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Total Sheets: 20
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'TUNITY

MOD 4.20

MILESTONE 4 DESIGN SPECIFICATION
MISSION PERFORMANCE REPORTING SUBSYSTEM
OVERVIEW

31 JANUARY 1986

PREPARED BY PROJECT 5996
CONTRACT NO. [redacted] (b)(1)

(b)(3)

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FOREWORD

This document is the Overview of the MOD4.20 Milestone 4 Design Specification for the Mission Performance Reporting Subsystem which is a function of the 'TUNITY System. It contains the engineering analysis and logical design for this function.

The Mission Performance Reporting Subsystem was generated as part of the 'TUNITY software development responsibilities under Contract No. [redacted] (b)(1) (b)(3)

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1. INTRODUCTION

The purpose of the Mission Performance Reporting Subsystem is to perform the computational analysis required to determine the geographical areas photographed during pan camera operations, identify targets photographed by the pan camera, and to prepare related reports and data base tables. Specifically, the purpose is to:

(a) Identify the WAC cells whose centers lie in the photographed area along with the obliquity sector in which the center lies, and the subvehicle point at or near the time of photography;

(b) Identify, for the pan camera system, which reporting targets lie in each frame of photography, calculate their film coordinates, and determine their framing status;

(c) Provide print-out and transmission tapes, as required of camera-operation and ephemeris-related data, and, for the pan camera system, provide reporting target data, for use by the user community; and

(d) Construct tables of the WAC-cell acquisition data, described in (a), for use in weather countdown in the Mission Performance Evaluation function.

The relationship of the MPR Subsystem to the 'TUNITY software system is shown in the 'TUNITY Overview.

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2. DESCRIPTION AND FLOW DIAGRAM

The Mission Performance Reporting Subsystem utilizes, as the starting point for its execution, 1) a best-fit ephemeris to define the vehicle position as a function of time, 2) the history of executed commands and 3) frame reference times (FRT) for frames exposed by the camera system. The Mission Performance Reporting Subsystem generates the output report on a rev-by-rev processing basis. Utilizing the ephemeris data and the Mission History Date, the pan camera photographic operations which occurred on the rev are first identified. The geographical bounds of the camera operations are then established and output as a portion of the MPR. The reporting point targets that are in each panoramic photographic operation on the rev are identified. The frame reference time and the ephemeris data are utilized to establish, for each frame in an operation, the geographical coordinates of frame corners and other reference points, and the location on the panoramic camera film of each reporting target. This reporting target data is then output as part of the MPR. Each succeeding rev is processed until all the revs in the rev span of interest have been processed.

Control of the Mission Performance Reporting Subsystem is maintained through the driver routine, 'TEMPER. The other routines which comprise the Mission Performance Reporting Subsystem are:

(a) 'TFRTDR processes data cards by calls to 'TFRTIN and 'TFRTCHK to read and check frame reference time (FRT) data for both camera systems. It also calls 'TFRTIN to process transition data TRAN cards and special operation SPOP cards. Upon request card option, 'TFRTDR will punch FRT data cards for PAN operations. 'TINCO, which provides for program control and setup, controls the disc access of the Best Fit Ephemeris and the Mission History Data.

(b) 'TFCOM identifies the WAC cells in the operation; identifies reporting point targets in pan operations; and controls the calculations which are related to each frame. 'TFCOM will also zero operation and frame corners for all Inertial operations input on SPOP cards.

(c) 'TITAN is a computational routine which provides the coordinates of the intersection of the principal optical ray and other off-axis rays with the surface of the earth.

(d) 'TEAZ is a computational routine which provides the azimuths of the vehicle velocity and ground track velocity.

(e) 'TMOSES controls the calling of the routine 'TSEF for the identification of the reporting targets in each pan camera frame.

(f) 'TSEF identifies those targets appearing in or intersecting a pan camera frame, calculates the precise coordinates of each target with reference to the film, and determines the target's framing status. 'TMPR is the second coreload driver.

(g) 'TOREP provides the formatting and output capability for generation of the MPR reports. 'TOREP1 provides the formatting and output for initial MPR reports.

(h) 'TODAB formats and outputs to the disc the IDs of WAC cells whose centers lie within a photographic operation, along with the obliquity sector of the cell center, the geographical coordinates of the sub-satellite point at the time of cell acquisition and flag if the cell was in an Engineering operation.

(i) 'TFUSE calculates the amount of film used, per optical bar, in a pan camera operation.

(j) 'TFRTIM inputs the FRT data from disc or cards, reads film usage BIAS and TOT cards, checks the data for format errors, and computes the missing frame times. It processes transition data TRAN cards, checking for format errors and maintaining items for the camera parameters portion of the MPR display. It also processes special operation SPOP cards, checking for format errors, and storing parameters for use in the MPR display.

An overview diagram of the Mission Performance Reporting Subsystem is shown in Figure 1. Each MPR routine is shown in each appropriate mode (e.g., rev, pan operation, pan frame, pan operation end, and rev end).

