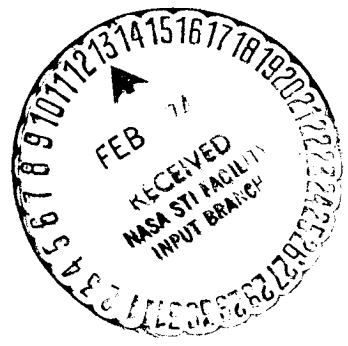
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

MSC INTERNAL NOTE NO. 69-FM-47

FEBUARY 17, 1969

REAL-TIME AUXILIARY COMPUTING FACILITY APOLLO 9 OPERATIONAL SUPPORT TEAM HANDBOOK



Flight Analysis Branch
MISSION PLANNING AND ANALYSIS DIVISION
MANNED SPACECRAFT CENTER
HOUSTON, TEXAS

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REAL-TIME AUXILIARY COMPUTING FACILITY APOLLO 9 OPERATIONAL SUPPORT TEAM HANDBOOK

By
Mission Operations Section
TRW Systems Group

February 17, 1969

MISSION PLANNING AND ANALYSIS DIVISION
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
MANNED SPACECRAFT CENTER
HOUSTON, TEXAS

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NOMENCLATURE

ABDP	APOLLO BLOCK DATA PROGRAM
AGC	APOLLO GUIDANCE COMPUTER
AGOP	APOLLO GENERALIZED OPTICS PROGRAM
AOT	ALIGNMENT OPTICAL TELESCOPE
APS	ASCENT PROPULSION SYSTEM
ARMACR	RTACF APOLLO REFERENCE MISSION PROGRAM
ARMP	APOLLO REFERENCE MISSICN PROGRAM
ARRS	APOLLO REAL-TIME RENDEZVOUS SUPPORT PROGRAM
ARS	APOLLO REENTRY SUPPORT PROGRAM
BCD	BINARY CODED DECIMAL
C.G.	CENTER OF GRAVITY
CLA	CONTINGENCY LANDING AREA
CM	COMMAND MODULE
CMC	COMMAND MODULE COMPUTER
COAS	CREWMAN OPTICAL ALIGNMENT SIGHT
COL	COLUMN
CSM	COMMAND AND SERVICE MODULE
DAP	DIGITAL AUTOPILOT
DD80	MAGNETIC TAPE TO MICROFILM CONVERTER
DMT	DETAILED MANEUVER TABLE
DPS	DESCENT PROPULSION SYSTEM
DSKYUP	DSKY UPDATE
ECI	EARTH CENTERED INERTIAL
EI	ENTRY INTERFACE
FAB	FLIGHT ANALYSIS BRANCH

FAP	FORTRAN ASSEMBLY PROGRAM
FASTRAND	UNIVAC MASS STORAGE MAGNETIC DRUM UNIT
FDAI	FLIGHT DIRECTOR ATTITUDE INDICATOR
FDO	FLIGHT DYNAMICS OFFICER
FORTRAN	FORMULA TRANSLATION
G	DECELERATION
GEMMV	GENERAL ELECTRIC MISSILE AND SATELLITE MULTI-VEHICLE PROGRAM
G.E.T.	GROUND ELAPSED TIME
GMT	GREENWICH MEAN TIME
GMTIUGRR	GREENWICH MEAN TIME OF THE INERTIAL GUIDANCE REFERENCE RELEASE
GMTL/O	GREENWICH MEAN TIME OF LIFT-OFF
GMTZS	GREENWICH MEAN TIME OF ZEROING SPACECRAFT
GOST	GUIDANCE OPTICAL SUPPORT TABLE
GPMP	GENERAL PURPOSE MANEUVER TABLE
GRR	GUIDANCE REFERENCE RELEASE
IBSYS	IBM SYSTEM (BASIC OPERATING SYSTEM FOR THE IBM 7094)
I.D.	IDENTIFICATION
IGA	INNER GIMBAL ANGLE
IMU	INERTIAL MEASUREMENT UNIT
IU	INSTRUMENT UNIT
L/D	LIFT-TO-DRAG RATIO
LES	LUNAR ESCAPE SYSTEM
LET	LAUNCH ESCAPE TOWER
LM	LUNAR MODULE
LM RCS	LUNAR MODULE, REACTION CONTROL SYSTEM CONSUMABLES PROGRAM
LO	LIFT-OFF

LOS	LINE OF SIGHT
LOST	LUNAR OPTICAL SIGHTING TABLE
LPD	LANDING POINT DESIGNATOR
LV	LAUNCH VEHICLE
LVLH	LOCAL VERTICAL/LOCAL HORIZONTAL
MGA	MIDDLE GIMBAL ANGLE
MPAD	MISSION PLANNING AND ANALYSIS DIVISION
MPT	MISSION PLAN TABLE
MRS	MASS PROPERTIES, REACTION CONTROL SYSTEM, SERVICE PROPULSION SYSTEM PROGRAM
MSC	MANNED SPACECRAFT CENTER
MSFC	MARSHALL SPACE FLIGHT CENTER
MSFN	MANNED SPACE FLIGHT NETWORK
NASA	NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
OST	OPTICAL SIGHTING TABLE
PAO	PUBLIC AFFAIRS OFFICE
PCF	PROGRAM CONTROL FILE
PGNCS	PRIMARY GUIDANCE AND NAVIGATION CONTROL SYSTEM
PIT	PARAMETER ITERATION TECHNIQUE
PLA	PRIMARY LANDING AREA
PSAT	PREDICTED SITE ACQUISITION TABLE
PTC	PASSIVE THERMAL CONTROL
PVT	PRESSURE-VOLUME-TEMPERATURE
OGA	OUTER GIMBAL ANGLE
RCS	REACTION CONTROL SYSTEM
REFSMMAT	REFERENCE SYSTEM TO STABLE MEMBER MATRIX TRANSFORMATION
REM	ROENTGEN EQUIVALENT MAN

RET	RETRO ELAPSED TIME
RTACF	REAL-TIME AUXILIARY COMPUTING FACILITY
RTCC	REAL-TIME COMPUTING COMPLEX
SCS	STABILIZATION CONTROL SYSTEM
SEENA	SPACECRAFT ELECTRICAL ENERGY NETWORK ANALYSIS
SHE	DESCENT PROPULSION SYSTEM SUPERCRITICAL HELIUM SYSTEM PROGRAM
S-IVB	SECOND STAGE OF THE SATURN IB LAUNCH VEHICLE
SM	SERVICE MODULE
SPAN	SOLAR PARTICLE ALERT NETWORK
SPECUS ARDC USSTD POE SMALL SPECAR	ATMOSPHERIC MODELS
SPS	SERVICE PROPULSION SYSTEM
SST	STAR SIGHTING TABLE
WSP	WORK SCHEDULE PROCESSOR

CS	CENTISECOND
DEG	DEGREE
ER	EARTH RADIUS
ER/HR	EARTH RADII PER HOUR
FT	FOOT
FT/SEC	FEET PER SECOND
HR	HOUR
KG	KILOGRAMS
KM	KILOMETER

LB	POUND
M	METER
MIN	MINUTE
M/CSEC	METERS PER CENTISECOND
M/SEC	METERS PER SECOND
N MI	NAUTICAL MILES
RAD	RADIANS
SEC	SECOND

REAL-TIME AUXILIARY COMPUTING FACILITY

APOLLO 9 OPERATIONAL SUPPORT TEAM HANDBOOK

MISSION OPERATIONS SECTION

TRW SYSTEMS GROUP

1. INTRODUCTION

THIS DOCUMENT PRESENTS THE OPERATING INSTRUCTIONS FOR THE APOLLO 9 REAL-TIME AUXILIARY COMPUTING FACILITY (RTACF) PROCESSORS AND IS INTENDED FOR USE BY THOSE INDIVIDUALS ASSIGNED TO THE RTACF APOLLO 9 OPERATIONAL SUPPORT TEAM. THE PROCESSORS DESCRIBED IN THIS HANDBOOK WERE DEVELOPED BY THE RTACF OPERATIONAL SUPPORT TEAM TO FULFILL THE RTACF REQUIREMENTS FOR THE SUPPORT OF THE APOLLO 9 MISSION. A DETAILED DISCUSSION OF THESE REQUIREMENTS AND A GENERAL DESCRIPTION OF THE PROCESSORS ARE PRESENTED IN THE RTACF APOLLO 9 FLIGHT ANNEX (REFERENCE 1).

