 1 x0	Note 6
7	0	I4	Memory window 1 y0	Note 6
8	0	I4	Memory window 1 xsize	Note 7
9	0	I4	Memory window 1 ysize	Note 7
...	...	...	...	...
28	0	A11	Memory window m right ascension	Note 5
29	0	A11	Memory window m declination	Note 5
30	0	I4	Memory window m x0	Note 6
31	0	I4	Memory window m y0	Note 6
32	0	I4	Memory window m xsize	Note 7
33	0	I4	Memory window m ysize	Note 7
34	0	**I5**	Tracking frame time (DPU cycles)	Note 8

continued on next page

continued from previous page				
Line No.	Offset	Type	Description	Note
35	0	**I5**	Exposure duration (tracking frames)	Note 8
36	0	E13.7	Total count rate	Note 9
37	0	E13.7	Source count rate	Note 9
38	0	E13.7	Signal to noise ratio	Note 9
39	0	I2	No. of science windows	Note 3

1. Identifies the record as an OM Exposure Record
2. The exposure identifier has the syntax ppppppoolleee.
3. Identifies the number of science windows associated with this exposure (0-5).
4. The number of memory windows that have been calculated (0-5).
5. The right ascension of the guide stars is expresseed as hours, minutes and seconds of arc in the form HH:MM:SS.SS. The declination of the guide stars is expressed as degrees, minutes and seconds of arc in the form ±DD:MM:SS.S. If the fields are not applicable then the value 'XXXXXXXXXXX' is placed in the fields.
6. The value '9999' indicates that this field is not applicable.
7. The value '0' (zero) indicates that this field is not applicable.
8. The value '0' (zero) is used to indicate that the field is undefined.
9. A negative value is used to indicate that the field is undefined.

8.1.9 OM Science Window Record

Table 12: PHS Tools Database File: OM science window record

Line No.	Offset	Type	Description	Note
1	0	A17	'OM SCIENCE WINDOW'	Note 1
2	0	I1	Window Id.	Note 2
3	0	I1	Window mode	Note 3
4	0	E13.7	Expected count rate	Note 5
5	0	I5	Sampling time	Note 4
6	0	I1	Fast memory area	Note 4
7	0	I4	Science window xsize	Note 6
8	0	I4	Science window ysize	Note 6

1. Identifies the record as an OM Science Window Record
2. Identifies the science window (1-5)
3. Identifies the mode of the science window (1=image, 2=fast)
4. These parameters are applicable to fast mode windows only. The value '0' (zero) is used to indicate that the field is undefined or not applicable.
5. A negative value is used to indicate that the field is undefined.
6. The value '0' (zero) is used to indicate that the field is undefined.