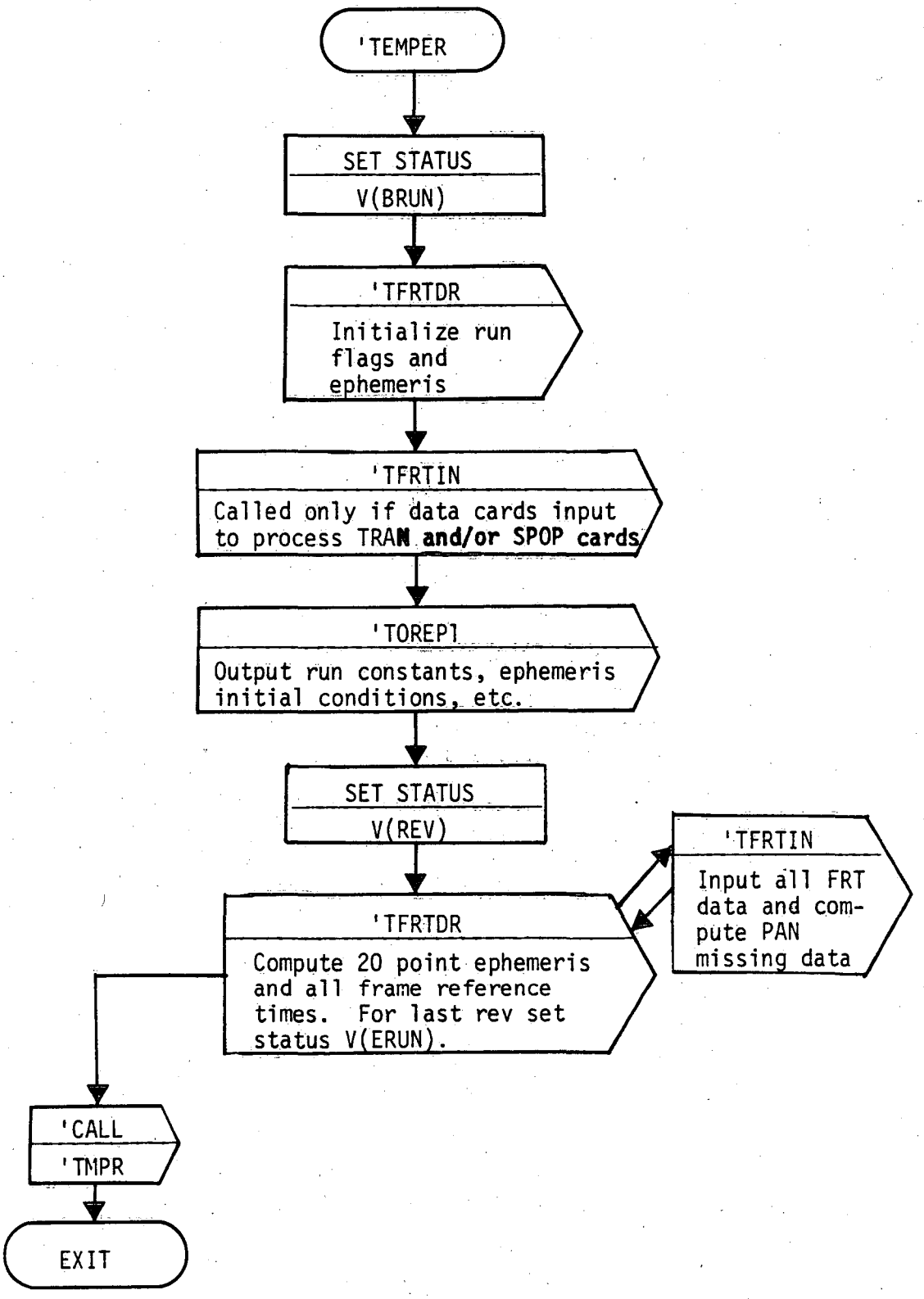

Figure 1. Mission Performance Reporting Subsystem
'TEMPER
(First Coreload)

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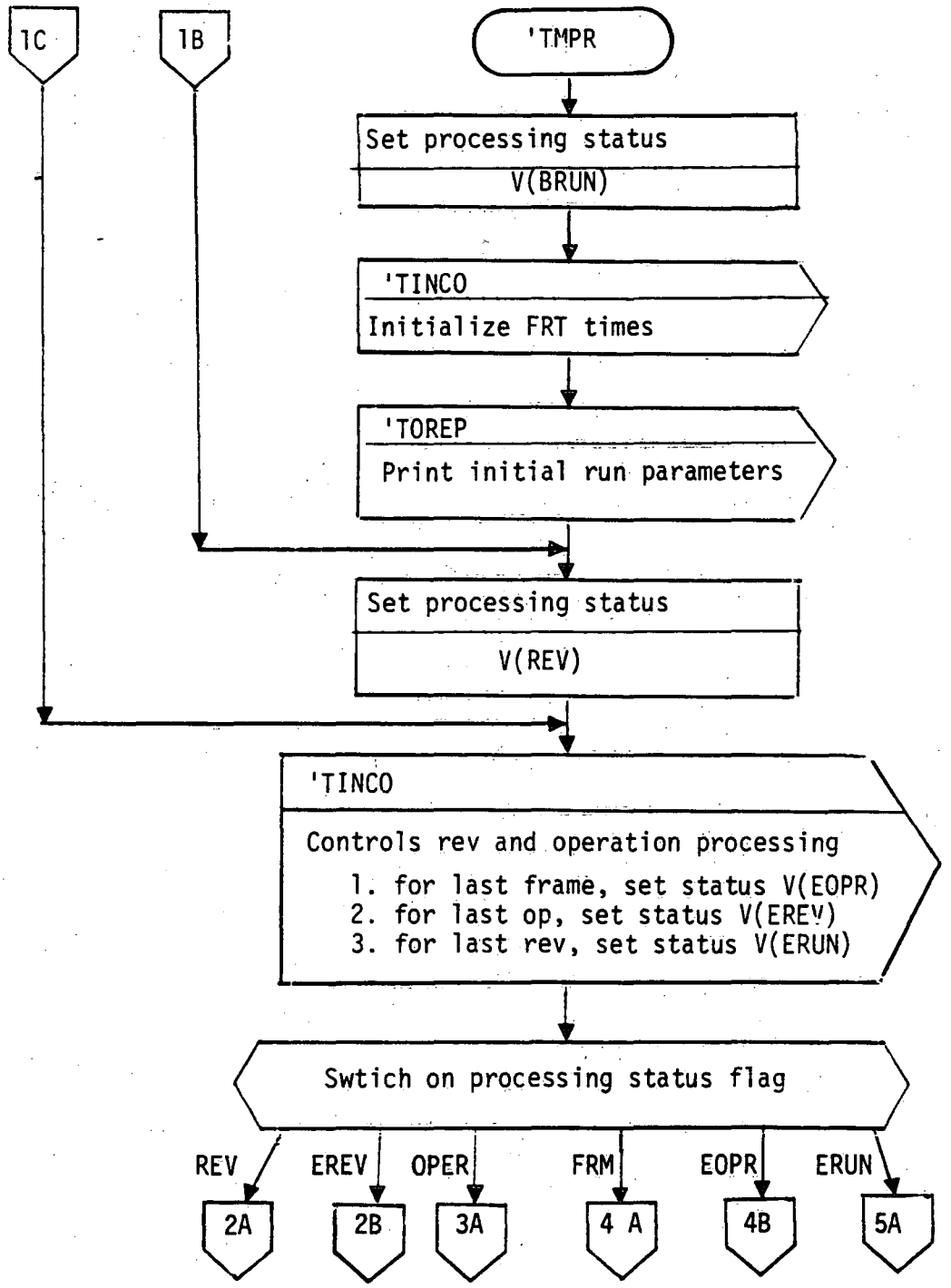