SINCE THE REQUIREMENTS AND THE PROCESSORS CONFIGURED TO FULFILL THOSE REQUIREMENTS WILL BE CONTINUALLY CHANGING PRIOR TO THE MISSION, AND POSSIBLY EVEN DURING THE MISSION, THIS HANDBOOK HAS BEEN PLACED ON COMPUTER CARDS FOR CONVENIENCE OF UPDATING.

2. OPERATING INSTRUCTIONS FOR THE GEMMV PROCESSORS

2.1 GENERAL

THIS SECTION PRESENTS THE TAPE SETUP AND THE CONTROL CARDS REQUIRED TO OPERATE THE GEMMV PROCESSORS ON THE UNIVAC 1108 DATA PROCESSING SYSTEM. ALSO PRESENTED IS A BRIEF DESCRIPTION OF EACH PROCESSOR ALONG WITH THE ON-LINE INPUTS REQUIRED FOR THEIR OPERATION.

2.2 TAPE SETUP FOR THE UNIVAC 1108 DATA PROCESSING SYSTEM

TAPE UNIT	TAPE DESCRIPTION
A	GEMMV PROGRAM (PCF) TAPE
B	MISSION TABLE TAPE
F	MISSION DATA TAPE

2.3 CONTROL CARD LISTING AND ON-LINE DECK SETUP FOR THE UNIVAC 1108 DATA PROCESSING SYSTEM

```
COLUMN 1  4    8
       *  MSG                    COMMENTS
          ASG A = XXXX           GEMMV PROGRAM (PCF) TAPE
                                 NUMBER
          ASG B = XXXX           MISSION TABLE TAPE NUMBER
          ASG F = XXXX           MISSION DATA TAPE NUMBER
          ASG G,N,V              SCRATCH UNITS ON FASTRAND
          XQT CUR                EXECUTE THE FOLLOWING IN-
                                 STRUCTIONS
              TRW A,B,F,G,N,V    REWIND UNITS A,B,F,G,N,V
              IN A               INPUT THE ENTIRE USER PCF
                                 FROM UNIT A
              .
              .                  SOURCE LANGUAGE CORRECT-
                                 IONS (PATCHES)
              .
           N XQT GEMMV           EXECUTE GEMMV PROGRAM
          XN$                    N IS THE FILE NUMBER OF
                                 THE DATA TAPE
          XM$                    M IS THE NUMBER OF GEMMV
                                 TABLES TO INPUT
          .
          .                      GEMMV TABLES
          .
          .
```

```
A
A
A
A
•                          A-ARRAY UPDATES FOR PHASE
                           1
•
A
   TRA 2,4                 EXECUTE PHASE 1
A
A
A
•                          A-ARRAY UPDATES FOR PHASE 2
•
A
   TRA 2,4                 EXECUTE PHASE 2
    •
    •                      GEMMV A-ARRAY UPDATES AND
    •                      PHASE EXECUTE CARDS
    •
A
A
A
•                          A-ARRAY UPDATES FOR PHASE N
•                          WHERE N IS THE LAST GEMMV
•                          PHASE
A
A
   TRA 2,4                 EXECUTE PHASE N
**FILE K                   LAST CARD IN THE GEMMV DECK
   EOF                     END OF FILE CARD
```

* INDICATES 7/8 OVERPUNCH IN COLUMN 1
** K IS THE NEXT FILE TO BE READ FROM THE PCF TAPE

2.4 THE GEMMV PROCESSORS

THIS SECTION PRESENTS A BRIEF DESCRIPTION OF THE GEMMV PROCESSORS AND THE ON-LINE INPUTS REQUIRED TO OPERATE EACH PROCESSOR. ALSO INCLUDED IS A FIGURE FOR EACH PROCESSOR THAT DEPICTS THE SEQUENCE OF THE GEMMV PHASES, THE FLAGS USED TO SKIP SPECIFIC PHASES, THE GROUPS OF PHASES THAT PERFORM FUNCTIONS, AND THE SPANS OF PHASES COVERED BY THE ITERATIVE (PIT) MODE AND BOUNDARY VALUE MODE.

2.4.1 ORBITAL MANEUVER PROCESSOR. - THIS PROCESSOR WILL BE USED TO SIMULATE ANY SPS OR RCS ORBITAL MANEUVER FOR WHICH THE BURN QUANTITIES HAVE PREVIOUSLY BEEN DETERMINED. THE OUTPUT DISPLAY FOR THIS PROCESSOR WILL BE A DMT.

ORBITAL MANEUVER PROCESSOR

(FILE 7 UNIVAC 1108)

A. STANDARD GEMMV INPUT QUANTITIES FOR THE ORBITAL MANEUVER DECK ARE LISTED BELOW

PHASE 1 - COAST TO ORBIT MANEUVER

INITIALIZATION

A905-11	FLAGS TO SKIP APPROPRIATE PHASES
A4871-3	VECTOR IDENTIFICATION
A368	REVOLUTION NUMBER
A93-5	LIFT-OFF TIME(HR, MIN, SEC)(G.M.T.)
A1138-40	VECTOR TIME (HR, MIN, SEC)(G.M.T.)
A240-2	POSITION COORDINATES (ER) (X,Y,Z)
A248-50	VELOCITY COORDINATES (ER/HR) (X,Y,Z)
A280	CURRENT WEIGHT (LB)

ORBITAL MANEUVER

A1148-50	TIME OF RCS IGNITION (HR, MIN, SEC) (G.E.T.)
A1018-26	REFSMMAT STORED ROW-WISE (NOT NECESSARY IF REFSMMAT IS COMPUTED AT IGNITION)
A912	FLAG TO COMPUTE REFSMMAT AT DEORBIT IGNITION (SINCE ALREADY SET TO 1 ON TAPE, SET TO 0 ONLY IF REFSMMAT IS INPUT.)
A913-5	IMU ROLL, PITCH, AND YAW GIMBAL ANGLES, RESPECTIVELY (NECESSARY IF REFSMMAT IS COMPUTED OR IF ALIGNMENT OPTION 6 IS SPECIFIED)
A924	ALIGNMENT OPTION
A925-7	BODY ROLL, PITCH, AND YAW, RESPECTIVELY, WHICH CORRESPOND TO ALIGNMENT OPTION
A932	GUIDANCE OPTION
A941-2	TERMINATION INDEX AND VALUE, RESPECTIVELY, OF RCS BURN
A928-9	TERMINATION INDEX AND VALUE, RESPECTIVELY, OF SPS BURN

PHASE 2 - (NOT EXECUTED)
PHASE 3 - (NOT EXECUTED)
PHASE 4 - (NOT EXECUTED)
PHASE 5 - (NOT EXECUTED)
PHASE 6 - (NOT EXECUTED)
PHASE 7 - (NOT EXECUTED)
PHASE 8 - (NOT EXECUTED)

PHASE 9 - RCS ULLAGE PRIOR TO ORBIT MANEUVER

PHASE 10 - SPS ORBIT MANEUVER

A120	INTEGRATION INTERVAL (MUST BE SET TO 0.25 SEC ONLY WHEN ORBITAL MANEUVER BURN IS LESS THAN 0.50 SEC.)

PHASE 11 - COAST TO APOGEE OR PERIGEE
PHASE 12 - COAST TO APOGEE OR PERIGEE
PHASE 13 - SHORT DURATION COAST
PHASE 14 - COAST FOR 1 SEC

A139	SET TO 1 TO TERMINATE RUN.

PHASES 15-20 - COAST FOR 1 SEC

B. IF A NAVIGATION UPDATE IS REQUIRED AT 12 MINUTES PRIOR TO SPS IGNITION, SET IN ADDITION THE FOLLOWING INDICES:

PHASE 1 - COAST TO ORBIT MANEUVER

A1148-50	G.E.T. WHICH IS 12 MINUTES PRIOR TO SPS IGNITION (HR, MIN, SEC)(THIS SHOULD REPLACE THE RCS IGNITION TIME.)
A4270	SET TO 1 TO OBTAIN NAVIGATION UPDATE AT THE END OF THE FIRST PHASE.

PHASE 8 - COAST FROM FIXED DELTA T SEPARATION TO DEORBIT

A648-9	TERMINATION INDEX AND VALUE, RESPECTIVELY (NORMALLY, THE INDEX SHOULD BE 123, AND THE VALUE SHOULD BE 705 SEC.)

C. IF P-40 DELTA V'S OR P-30 DELTA V'S AND DELTA V RESIDUALS IN THE RCS CONTROL ARE TO BE INPUT, SET IN ADDITION THE FOLLOWING INDICES:

PHASE 1 - INITIAL COAST PHASE

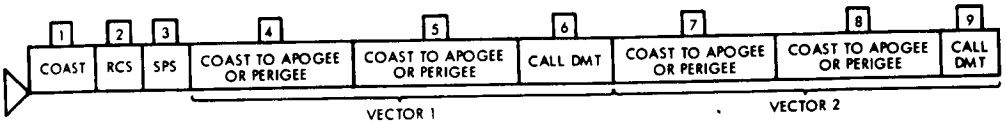
A925	ROLL ANGLE AT IGNITION (LVLH)

PHASE 9 - ULLAGE PRIOR TO DEORBIT BURN

A996-8	RESIDUAL DELTA VX, DELTA VY, DELTA VZ, INPUT, RESPECTIVELY
A999-1001	P-40 DELTA VX, DELTA VY, DELTA VZ INPUT, RESPECTIVELY
A987-9	P-30 DELTA VX, DELTA VY, DELTA VZ INPUT, RESPECTIVELY

2.4.2 AVERAGE-G NAVIGATION EVALUATION PROCESSOR. - THIS PROCESSOR WILL BE USED TO DETERMINE WHETHER IT IS NECESSARY TO PERFORM A NAVIGATION UPDATE PRIOR TO A PLANNED MANEUVER.

THE NAVIGATION UPDATE EVALUATION IS PERFORMED BY THE GEMMV PROGRAM BY EMPLOYING THE FOLLOWING LOGIC. A SPACECRAFT TELEMETRY VECTOR AND A RTCC STATE VECTOR ARE INPUT IN PHASE 1 AND PROPAGATED TO THE MANEUVER TIME. THE MANEUVER IS SIMULATED USING THE TELEMETRY VECTOR AND CMC GUIDANCE. THEN THE INCREMENTAL VELOCITIES THROUGHOUT THE SIMULATION ARE APPLIED TO THE RTCC STATE VECTOR.



AVERAGE-G NAVIGATION EVALUATION PROCESSOR

(FILE 9 UNIVAC 1108)

A. STANDARD GEMMV INPUT QUANTITIES FOR AVERAGE-G DECK ARE LISTED BELOW.

PHASE 1 - COAST TO ULLAGE PHASE

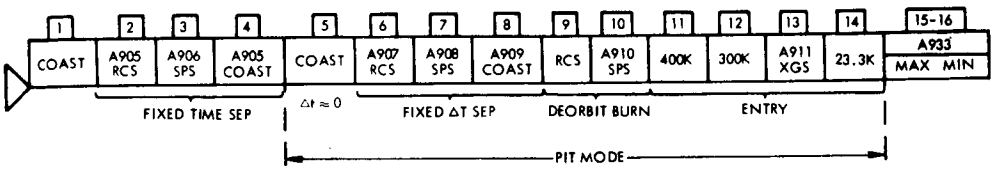
	VECTOR 1
A4871-3	VECTOR IDENTIFICATION
A368	REVOLUTION NUMBER
A93-5	LIFT-OFF TIME (HR, MIN, SEC)(G.M.T.)
A1138-40	VECTOR TIME (HR, MIN, SEC)(G.M.T.)
A240-2	POSITION COORDINATES (ER)(X, Y, Z)
A248-50	VELOCITY COORDINATES (ER/HR)(X,Y,Z)
A280	CURRENT WEIGHT (LB)
	VECTOR 2
A2138-40	VECTOR TIME (HR, MIN, SEC)(G.M.T.)
A1240-2	POSITION COORDINATES (ER) (X,Y,Z)
A1248-50	VELOCITY COORDINATES (ER/HR)(X, Y, Z)
A1280	CURRENT WEIGHT (LB)
A96	SET TO 1 IF VECTOR TIMES ARE DIFFERENT.
	ORBIT MANEUVER
A1148-50	TIME OF RCS IGNITION (HR, MIN, SEC) (G.E.T.)
A1018-26	REFSMMAT STORED ROW-WISE (NOT NECESSARY IF REFSMMAT IS COMPUTED AT IGNITION)
A912	SET TO 0 FOR INPUT REFSMMAT
A913-5	IMU ROLL, PITCH, AND YAW GIMBAL ANGLES, RESPECTIVELY (NECESSARY IF REFSMMAT IS COMPUTED)
A924	ALIGNMENT OPTION
A925-7	BODY ROLL, PITCH, AND YAW ANGLES, RESPECTIVELY, WHICH CORRESPOND TO ALIGNMENT OPTION
A932	GUIDANCE OPTION
A941-2	TERMINATION INDEX AND VALUE, RESPECTIVELY, OF RCS ULLAGE BURN
A928-9	TERMINATION INDEX AND VALUE, RESPECTIVELY, OF SPS MANEUVER

PHASE 2 - RCS ULLAGE PHASE
PHASE 3 - SPS MANEUVER PHASE
PHASE 4 - COAST TO FIRST GAMMA STOP (VECTOR 1)
PHASE 5 - COAST TO SECOND GAMMA STOP (VECTOR 1)
PHASE 6 - TEN-SECOND COAST CALL DMT (VECTOR 1)
PHASE 7 - COAST TO FIRST GAMMA STOP (VECTOR 2)
PHASE 8 - COAST TO SECOND GAMMA STOP (VECTOR 2)
PHASE 9 - TEN-SECOND COAST CALL DMT (VECTOR 2)

PHASE 10 - RUN TERMINATION

A139 SET TO 1 TO TERMINATE RUN.

2.4.3 CONTINGENCY LANDING AREA (CLA) PROCESSOR. - THIS PROCESSOR WILL BE USED TO DETERMINE THE DEORBIT MANEUVER IGNITION TIME REQUIRED TO ACHIEVE A TARGET LONGITUDE WHICH IS NORMALLY LOCATED IN A CONTINGENCY LANDING AREA. THIS PROCESSOR HAS THE CAPABILITY TO SIMULATE A MANEUVER AT A FIXED TIME OR AT A SPECIFIED TIME INTERVAL PRIOR TO THE DEORBIT MANEUVER, AND AN ENTRY PROFILE CONSISTING OF A CONSTANT LIFT VECTOR ORIENTATION TO A SPECIFIED G-LOAD, AND THEN A CONSTANT BANK ANGLE TO DROGUE CHUTE DEPOLYMENT. THIS PROCESSOR CAN ALSO SIMULATE A ZERO AND FULL LIFT ENTRY PROFILE.