Figure 1. Mission Performance Reporting Subsystem Overview Diagram (Second coreload) 'TMPR

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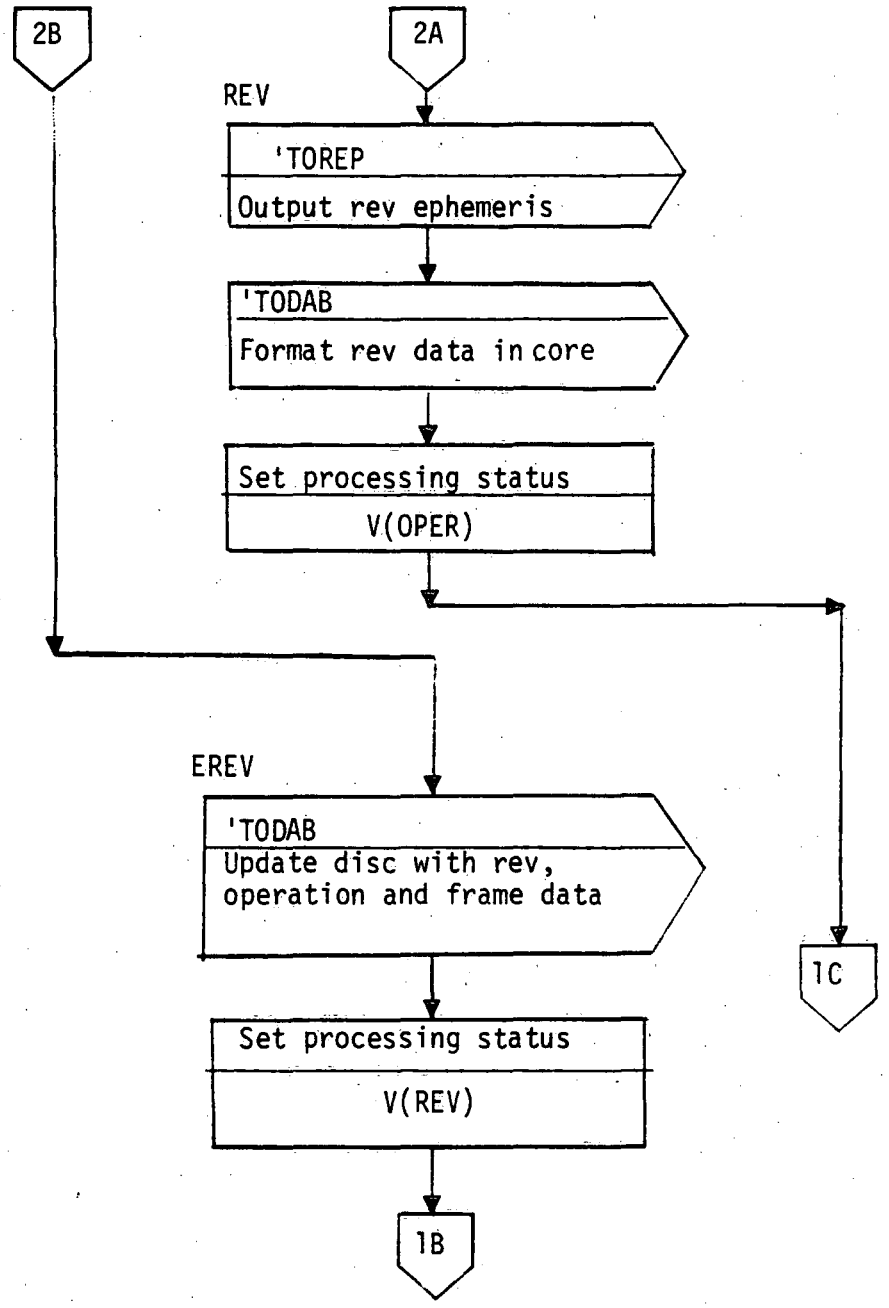

Figure 1. Mission Performance Reporting Subsystem Overview Diagram (Second coreload) 'TMPR