CONTINGENCY LANDING AREA PROCESSOR

(FILE 1 UNIVAC 1108)

A. STANDARD GEMMV INPUT QUANTITIES FOR THE CLA DECK ARE LISTED BELOW.

PHASE 1 - INITIAL COAST PHASE

	INITIALIZATION
A905-11	FLAGS TO SKIP APPROPRIATE PHASES
A4871-3	VECTOR IDENTIFICATION
A368	REVOLUTION NUMBER
A93-5	LIFT-OFF TIME (HR, MIN, SEC)(G.M.T.)
A1138-40	VECTOR TIME (HR, MIN, SEC)(G.M.T.)
A240-2	POSITION COORDINATES (ER) (X,Y,Z)
A248-50	VELOCITY COORDINATES (ER/HR)(X,Y,Z)
A280	CURRENT WEIGHT (LB)
A1906	ITERATION FLAG (SET TO 1 TO SUPPRESS ITERATION)
	FIXED TIME MANEUVER
A1148-50	TIME OF RCS IGNITION (HR, MIN, SEC) (G.E.T.)
A916	ALIGNMENT OPTION FOR MANEUVER
A917-9	BODY ROLL, PITCH, AND YAW ANGLES, RESPECTIVELY, WHICH CORRESPOND TO THE ALIGNMENT OPTION
A931	GUIDANCE OPTION FOR MANEUVER
A920-1	TERMINATION INDEX AND VALUE, RESPECTIVELY, OF RCS BURN
A922-3	TERMINATION INDEX AND VALUE, RESPECTIVELY, OF SPS BURN
	FIXED DELTA T MANEUVER
A1148-50	TIME OF RCS IGNITION (HR, MIN, SEC) (G.E.T.)
A916	ALIGNMENT OPTION FOR MANEUVER
A917-9	BODY ROLL, PITCH, AND YAW ANGLES, RESPECTIVELY, WHICH CORRESPOND TO THE ALIGNMENT OPTION
A931	GUIDANCE OPTION FOR MANEUVER
A920-1	TERMINATION INDEX AND VALUE, RESPECTIVELY, OF RCS BURN
A922-3	TERMINATION INDEX AND VALUE, RESPECTIVELY, OF SPS BURN
	DEORBIT MANEUVER

A1148-50	TIME OF RCS IGNITION (HR, MIN, SEC) (G.E.T.) IF A FIXED TIME MANEUVER HAS BEEN PERFORMED, SET A1148-50 IN PHASE 4 INSTEAD OF PHASE 1.
A1018-26	REFSMMAT STORED ROW-WISE (NOT NECESSARY IF REFSMMAT IS COMPUTED AT IGNITION)
A912	FLAG TO COMPUTE REFSMMAT AT DEORBIT IGNITION (SINCE ALREADY SET TO 1 ON TAPE SET TO 0 ONLY IF REFSMMAT IS INPUT.)
A913-5	IMU ROLL, PITCH, AND YAW GIMBAL ANGLES, RESPECTIVELY (NECESSARY IF REFSMMAT IS COMPUTED OR IF ALIGNMENT OPTION 6 IS SPECIFIED)
A924	ALIGNMENT OPTION
A925-7	BODY ROLL, PITCH, AND YAW, RESPECTIVELY, WHICH CORRESPOND TO ALIGNMENT OPTION
A932	GUIDANCE OPTION
A941-2	TERMINATION INDEX AND VALUE, RESPECTIVELY, OF RCS BURN
A928-9	TERMINATION INDEX AND VALUE, RESPECTIVELY, OF SPS DEORBIT BURN

ENTRY

A901	LIFT VECTOR ORIENTATION (BANK ANGLE) FLOWN TO A SPECIFIED G-LEVEL (USED ONLY IF A911 IS SET TO 0)
A902	LIFT VECTOR ORIENTATION (BANK ANGLE) FLOWN FROM A SPECIFIED G-LEVEL (IF A911=0) OR FROM 300K FEET (IF A911=1)
A1902	LONGITUDE OF TARGET
A911	SET TO 0 TO EXECUTE THE COAST TO X-G'S PHASE.
A29C7	SET TO SPECIFIED G-LEVEL TO INITIATE THE ENTRY MODE (NECESSARY ONLY IF A911 IS SET TO 0).
A1172	ENTRY LIFT MULTIPLIER TO BE USED FROM A SPECIFIED G-LEVEL (IF A911=0) OR FROM 300K FEET (IF A911=1)
A904	ENTRY WEIGHT (LB)
A933	SET TO 0 IF FOOTPRINT IS DESIRED.

PHASE 2 - FIXED TIME RCS SEPARATION
PHASE 3 - FIXED TIME SPS SEPARATION
PHASE 4 - COAST AFTER FIXED TIME SEPARATICN
PHASE 5 - COAST TO DEORBIT BURN

PHASE 6 - RCS SEPARATION AT FIXED TIME PRICR TO DEORBIT

A97	NUMBER OF SECONDS AFTER THE FIXED DELTA T MANEUVER INITIATICN THAT PHASE 6 IS TO TERMINATE (SET TO A LARGE NUMBER IF A TERMINATICN IS INPUT FOR PHASE 6)

PHASE 7 - SPS SEPARATION AT FIXED TIME PRICR TO DEORBIT
PHASE 8 - COAST FROM SEPARATION TO DEORBIT
PHASE 9 - RCS ULLAGE PRIOR TO DEORBIT BURN
PHASE 9 - RCS ULLAGE PRIOR TO DEORBIT BURN
PHASE 10 - SPS DEORBIT BURN
PHASE 11 - COAST TO 433K FEET
PHASE 12 - COAST TO 300K FEET
PHASE 13 - COAST TO X-G POINT
PHASE 14 - COAST TO 23.3K FEET
PHASE 15 - MAXIMUM LIFT FOOTPRINT EXECUTICN
PHASE 16 - MINIMUM LIFT FOOTPRINT EXECUTICN

B. IF A NAVIGATION UPDATE IS REQUIRED AT 12 MINUTES PRIOR TO DEORBIT IGNITION, SET IN ADDITION THE FOLLOWING INDICES.

PHASE 1 - INITIAL COAST

A1148-50	G.E.T. WHICH IS 12 MINUTES PRIOR TO DE-ORBIT IGNITION (HR, MIN, SEC)(THIS SHOULD REPLACE THE RCS IGNITION TIME.)
A909	SET TO 0 SO THAT THE COAST FROM SEPARATION TO DEORBIT PHASE WILL BE EXECUTED. (THIS PHASE WILL BE USED TO EXECUTE THE NAVIGATION UPDATE.)

PHASE 5 - COAST TO DEORBIT BURN

A4270	SET TO 1 TO EXECUTE NAVIGATION UPDATE AT END OF THIS PHASE.

PHASE 8 - COAST FROM SEPARATION TO DEORBIT

A649	SET TO 705 TO TERMINATE THIS COAST 705 SECONDS PRIOR TO RCS ULLAGE.(IN CASE OF AN RCS DEORBIT BURN THIS VALUE SHOULD BE SET TO 720 SECONDS.)

C. IF P-40 DELTA V'S OR P-30 DELTA V'S AND DELTA V RESIDUALS IN THE RCS CONTROL AXIS ARE TO BE INPUT, SET IN ADDITION THE FOLLOWING INDICES.

PHASE 1 - INITIAL COAST PHASE

A925	ROLL ANGLE AT IGNITICN (LVLH)

PHASE 9 - ULLAGE PRIOR TO DEORBIT BURN

A996-8	RESIDUAL DELTA VX, DELTA VY, DELTA VZ INPUT, RESPECTIVELY
A999-1001	P-40 DELTA VX, DELTA VY, DELTA VZ INPUT, RESPECTIVELY
A987-9	P-30 DELTA VX, DELTA VY, DELTA VZ INPUT, RESPECTIVELY

D. IF IT IS DESIRED TO ITERATE ON DELTA V WHILE HOLDING TIME OF IGNITION FIXED, SET IN ADDITION THE FOLLOWING INDICES.

PHASE 1 - INITIAL COAST PHASE

A1901	SET TO 0 TO CALL SPECIAL ITERATION IN PIT MODE.
A147	SET TO 6 TO START ITERATIVE LOOP AT BEGINNING OF SPS DEORBIT PHASE.
A148-9	TARGET INDEX AND VALUE, RESPECTIVELY, FOR PIT MODE

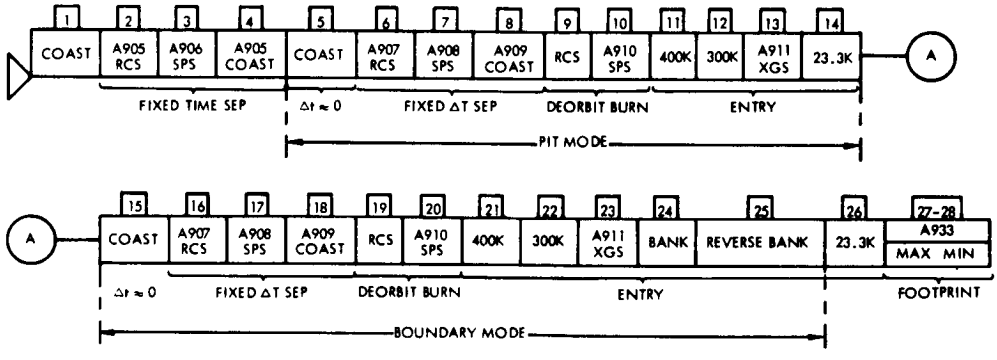
E. IF IT IS DESIRED TO COMPUTE A REFSMMAT AT SOME TIME OTHER THAN DEORBIT IGNITION, SET IN ADDITION THE FOLLOWING INDEX.

PHASE - WHERE REFSMMAT IS DESIRED

A1128	SET TO 1 TO COMPUTE REFSMMAT AT BEGINNING OF THE PHASE.

2.4.4 PRIMARY LANDING AREA (PLA) PROCESSOR. - THIS PROCESSOR WILL BE USED TO DETERMINE THE DEORBIT MANEUVER IGNITION TIME AND THE TIME TO REVERSE BANK ANGLE REQUIRED TO ACHIEVE A TARGET (LONGITUDE AND LATITUDE) LANDING POINT WHICH IS NORMALLY LOCATED IN A PRIMARY LANDING AREA. IT HAS THE CAPABILITY TO SIMULATE A MANEUVER AT A FIXED TIME OR AT A SPECIFIED TIME INTERVAL PRIOR TO THE DEORBIT MANEUVER, THE DEORBIT MANEUVER, AND AN ENTRY PROFILE CONSISTING OF A SPECIFIED LIFT VECTOR ORIENTATION TO A GIVEN G-LOAD, AND THEN A POSITIVE BANK ANGLE FOLLOWED BY THE NEGATIVE OF THAT BANK ANGLE TO DROGUE CHUTE DEPLOYMENT. THE PROCESSOR ALSO HAS THE CAPABILITY TO SIMULATE A ZERO AND FULL LIFT ENTRY PROFILE.

THE PLA PROCESSOR IS THE ONLY GEMMV PROCESSOR THAT EMPLOYS THE BOUNDARY VALUE MODE. THE PROCESSOR USES THE ITERATIVE MODE (PIT). PRIOR TO THE BOUNDARY MODE, TO DETERMINE THE IGNITION TIME REQUIRED TO ACHIEVE A LONGITUDE TARGET LANDING POINT . THIS IGNITION TIME IS THEN USED BY THE BOUNDARY VALUE MODE AS AN INITIAL GUESS. IF THE IGNITION TIME TO ACHIEVE A LONGITUDE TARGET IS AVAILABLE, THE PIT MODE MAY BE SUPPRESSED.



PRIMARY LANDING AREA PROCESSOR

(FILE 2 UNIVAC 1108)

A. STANDARD GEMMV INPUT QUANTITIES FOR THE PLA DECK ARE LISTED BELOW

PHASE 1 - INITIAL COAST PHASE

	INITIALIZATION
A905-11	FLAGS TO SKIP APPROPRIATE PHASES
A4871-3	VECTOR IDENTIFICATION
A368	REVOLUTION NUMBER
A93-5	LIFT-OFF TIME (HR, MIN, SEC) (G.M.T.)
A1138-40	VECTOR TIME (HR, MIN, SEC) (G.M.T.)
A240-2	POSITION COORDINATES (ER) (X, Y, Z)
A248-50	VELOCITY COORDINATES (ER/HR) (X, Y, Z)
A280	CURRENT WEIGHT (LB)
A1906	ITERATION FLAG (SET TO 1 TO SUPPRESS ITERATION)
	FIXED TIME MANEUVER
A1148-50	TIME OF RCS IGNITION (HR, MIN, SEC) (G.E.T.)
A916	ALIGNMENT OPTION FOR MANEUVER
A917-9	BODY ROLL, PITCH, AND YAW ANGLES, RESPECTIVELY, WHICH CORRESPOND TO THE ALIGNMENT OPTION
A931	GUIDANCE OPTION FOR MANEUVER
A920-1	TERMINATION INDEX AND VALUE, RESPECTIVELY, OF RCS BURN
A922-3	TERMINATION INDEX AND VALUE, RESPECTIVELY, OF SPS BURN
	FIXED DELTA T MANEUVER
A1148-50	TIME OF RCS IGNITION (HR, MIN, SEC) (G.E.T.)
A916	ALIGNMENT OPTION FOR MANEUVER
A917-9	BODY ROLL, PITCH, AND YAW ANGLES, RESPECTIVELY, WHICH CORRESPOND TO THE ALIGNMENT OPTION
A931	GUIDANCE OPTION FOR MANEUVER
A920-1	TERMINATION INDEX AND VALUE, RESPECTIVELY, OF RCS BURN
A922-3	TERMINATION INDEX AND VALUE, RESPECTIVELY, OF SPS BURN

DEORBIT MANEUVER

A1148-50	TIME OF RCS IGNITION (HR, MIN, SEC) (G.E.T.) IF A FIXED TIME MANEUVER HAS BEEN PERFORMED, SET A1148-50 IN PHASE 4 INSTEAD OF PHASE 1.
A1018-26	REFSMMAT STORED ROW-WISE (NOT NECESSARY IF REFSMMAT IS COMPUTED AT IGNITION)
A912	FLAG TO COMPUTE REFSMMAT AT DEORBIT IGNITION (SINCE ALREADY SET TO 1 ON TAPE, SET TO 0 ONLY IF REFSMMAT IS INPUT.)
A913-5	IMU ROLL, PITCH, AND YAW GIMBAL ANGLES, RESPECTIVELY (NECESSARY IF REFSMMAT IS COMPUTED OR IF ALIGNMENT OPTION 6 IS SPECIFIED)
A924	ALIGNMENT OPTION
A925-7	BODY ROLL, PITCH, AND YAW RESPECTIVELY, WHICH CORRESPOND TO ALIGNMENT OPTION
A932	GUIDANCE OPTION
A941-2	TERMINATION INDEX AND VALUE, RESPECTIVELY, OF RCS BURN
A928-9	TERMINATION INDEX AND VALUE, RESPECTIVELY, OF SPS BURN

ENTRY

A901	LIFT VECTOR ORIENTATION (BANK ANGLE) FLOWN TO A SPECIFIED G-LEVEL (USED ONLY IF A911 IS SET TO 0.)
A902	LIFT VECTOR ORIENTATION (BANK ANGLE) FLOWN FROM A SPECIFIED G-LEVEL (IF A911 = 0) IF A911 = 1, SEE F.
A1902-3	LONGITUDE AND LATITUDE OF THE TARGET
A911	SET TO 0 TO EXECUTE THE COAST TO X-G'S PHASE.
A2907	SET TO SPECIFIED G-LEVEL TO INITIATE THE ENTRY MODE (NECESSARY ONLY IF A911 IS SET TO 0.)
A1172	ENTRY LIFT MULTIPLIER TO BE USED FROM A SPECIFIED G-LEVEL (IF A911=0) OR FROM 300K FEET (IF A911=1)
A904	ENTRY WEIGHT (LB)
A933	SET TO 0 IF FOOTPRINT IS DESIRED.

PHASE 2 - FIXED TIME RCS SEPARATION
PHASE 3 - FIXED TIME SPS SEPARATION
PHASE 4 - COAST AFTER FIXED TIME SEPARATION
PHASE 5 - COAST TO DEORBIT BURN

PHASE 6 - RCS SEPARATION AT FIXED TIME PRIOR TO DEORBIT

A97	NUMBER OF SECONDS AFTER THE FIXED DELTA T MANEUVER INITIATION THAT PHASE 6 IS TO TERMINATE (SET TO A LARGE NUMBER IF A TERMINATION IS INPUT FOR PHASE 6)

PHASE 7 - SPS SEPARATION AT FIXED TIME PRIOR TO DEORBIT
PHASE 8 - COAST FROM SEPARATION TO DEORBIT
PHASE 9 - RCS ULLAGE PRIOR TO DEORBIT BURN
PHASE 10 - SPS DEORBIT BURN
PHASE 11 - COAST TO 400K FEET
PHASE 12 - COAST TO 300K FEET
PHASE 13 - COAST TO X-G POINT
PHASE 14 - COAST TO 23.3K FEET

PHASE 15 - COAST TO DEORBIT

A655 — SET TO 125000 ONLY IF A911 = 0, A901 = 180, AND A2907 = 1.