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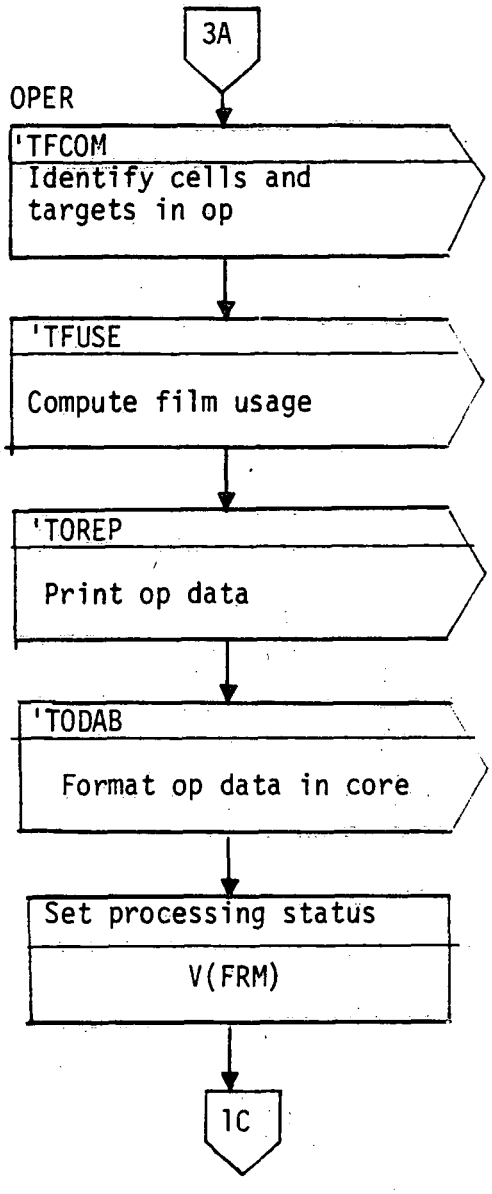

Figure 1. MPR Subsystem Overview Diagram (Second coreload) 'TMPR

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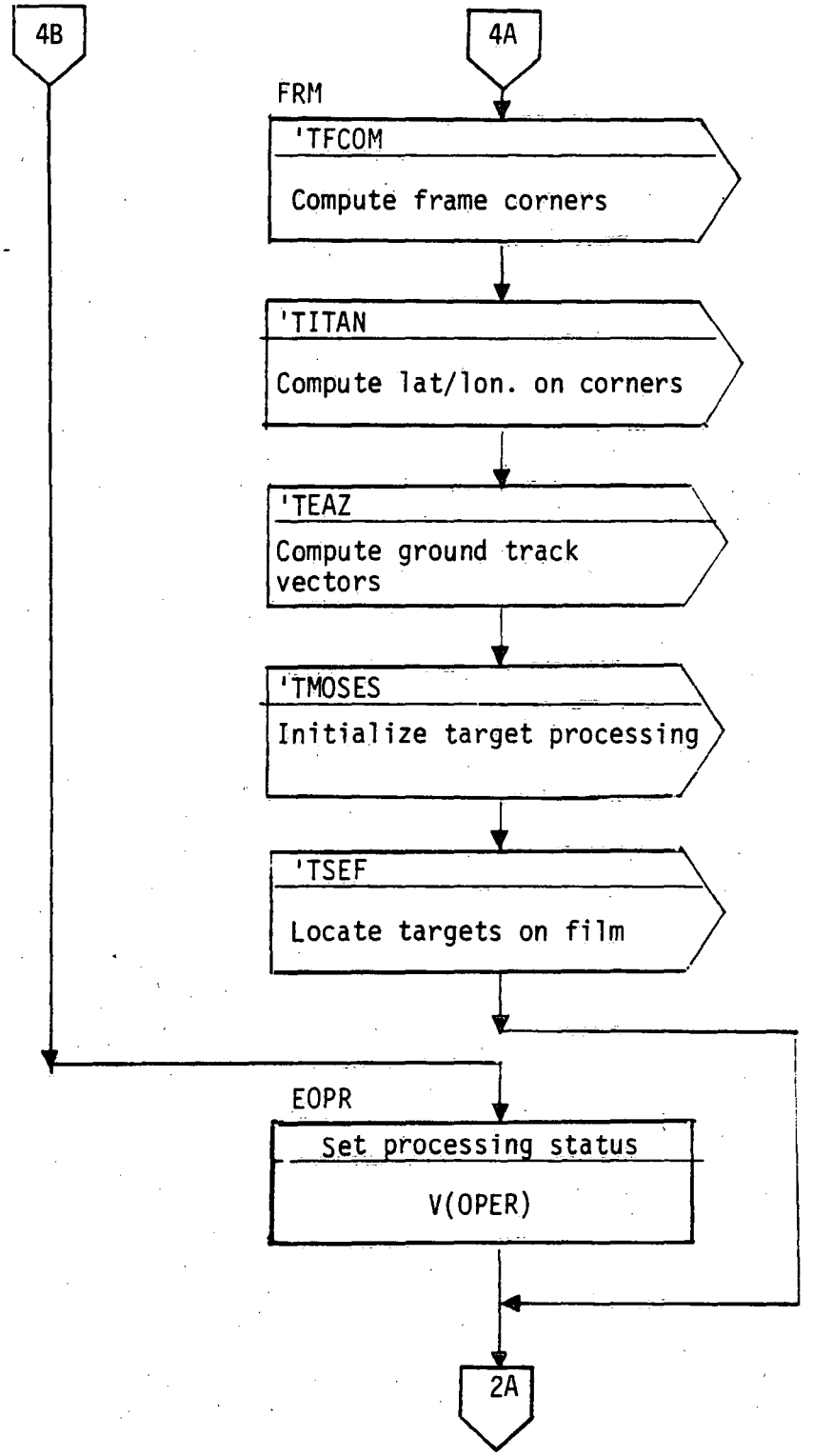

Figure 1. MPR Subsystem Overview Diagram (Second coreload) 'TMPR

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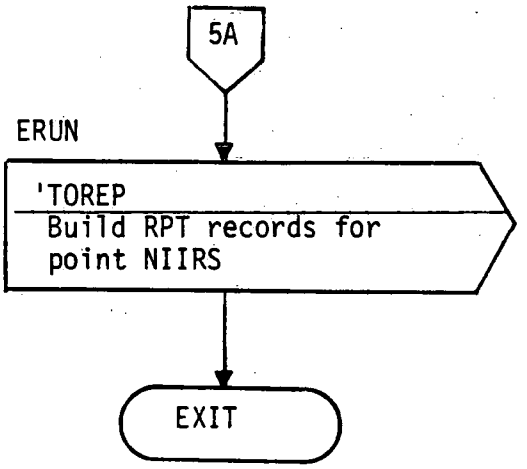

Figure 1. MPR Subsystem Overview Diagram
(Second coreload) 'TMPR

3. USAGE

The purpose of the Mission Performance Reporting Subsystem is to prepare the data base information and printed reports required to analyze the payload data for the mission. The data base information generated by MPR consists of the 'TNP, 'TYR and 'TYM data blocks. The 'TNP data blocks contain essential information about each RPT displayed in the MPR output. The RPT data in the 'TNP data block is used by the 'TREAT core-load of MPE. The 'TYR and 'TYM data blocks described each WAC cell photographed during pan camera operations that occur within the rev span specified on the 'TEMPER function request card. This data is passed to the 'TMOD Mission Objectives Evaluation function which counts down each WAC cell according to the verified weather in the area. The MPR printed reports refer to the Mission Performance Report which is primarily a listing by rev of each pan camera operation occurring during a given rev span. Each frame of pan operations and each reporting target acquired in the pan frames are also listed in the report. A detailed description of the format of this report can be found in the Appendix to the routine 'TOREP.

The MPR function is designed so processing is done on a rev basis. The minimum rev span which can be processed is one rev. Nominally, it is expected to be run about once per day which means rev spans containing from 12 to 18 revs. Prior to running MPR over a given rev span, 'THISTLE must be run to generate command history data. These data consist of the 'TGA, 'TGX, 'TGY, 'TAB, 'TAE, 'TGT, 'TGU, 'TFW data blocks. Each pan operation to be processed by 'TEMPER must be defined in these data blocks. It is up to the user to determine that this is so by insuring that 'THISTLE is run for each rev to be processed by 'TEMPER. In addition, 'TELOP nominally provides telemetry data in the 'TMA, 'TMF, 'TMG data blocks.

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In addition to running 'THISTLE and 'TELOP over the span of interest, the user must generate a valid ephemeris which covers the given span. Although the MPR routines will run with any valid ephemeris, a BFE should be used since it is important to know as precisely as possible the position of the vehicle during a camera operation.

A nominal MPR run will produce the Mission Performance Report on the on-line printer, the system output tape, and the transmission tapes. The on-line output can be suppressed using the NOPR parameter on the 'TEMPER function request card. Error messages however, will be forced on-line. The system output and on-line printer can be suppressed simultaneously using the NOSO parameter. Transmission tape output can be suppressed using the NOTT option.

Also output with each MPR run is the WAC cell acquisition data for each pan operation in the rev span. This data is output on the disc and may be suppressed upon request card option.

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4. INPUT

The Mission Performance Reporting Subsystem is initiated by an operations request card. The data required by the function includes the best-fit ephemeris data, frame-reference-time data, reporting target file, and the Mission History data contained in the 'TGA, 'TGX, 'TGY, 'TGZ, 'TAB, 'TGT, 'TGU, and 'TAE data blocks. Nominally, telemetry data contained in the 'TMA, 'TMF, 'TMG data blocks will be provided.

4.1 Operation Request Card

*'TEMPER VE *ephem* *start'rev* *end'rev* [*out'unit*] {S} [*stak'opt*] {S}

[*disc'opt*] [*db'opt*] [*card'opt*] {S} $

Field Parameter	Field Identifier	Field Parameter Size (Type)	Field Description
ephem	VE	XXXXXXXX(BCI)	Ephemeris I.D. Up to eight characters may be used to specify the ephemeris name requested for 'TEMPER processing. The first character must be an alpha character (mandatory field)
start'rev	--	XXXX(I)	Start rev of span to be processed (mandatory field) (0-4095)
end'rev	--	XXXX(I)	End rev of span to be processed (mandatory field) (0-4095)
out'unit	--	XXXX(H)	Output specifier NOTT = No transmission tape. This parameter causes a flag to be set which suppresses the construction of the transmission tape NOSO = No system output. This parameter causes a flag to be set which suppresses the system output tape and on-line printer

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Field Parameter	Field Identifier	Field Parameter Size (Type)	Field Description
			NOPR = No printer output. This parameter causes a flag to be set which suppresses the printer output
stak'opt	--	XXXXX(H)	Transmission tape stack option STAKA = Stack transmission tape A output. This parameter causes a flag to be set which results in the MPR report being generated behind a previously generated report on the transmission tape A
db'opt	--	XXXX(H)	Data base output suppress flag NODB = This parameter will suppress output of 'TYR and 'TYM data blocks
card'opt	--	XXXX(H)	Data card input/output option flag SS = This parameter causes frame reference time data cards to be punched on-line for all pan operations in rev span CARD = This parameter indicates that data cards are to be read.

Field Parameter	Field Identifier	Field Parameter Size (Type)	Field Description
disc'opt	--	XXXX(H)	Reporting Target File Disc Option

DISC = This parameter causes a flag ('TAADO) to be set which will result in the Reporting Target File being transferred by 'TFIDOG from tape to disc. MPR will then access the information from disc during the run instead of running from tape .

Special Comments:

(1) Mandatory fields must be in the order presented.

(2) Optional fields [ ], may be specified in any order as long as they follow the mandatory fields.

(3) {S} indicates that the preceeding field may be repeated to specify any or all output options.

(4) Cards and normal Mission Performance Report output cannot be generated on the same run. If SS is specified, the CARD option will be ignored.

(5) The TOT CARD must be used on an MPR re-run if:

a) System is not re-loaded and the last OP of the previous day's MPR does not have the same mode/scan compatibility as the first OP of the current MPR.

Limitations

The maximum number of revs in the rev span specified on the operations request card is 800. The maximum number of operations that can be processed is 15 per rev and 4095 per mission.

If the optional parameter CARD is specified on the operations request card, the minimum permissible card input is the TERM card.

When 'TEMPER must be rerun, the data base must be reloaded.