PHASE 16 - RCS SEPARATION AT FIXED TIME PRIOR TO DEORBIT
PHASE 17 - SPS SEPARATION AT FIXED TIME PRIOR TO DEORBIT
PHASE 18 - COAST FROM SEPARATION TO DEORBIT
PHASE 19 - RCS ULLAGE PRIOR TO DEORBIT BURN
PHASE 20 - SPS DEORBIT BURN
PHASE 21 - COAST TO 400K FEET
PHASE 22 - COAST TO 300K FEET
PHASE 23 - COAST TO X-G POINT
PHASE 24 - COAST TO BANK REVERSE
PHASE 25 - REVERSE BANK
PHASE 26 - COAST TO 23.3K FEET
PHASE 27 - MAXIMUM LIFT FOOTPRINT EXECUTION
PHASE 28 - MINIMUM LIFT FOOTPRINT EXECUTION

B. IF A NAVIGATION UPDATE IS REQUIRED AT 12 MINUTES PRIOR TO DEORBIT IGNITION, SET IN ADDITION THE FOLLOWING INDICES

PHASE 1 - INITIAL COAST

A1148-50 — G.E.T. WHICH IS 12 MINUTES PRIOR TO DEORBIT IGNITION (HR, MIN, SEC) (THIS SHOULD REPLACE THE RCS IGNITION TIME.)

A909 — SET TO 0 SO THAT THE COAST FROM SEPARATION TO DEORBIT PHASE WILL BE EXECUTED. (THIS PHASE WILL BE USED TO EXECUTE THE NAVIGATION UPDATE.)

PHASE 8 - COAST FROM SEPARATION TO DEORBIT (PIT MODE)
AND
PHASE 18 - COAST FROM SEPARATION TO DEORBIT (BOUNDARY MODE)

A649 — SET TO 705 TO TERMINATE THIS COAST 705 SECONDS PRIOR TO RCS ULLAGE (FOR AN RCS DEORBIT BURN THIS VALUE SHOULD BE SET TO 720 SECONDS.)

PHASE 15 - COAST TO DEORBIT BURN

A4270 — SET TO 1 TO EXECUTE NAVIGATION UPDATE AT END OF THIS PHASE.

C. IF P-40 DELTA V'S OF P-30 DELTA V'S AND DELTA V RESIDUAL IN THE RCS CONTROL AXES ARE TO BE INPUT, SET IN ADDITION THE FOLLOWING INDICES

PHASE 1 - INITIAL COAST PHASE

A925	ROLL ANGLE AT IGNITICN (LVLH)

PHASE 9 - ULLAGE PRIOR TO DEORBIT BURN
AND
PHASE 19 - ULLAGE PRIOR TO DEORBIT BURN

A996-8	RESIDUAL DELTA VX, DELTA VY, DELTA VZ INPUT, RESPECTIVELY
A999-1001	P-40 DELTA VX, DELTA VY, DELTA VZ INPUT, RESPECTIVELY
OR	
A987-9	P-30 DELTA VX, DELTA VY, DELTA VZ INPUT, RESPECTIVELY

D. IF IT IS DESIRED TO ITERATE ON DELTA V WHILE HOLDING TIME OF IGNITION FIXED, SET IN ADDITION THE FOLLOWING INDICES

PHASE 1 - INITIAL COAST PHASE

A1901	SET TO 0 TO CALL SPECIAL ITERATION IN PIT MODE.
A147	SET TO 6 TO START ITERATIVE LOOP AT BEGINNING OF SPS DEORBIT PHASE.
A148-9	TARGET INDEX AND VALUE, RESPECTIVELY, FOR PIT MODE

E. IF IT IS DESIRED TO SUPPRESS THE PIT MODE, SET IN ADDITION THE FOLLOWING INDEX

PHASE 1 - INITIAL COAST PHASE

A1906	SET TO 1.

F. IF THE COAST TO X-G POINT PHASE IS NOT EXECUTED, SET IN ADDITION THE FOLLOWING INDICES'

PHASE 1 - INITIAL COAST PHASE

A902	SET TO 0.

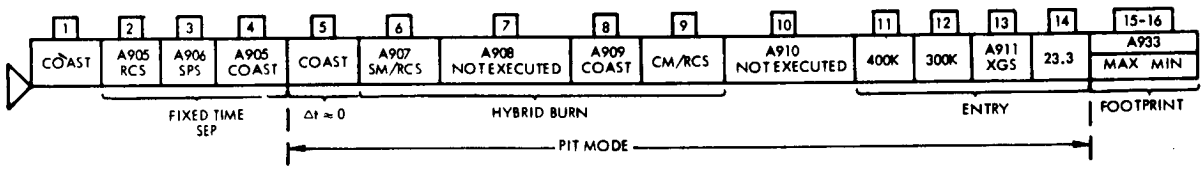
PHASE 15 - COAST TO DEORBIT

A902	LIFT VECTOR ORIENTATION (BANK ANGLE) FLOWN FROM 300K FEET

2.4.5 HYBRID DEORBIT PROCESSOR. -THIS PROCESSOR WILL BE USED TO DETERMINE THE HYBRID DEORBIT IGNITION TIME REQUIRED TO ACHIEVE A TARGET LONGITUDE. THIS PROCESSOR HAS THE CAPABILITY TO SIMULATE A MANEUVER AT A SPECIFIED TIME, THE HYBRID DEORBIT MANEUVER, AND ENTRY PROFILE CONSISTING OF A CONSTANT LIFT VECTOR ORIENTATION TO A SPECIFIED G-LOAD, AND THEN A CONSTANT BANK ANGLE TO DROGUE CHUTE DEPLOYMENT.

A HYBRID DEORBIT IS PERFORMED IN TWO BURNS BY USING THE SM AND CM RCS THRUSTERS TO ACCOMPLISH A FIXED INCREMENTAL VELOCITY CHANGE WITH A CONSTANT INERTIAL THRUST VECTOR ORIENTATION. THIS ORIENTATION IS DEFINED AS FOLLOWS. AT THE CENTROID OF THE HYBRID DEORBIT BURNS, THE THRUST VECTOR DIRECTION IS OPPOSITE THE GEOCENTRIC LOCAL HORIZONTAL. AFTER THE CM/RCS BURN, A 60-SECOND COAST ALLOWS TIME TO PERFORM CM/RCS SEPARATION AND REORIENTATION OF THE CM SO THAT THE EFFECTIVE THRUST VECTOR ORIENTATION REMAINS CONSTANT.

THE HYBRID DEORBIT BURN IS SIMULATED BY THE GEMMV PROGRAM BY EMPLOYING THE FOLLOWING LOGIC. IN PHASE 4 THE VECTOR IS PROPAGATED TO THE SM/RCS BURN TIME AND THE NECESSARY QUANTITIES ARE INPUT TO CALCULATE AN ANALYTIC CENTROID OF THE COMBINATION BURN. PHASE 6 WHICH IS EXECUTED NEXT, PERFORMS THE CENTROID CALCULATION, PROPAGATES THE TRAJECTORY TO THE CENTROID, PERFORMS THE NECESSARY LVLH THRUST VECTOR ATTITUDE ALIGNMENT, PROPAGATES BACKWARD TO SM/RCS BURN INITIATION HOLDING THE INERTIAL ATTITUDE, AND THEN INTEGRATES THROUGH THE SM/RCS BURN. THE TRAJECTORY IS THEN PROPAGATED TO CM/RCS BURN INITIATION IN PHASE 8, AND THE CM/RCS BURN IS SIMULATED IN PHASE 9.