4.2 DATA CARDS

Formats of data cards are shown in the Appendix. Data cards used by this function are as follows:

Data Card	Description
REV	Specifies rev number for subsequent data
OP	Specifies frame reference time data for identified pan operation
BIAS	Specifies footage bias to be added to interoperation film usage for identified pan operation.
SPOP	Specifies special operation (Engineering or Inertial)
TOT	Specifies override interoperation film usage for identified pan operation
TERM	Terminates read of data cards
TRAN	Specifies actual film and filter transition times for the pan camera.

4.3 TAPE

The Mission Performance Reporting Subsystem requires the user to equip a 'TTR tape on the logical unit specified by the CBLK item 'CMRRIN.

5. OUTPUT

The outputs of the Mission Performance Reporting Subsystem are the 'TNP, 'TYM, and 'TYR data blocks (to disc storage). The 'TNP block, which is set by 'TOREP, contains the rev number, operation number, frame number, ID, time of acquisition, and y-film coordinate of each RPT included in the MPR reports. This data is used by the 'TREAT coreload of MPE to compute NIIRS probabilities of photographic quality for each RPT. The 'TYM and 'TYR data blocks contain the IDs of the WAC cells seen in the pan photographic operations plus related data, and the Mission Performance Report on-line printer, system output tape and/or transmission tape. The data blocks are described in greater detail in 'TODAB. The format of the Mission Performance report is described in 'TOREP.

Unless the NOTT parameter is specified on the function request card a transmission tape will be output. This requires the user to equip the logical units specified in the CBLK items 'CMRROT and 'CMRGUT.

If the SS parameter is specified, the only output will be a deck of punched cards containing the frame reference times of the pan camera system for the specified rev span. The format of the punched cards is consistent with the card format description in the Appendix. However, the TERM card is not provided as part of the punched card output.

If the CARD option is used, a listing of the data cards will be forced to the printer. Data card print is controlled by in the 'CMP block.

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APPENDIX

FRAME REFERENCE TIME DATA CARDS

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APPENDIX

FRAME REFERENCE TIME DATA CARDS

1. DATA CARD USAGE

The frame reference time data cards provide to the Mission Performance Reporting Subsystem a means of accurately establishing a reference time for the processing of data related to each frame in the photographic operations. The timing information provided by the frame reference time data cards is obtained from downlink telemetry.

The data deck structure is shown in Figure 2. The REV and OP cards are required to be in the order shown in the figure; BIAS and TOT cards may appear anywhere and in any order between two REV cards or between the REV and TERM cards. The format of the cards and data requirements are given in the following paragraphs.

2. DATA CARD DESCRIPTION

The cards which comprise the frame reference time data card deck are:

- REV Card - Specifies the rev number for the subsequent data cards. Must be present for each rev for which there are OP, BIAS or TOT cards.
- OP CARD - Provides the reference time of a pan frame along with an identification of the optical bar (i.e., forward or aft), the operation and frame count for the pan frame associated with the reference time.
- BIAS Card - Provides footage BIAS for interoperation film usage.
- TOT Card - Provides override interoperation film footage.
- SPOP Card - Provides for special operations

- TERM Card - Specifies the end of data cards.
- TRAN Card - Specifies the time of transition for Film and/or Filter Types.

Complete definitions of the card formats for the REV, OP, BIAS, TOT, TRAN and TERM cards, respectively, are given in Table 1 through 7. The frame reference time card deck structure is shown in Figure 2.

3. DATA REQUIREMENTS

3.1 Nominal Data Requirements

3.1.1 Pan Camera Data

It will not be necessary to input frame reference times and numbers for every frame in the operation. Intermediate frame reference times can be determined very accurately through linear interpolation since the optical bar rotation rate, for all practical purposes, is constant. However, since the acceleration rate of the optical bar results in a .1% uncertainty in the rotation rate can change during an operation due to V_X/h updates, the nominal requirement for data will be defined as:

(1) The data sets corresponding to the first and last frame in the operation for each optical bar and

(2) Two complete data sets for each optical bar (used to compute V_X/h) corresponding to frames within each span of constant rotation rate (i.e., between V_X/h updates).

It is desirable that these data sets correspond to the frames before and after the V_X/h change since the greatest accuracy can be achieved with these sets.

It is recognized that the commanded time for the V_X/h change is computed with no prior knowledge of the position of the optical bar. Therefore, the following rules will be used to determine the first frame affected by a V_X/h change when interpolation is used.

(1) If the commanded time for V_x/h change is within the executable time span, apply the change to the current frame.

(2) If not, apply the change to the next frame.

A definition of executable time span for V_x/h changes will be that which is more than 1/2 of one OB revolution prior to frame reference time.

3.2 Minimum Data Requirement Assuming Lost Data

Although the nominal requirement is desired, the minimum number of data sets required to process an operation is defined by the following rules:

3.2.1 Pan Camera

Only two data sets are required for each optical bar if the two sets correspond to the first and last frames in the operation.

The unknown frame times will be computed using methods previously described. The commanded V_x/h will be used in the computation of intermediate times. It is recognized that for long operations the uncertainties in OB rotation rate may result in additional frames being computed or some frames being omitted. If such an event is encountered, an error condition will occur. Therefore, using the minimum requirement is not recommended. It should by no means be construed as an acceptable minimum if additional data are available.

3.3 Summary

The following guidelines are given:

(1) If all data are available, the nominal requirement is sufficient.

(2) If data are lost, verify that the minimum requirement is satisfied and input as much data as is available keeping in mind that the nominal requirement is sufficient.

3.4 Restrictions

The following restrictions apply to data cards:

- The maximum number of pan frame reference times that may be input for any rev is 600 per optical bar.

- The first and last frame reference time must be input for each operation in the rev.

- Only complete data sets (e.g., data sets containing the camera flag ("A", "B", or "C"), the frame count, and frame reference time [vehicle time]) may appear on input data cards.

- If less than two frame reference times are input between (V_x/h or V/h) updates, the commanded value of (V_x/h or V/h) will be used and all frame times computed using commanded (V_x/h or V/h) will be identified.

- An error condition may occur if insufficient frame data (i.e., less than the nominal requirement, Part 3.1) are input for an operation. Using commanded values of (V_x/h) or V/h) for long operations may cause an error since input actual frame reference times are checked for keypunch errors by comparing the input value to a computed value. Using the commanded value of (V_x/h or V/h) may cause the computed value to diverge to a value greater than or less than the input time. 'CTEFTT specifies the expected maximum difference between commanded and computed (V_x/h or V/h). Therefore, as previously mentioned, the minimum requirement (Part 3.2) <u>is not</u> recommended.

- All OP, BIAS, and TOT cards placed between two REV cards (or a REV card and a TERM card) will be assigned to the preceding REV card.

- Rev numbers and operation numbers must be in increasing order, with the first operation number being one.

- TRAN and SPOP cards must be the first cards in the deck after the 'TEMPER function card. Either card may be input first.

- Two filter and two film type transitions per camera may be specified per run on to a maximum of eight TRAN cards.

- Four special operations may be specified per run on up to a maximum of four SPOP cards.

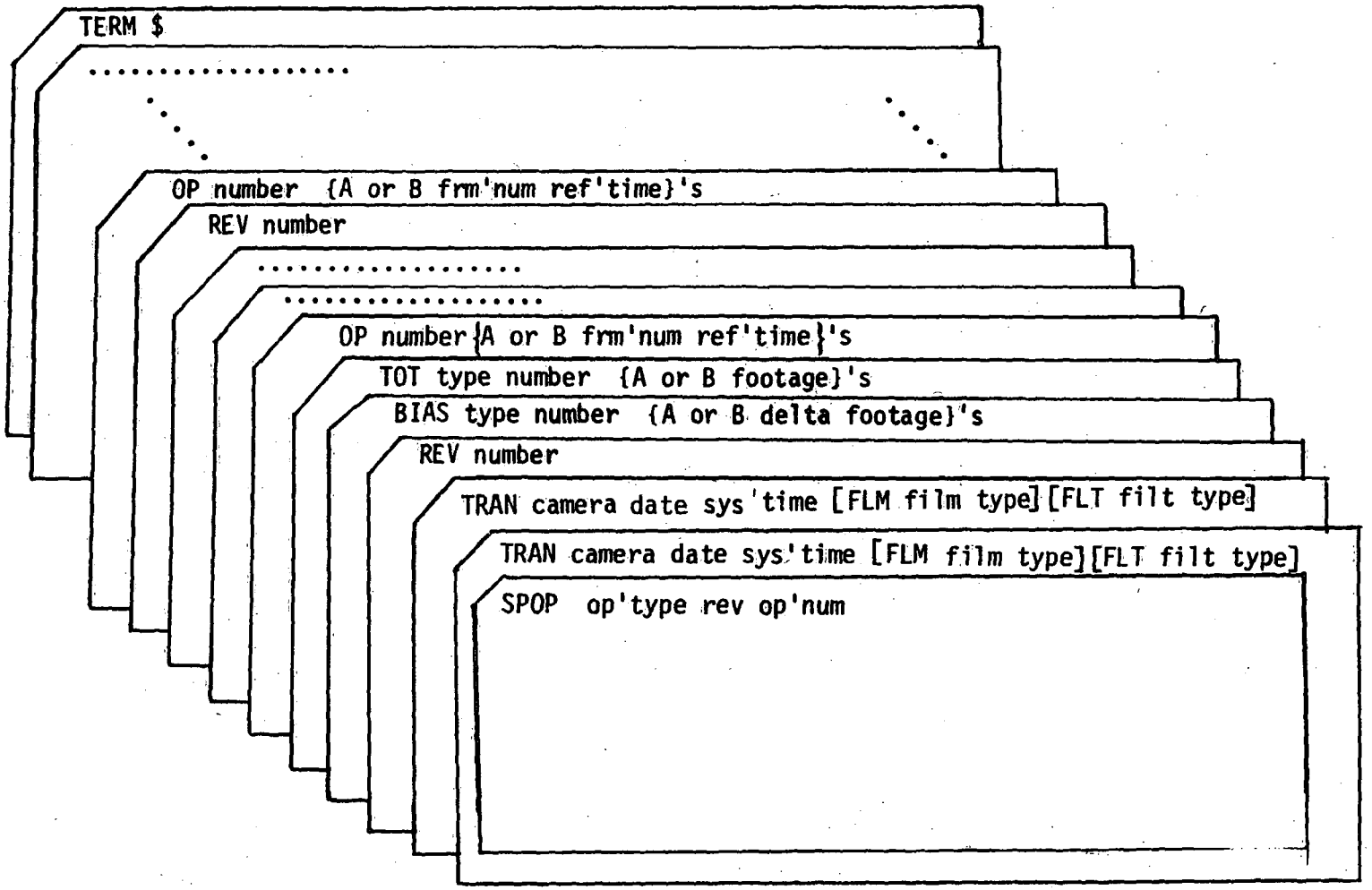

Figure 2. Data Deck Structure (Sheet 1 of 1)

Table 1. DATA CARD

REV CARD

Name: Rev Card
Purpose: To specify the rev number for subsequent data
Identifier(s): REV as first parameter (columns 1 through 3)
Applicable Data Block(s): 'TAA
Data Block(s) Set By: INHALE (a procedure of 'TFRTIN)
Subsystem: MPR

REV *rev'no*

Field Parameter	Field Identifier	Field Parameter Size (Type)	Field Description	COMPOOL Name
rev'no	- .	XXXX(I)	Rev number for subsequent data (0-4095)	'TAANR

Special Comments: The REV card is semi-free field with REV in columns 1 through 3.