HYBRID DEORBIT PROCESSOR

(FILE 8 UNIVAC 1108)

A. STANDARD GEMMV INPUT QUANTITIES FOR THE HYBRID DEORBIT DECK LISTED BELOW

PHASE 1 - INITIAL COAST PHASE

	INITIALIZATION
A905-11	FLAGS TO SKIP APPROPRIATE PHASES
A4871-3	VECTOR IDENTIFICATION
A368	REVOLUTION NUMBER
A93-5	LIFT-OFF TIME (HR, MIN, SEC) (G.M.T.)
A1138-40	VECTOR TIME (HR, MIN, SEC) (G.M.T.)
A240-2	POSITION COORDINATES (ER) (X, Y, Z)
A248-50	VELOCITY COORDINATES (ER/HR) (X, Y, Z)
A280	CURRENT WEIGHT (LB)
A1906	ITERATION FLAG (ALREADY SET TO 0 ON TAPE SET TO 1 TO SUPPRESS ITERATION.)
	HYBRID DEORBIT MANEUVER
A1148-50	TIME OF RCS IGNITION (HR, MIN, SEC) (G.E.T.)
A1018-26	REFSMMAT STORED ROW-WISE (NOT NECESSARY IF REFSMMAT IS COMPUTED AT IGNITION)
A912	FLAG TO COMPUTE REFSMMAT AT DEORBIT IGNITION (SINCE ALREADY SET TO 1 ON TAPE, SET TO 0 ONLY IF REFSMMAT IS INPUT.)
A913-5	IMU ROLL, PITCH, AND YAW GIMBAL ANGLES, RESPECTIVELY, (NECESSARY IF REFSMMAT IS COMPUTED OR IF ALIGHMENT OPTION 6 IS SPECIFIED)
A916	ALIGNMENT OPTION FOR HYBRID MANEUVER (SET TO 1 ON TAPE.)
A917-9	BODY ROLL, PITCH, AND YAW ANGLES, RESPECTIVELY, WHICH CORRESPOND TO THE ALIGNMENT OPTION (SET TO 0, 0, 180 ON TAPE.)
A925	CM BODY ROLL (SET TO 180 ON TAPE.)
A931	HYBRID DEORBIT GUIDANCE OPTION (SET TO 6 ON TAPE.)
A904	CM PREBURN WEIGHT
A2923	DELTA V OF SM RCS BURN
A2924	DELTA T OF COAST BETWEEN SM RCS AND CM RCS BURNS (SET TO 60 ON TAPE.)
A2925	DELTA V OF CM RCS BURN
A901	LIFT VECTOR ORIENTATION (BANK ANGLE) FLOWN TO A SPECIFIED G-LEVEL (USED ONLY IF A911 IS SET TO 0)

A902	LIFT VECTOR ORIENTATION (BANK ANGLE) FLOWN FROM A SPECIFIED G-LEVEL (IF A911 = 0) OR FROM 300K FEET (IF A911 =1)
A1902	LONGITUDE OF TARGET
A911	SET TO 0 TO EXECUTE THE COAST TO X-G'S PHASE.
A2907	SET TO SPECIFIED G-LEVEL TO INITIATE THE ENTRY MODE (NECESSARY ONLY IF A911 IS SET TO 0).
A1172	ENTRY LIFT MULTIPLIER TO BE USED FROM A SPECIFIED G-LEVEL (IF A911 = 0) OR FROM 300K FEET (IF A911 = 1)
A933	SET TO 0 IF FOOTPRINT IS DESIRED.

PHASE 2 - ULLAGE MANEUVER PHASE
PHASE 3 - SPS DEORBIT BURN PHASE
PHASE 4 - COAST TO HYBRID DEORBIT BURN TIME PHASE
PHASE 5 - COAST TO SM RCS BURN PHASE
PHASE 6 - SM RCS BURN PHASE
PHASE 7 - NOT EXECUTED
PHASE 8 - COAST BETWEEN SM AND CM BURNS PHASE
PHASE 9 - CM RCS BURN PHASE
PHASE 10 - NOT EXECUTED
PHASE 11 - COAST TO 400K PHASE
PHASE 12 - COAST TO 300K PHASE
PHASE 13 - COAST TO X-G'S PHASE
PHASE 14 - COAST TO 23.3K PHASE
PHASE 15 - MAXIMUM LIFT FOOTPRINT PHASE
PHASE 16 - MINIMUM LIFT FOOTPRINT PHASE

B. IF AN ULLAGE OR A PARTIAL SPS DEORBIT BURN IS TO BE PERFORMED PRIOR TO THE HYBRID DEORBIT, SET IN ADDITION

PHASE 1 - INITIAL COAST PHASE

A1018-26	REFSMMAT STORED ROW-WISE (NOT NECESSARY IF REFSMMAT IS COMPUTED AT ULLAGE OR SPS IGNITION)
A928-9	TERMINATION INDEX AND VALUE, RESPECTIVELY, OF SPS BURN
A1148-50	TIME OF ULLAGE MANEUVER (HR, MIN, SEC) (G.E.T.)
A905	SET TO 0 FOR ULLAGE
A906	SET TO 0 FOR SPS BURN

PHASE 2 - ULLAGE MANEUVER PHASE

A1128	FLAG TO COMPUTE REFSMMAT AT ULLAGE OR SPS IGNITION (SINCE ALREADY SET TO 0 ON TAPE SET TO 1 ONLY IF REFSMMAT IS TO BE COMPUTED FOR ULLAGE OR SPS IGNITION.)

A1027-29	IMU ROLL, PITCH, AND YAW GIMBAL ANGLES, RESPECTIVELY, FOR ULLAGE OR SPS MANEUVER (NECESSARY CNLY IF REFSMMAT IS COMPUTED AT ULLAGE OR SPS IGNITION)
A225	ATTITUDE OPTICN FOR ULLAGE OR SPS MANEUVER (SET TO 4 ON TAPE.)
A1118-20	ROLL, PITCH, AND YAW ATTITUDES FOR ULLAGE OR SPS MANEUVER
A930	GUIDANCE OPTION FOR ULLAGE OR SPS MANEUVER (SET TO 4 ON TAPE.)
A648	ULLAGE TERMINATICN INDEX (SET TO 123 ON TAPE.)
A649	ULLAGE TERMINATION VALUE (SET TO 15 ON TAPE.)

PHASE 4 - COAST TO HYBRID DEORBIT BURN TIME PHASE

A912	SET TO 0 IF REFSMMAT INPUT
A1018-26	REFSMMAT STORED ROW-WISE (NOT NECESSARY ONLY IF PLATFORM ALIGNMENT HAS BEEN PERFORMED AFTER ULLAGE OR SPS MANEUVER)
A1148-50	TIME OF SM RCS BURN (HR, MIN, SEC) (G.E.T.)

IF NO ULLAGE OR SPS, PUT ALL UPDATES IN FIRST PHASE.

2.4.6 CONTINGENCY LANDING AREA (CLA) PROCESSOR WITH VENTING.- THIS PROCESSOR WILL BE USED TO SIMULATE S-IVB VENTING IN ORDER TO GENERATE AN IU NAVIGATION UPDATE, SEPARATION, AND A CLA DEORBIT.

CONTINGENCY LANDING AREA PROCESSOR WITH VENTING

(FILE 10 UNIVAC 1108)

A. STANDARD GEMMV INPUT QUANTITIES FOR NAVIGATION UPDATE DECK ARE LISTED BELOW

PHASE -1 - S-IVB VENTING COAST PHASE 1

A4871-3	VECTOR IDENTIFICATION
A368	REVOLUTION NUMBER
A93-5	LIFT-OFF TIME (HR, MIN, SEC)(G.M.T.)
A1138-40	VECTOR TIME (HR, MIN, SEC)(G.M.T.)
A240-2	POSITION COORDINATES (ER) (X,Y,Z)
A248-50	VELOCITY COORDINATES (ER/HR)(X,Y,Z)
A280	CURRENT WEIGHT (LB)
	ADDITIONAL UPDATES
A1148-50	TIME OF FIXED TIME OR FIXED DELTA T SEP (HR,MIN,SEC) (G.E.T.)
A293	S-IVB REFERENCE AREA

PHASE 0 - S-IVB VENTING COAST PHASE 2

A150	SET TO 1 TO SKIP THIS PHASE

PHASE 1 - COAST PHASE AFTER VENTING

	INITIALIZATION
A150	SET TO 1 TO SKIP THIS PHASE
A905-11	FLAGS TO SKIP APPROPRIATE PHASES
	FIXED TIME MANEUVER
A916	ALIGNMENT OPTION FOR MANEUVER
A917-9	BODY ROLL, PITCH, AND YAW ANGLES, RESPECTIVELY, WHICH CORRESPOND TO THE ALIGNMENT OPTION
A931	GUIDANCE OPTION FOR MANEUVER
A920-1	TERMINATION INDEX AND VALUE, RESPECTIVELY, OF RCS BURN
A922-3	TERMINATION INDEX AND VALUE, RESPECTIVELY, OF SPS BURN
	FIXED DELTA T MANEUVER
A916	ALIGNMENT OPTION FOR MANEUVER
A917-9	BODY ROLL, PITCH, AND YAW ANGLES, RESPECTIVELY, WHICH CORRESPOND TO THE ALIGNMENT OPTION
A931	GUIDANCE OPTION FOR MANEUVER