Table 2. FRAME REFERENCE TIME DATA CARDS

PAN OPERATION CARD

Name: Pan Operation Card
Purpose: To specify frame data for the identified operation
Identifier(s): OP as first parameter (columns 1 and 2)
Applicable Data Block(s): 'TAA
Data Block(s) Set By: INHALE (a procedure of 'TFRTIN)
Subsystem: MPR

OP *op'num* (*obar* *frm'num* *ref'time*) {S}

Field Parameter	Field Identifier	Field Parameter Size (Type)	Field Descriptor	COMPOOL Name
op'num	-	XX(I)	Intra-rev operation number for subsequent operations data	'TAAROP
obar	-	X(H)	Optical bar for operation A = forward optical bar B = aft optical bar	-
frm'num	-	XXXX(I)	Frame number for optical bar specified, from onboard counter via telemetry	'TAAQCF 'TAAPCF
ref'time	-	(F)	Vehicle time, sec. (0.0 - 3,355, 443.0)	'TAAQFT

Special Comments: The repeatable data sets may be continued to the next data card(s) without repeating the OP parameter.

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Table 4. FILM USAGE DATA CARD

BIAS CARD

Name: Film Usage Bias Card

Purpose: To input footage bias for interoperation film usage or photographic operation film usage

Identifier: BIAS as the first parameter

Applicable Data Block: 'T9A

Data Block Set By: Procedure INHALE of 'TFRTIN

Subsystem: MPR

BIAS *type op'num (camera footage)* {S}

Field Parameter	Field Identifier	Field Parameter Size (Type)	Field Description	COMPOOL Name
type	-	XX(H)	PO = bias photographic operation film usage IO = bias interoperation film usage	-
op'num	-	XX(I)	Inter-rev operation number for data	-
camera	-	X(H)	Camera A = forward camera B = aft camera	-
footage	-	(F)	Film usage bias to be added to interoperation film usage, ft.	'T9AFBA 'T9AFBB

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Table 4.5. SPECIAL OPERATIONS DATA CARD

SPOP CARD

Name: Special Operations Card

Purpose: To provide special processing in cases where the pan System is not nominal, i.e., Inertial or Engineering Operations

Identifier: SPOP as the first parameter

Applicable Data Block: 'TAA

Data Block Set By: Procedure INHALE in 'TFRTIN

Subsystem: MPR

SPOP *op'type* *rev* *op'num*

Field Parameter	Field Identifier	Field Parameter Size (Type)	Field Description	Range	COMPOOL Name
op/type	-	XXX(H)	Type of special operation ENG = Engineering op INE = Inertial op (SSP or stellar cal shot)	-	'TAAOT
rev	-	XXXX(I)	Rev number of special operation	0-8191	'TAAREV
op'num		XX(I)	Intre-rev operation number	1-15	'TAAOPR

Special Comments:

(1) All four fields must appear.

(2) A maximum of 4 SPOP cards can be input per MPR run.

Table 5. FILM USAGE DATA CARD

TOT CARD

Name: Other Non-photographic Film Usage Card

Purpose: To input film usage for non-normal type operation which overrides interoperation film footage

Identifier: TOT as the first parameter

Applicable Data Block: 'T9A

Data Block Set By: Procedure INHALE in 'TFRTIN

Subsystem: MPR

TOT *type* *op'num* (*camera* *footage*) {S}

Field Parameter	Field Identifier	Field Parameter Size (Type)	Field Description	COMPOOL Name
type		XX(H)	PO = Override photographic operation film usage IO = override interoperation film usage	
op'num	-	XX(I)	Inter-rev operation number for data	
camera	-	X(H)	Camera A = forward camera B = aft camera	
footage	-	(F)	Film usage override to interoperation usage, ft.	'T9AFPA 'T9AFPB

Table 6. TERM CARD

Name: Card Read Termination Card

Purpose: To terminate all reading of data cards/images

Identifier(s): TERM as first and only parameter (columns 1 - 4)

Applicable Data Block(s): None

Data Block(s) Set By: None

Subsystem: MOD, DBM, MPR

TERM $

Field Parameter	Field Identifier	Field Parameter Size (Type)	Field Descriptor	COMPOOL Name
None	-	-	-	-

Special Comments: The TERM card is a fixed field card with TERM (BCD) in columns 1 through 4. The dollar sign is not necessary on the TERM card.

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Table 7. TRANSITION DATA CARD

Name:	Actual Film and Filter Transition Time Card
Purpose:	To input film types and filter changes during the MPR span
Identifier(s):	TRAN as the first parameter
Applicable Data Block(s):	'TRN
Data Block Set By:	Procedure INHALE of 'TFRTIN
Subsystem:	MPR

TRAN *camera rev system time* [FLM *film type* FLT *filter*][1]

Field Parameter	Field Identifier	Field Parameter Size (Type)	Field Descriptor	Compool Name
camera	-	X(H)	Camera A = forward camera B = aft camera	'TRNCAM
rev	-	XXXX(I)	Revolution number	'TRNDAT
system time	-	XXXXX.XXX	Universal Time (system time) 0 to 86399.999 seconds	'TRNSEC
film type	FLM	XXXXXXXX(H)	Film type NOTE: If numeric value input, a hollerith modifier must be used (e.g., H(1414))	'TRNFLM
filter	FLT	XXXXXXXX(H)	Filter	'TRNFLT

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Special Comments:

(1) At least one field must appear.

(2) The filter transition will only be displayed when there is an actual change of filter type.

(3) A maximum of 8 TRAN cards can be input per MPR run.

(4) When film is input without a filter type on the TRAN card, the filter type will default to the type that is associated with the film in the 'COPFLM table.

(5) Filter must be eight characters where any necessary blanks are to be placed at the right. e.g. H(CLEAR) where there are three blanks at the end of CLEAR.

(6) The camera/film type/filter type combination must agree with one of the combination's in the 'COP block (in particular 'COPCAM, 'COPTYP and 'COPFLR.)

~~SECRET/ HX~~

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