A920-1	TERMINATION INDEX AND VALUE, RESPECTIVELY, OF RCS BURN
A922-3	TERMINATION INDEX AND VALUE, RESPECTIVELY, OF SPS BURN
	DEORBIT MANEUVER
A1148-50	TIME OF RCS IGNITION (HR, MIN, SEC) (G.E.T.) IF A FIXED TIME MANEUVER HAS BEEN PERFORMED, SET A1148-50 IN PHASE 4 INSTEAD OF PHASE 1. (NOT REQUIRED IF FIXED DELTA T SEP IS PERFORMED)
A1018-26	REFSMMAT STORED ROW-WISE (NOT NECESSARY IF REFSMMAT IS COMPUTED AT IGNITION)
A912	FLAG TO COMPUTE REFSMMAT AT DEORBIT IGNITION (SINCE ALREADY SET TO 1 ON TAPE SET TO 0 ONLY IF REFSMMAT IS INPUT.)
A913-5	IMU ROLL, PITCH, AND YAW GIMBAL ANGLES, RESPECTIVELY (NECESSARY IF REFSMMAT IS COMPUTED OR IF ALIGNMENT OPTION 6 IS SPECIFIED)
A924	ALIGNMENT OPTION
A925-7	BODY ROLL, PITCH, AND YAW, RESPECTIVELY, WHICH CORRESPOND TO ALIGNMENT OPTION
A932	GUIDANCE OPTION
A941-2	TERMINATION INDEX AND VALUE, RESPECTIVELY, OF RCS BURN
A928-9	TERMINATION INDEX AND VALUE, RESPECTIVELY, OF SPS DEORBIT BURN
	ENTRY
A901	LIFT VECTOR ORIENTATION (BANK ANGLE) FLOWN TO A SPECIFIED G-LEVEL (USED ONLY IF A911 IS SET TO 0)
A902	LIFT VECTOR ORIENTATION (BANK ANGLE) FLOWN FROM A SPECIFIED G-LEVEL (IF A911=0) OR FROM 300K FEET (IF A911=1)
A1902	LONGITUDE OF TARGET
A911	SET TO 0 TO EXECUTE THE COAST TO X-G'S PHASE.
A29C7	SET TO SPECIFIED G-LEVEL TO INITIATE THE ENTRY MODE (NECESSARY CNLY IF A911 IS SET TO 0).
A1172	ENTRY LIFT MULTIPLIER TO BE USED FROM A SPECIFIED G-LEVEL (IF A911=0) OR FROM 300K FEET (IF A911=1)
A904	ENTRY WEIGHT (LB)
A933	SET TO 0 IF FOOTPRINT IS DESIRED.

PHASE 2 - FIXED TIME RCS SEPARATION

A280	SEPARATION WEIGHT (IF FIXED TIME SEP IS EXECUTED)
A293	CSM REFERENCE AREA (IF FIXED TIME SEP IS EXECUTED)

PHASE 3 - FIXED TIME SPS SEPARATION
PHASE 4 - COAST AFTER FIXED TIME SEPARATION
PHASE 5 - COAST TO DEORBIT BURN
PHASE 6 - RCS SEPARATION AT FIXED TIME PRIOR TO DEORBIT

A280	SEPARATION WEIGHT (IF FIXED DELTA T SEP IS EXECUTED)
A293	CSM REFERENCE AREA (IF FIXED DELTA T SEP IS EXECUTED)
A97	NUMBER OF SECONDS AFTER THE FIXED DELTA T MANEUVER INITIATION THAT PHASE 6 IS TO TERMINATE (SET TO A LARGE NUMBER IF A TERMINATION IS INPUT FOR PHASE 6)

PHASE 7 - SPS SEPARATION AT FIXED TIME PRIOR TO DEORBIT
PHASE 8 - COAST FROM SEPARATION TO DEORBIT
PHASE 9 - RCS ULLAGE PRIOR TO DEORBIT BURN
PHASE 10 - SPS DEORBIT BURN
PHASE 11 - COAST TO 433K FEET
PHASE 12 - COAST TO 300K FEET
PHASE 13 - COAST TO X-G POINT
PHASE 14 - COAST TO 23.3K FEET
PHASE 15 - MAXIMUM LIFT FOOTPRINT EXECUTION
PHASE 16 - MINIMUM LIFT FOOTPRINT EXECUTION

B. ADDITIONAL GEMMV INPUT QUANTITIES FOR IU NAVIGATION UPDATE DATA ARE LISTED BELOW:

PHASE WHERE IU NAVIGATION UPDATE IS DESIRED:

A152	SET TO 1 TO CALL IU NAVIGATION UPDATE AT END OF PHASE OR -1 AT BEGINNING OF PHASE
A153	SET TO GMTL/O -GMTIUGRR (SEC).
A309	LAUNCH AZIMUTH

C. IF P-40 DELTA V'S OR P-30 DELTA V'S AND DELTA V RESIDUALS IN THE RCS CONTROL AXIS ARE TO BE INPUT, SET IN ADDITION THE FOLLOWING INDICES.

PHASE 1 - INITIAL COAST PHASE

A925	ROLL ANGLE AT IGNITICN (LVLH)

PHASE 9 - ULLAGE PRIOR TO DEORBIT BURN

A996-8	RESIDUAL DELTA VX, DELTA VY, DELTA VZ INPUT, RESPECTIVELY
A999-1001	P-40 DELTA VX, DELTA VY, DELTA VZ INPUT, RESPECTIVELY
A987-9	P-30 DELTA VX, DELTA VY, DELTA VZ INPUT, RESPECTIVELY

D. IF IT IS DESIRED TO ITERATE ON DELTA V WHILE HOLDING TIME OF IGNITION FIXED, SET IN ADDITICN THE FOLLOWING INDICES.

PHASE 1 - INITIAL COAST PHASE

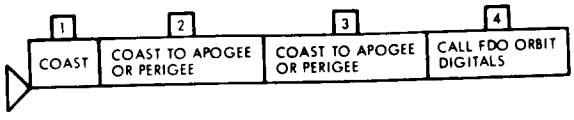
A1901	SET TO 0 TO CALL SPECIAL ITERATION IN PIT MODE.
A147	SET TO 6 TO START ITERATIVE LOOP AT BEGINNING OF SPS DEORBIT PHASE.
A148-9	TARGET INDEX AND VALUE, RESPECTIVELY, FOR PIT MODE

E. IF IT IS DESIRED TO COMPUTE A REFSMMAT AT SOME TIME OTHER THAN DEORBIT IGNITION, SET IN ADDITION THE FOLLOWING INDEX.

PHASE - WHERE REFSMMAT IS DESIRED

A1128	SET TO 1 TO COMPUTE REFSMMAT AT BEGINNING OF THE PHASE.

2.4.7 FDO ORBIT DIGITALS PROCESSOR. -THIS PROCESSOR WILL BE USED TO DISPLAY, FOR ANY THRESHOLD TIME, THE ORBITAL PARAMETERS CORRESPONDING TO THE THRESHOLD TIME AS WELL AS THE ASSOCIATED APOGEE AND PERIGEE PARAMETERS. THE OUTPUT WILL BE IN THE FORMAT OF THE RTCC FDO ORBIT DIGITALS DISPLAY.



FDO ORBIT DIGITALS PROCESSOR

(SPECIAL FDO ORBIT DIGITALS DECK FILE 4 UNIVAC 1108)

STANDARD GEMMV INPUT QUANTITIES FOR THIS PROCESSOR ARE LISTED BELOW

PHASE 1 - INITIAL COAST PHASE

INITIALIZATION

A4871-3	VECTOR IDENTIFICATION
A368	REVOLUTION NUMBER
A93-5	LIFT-OFF TIME (HR, MIN, SEC) (G.M.T.)
A1138-40	VECTOR TIME (HR, MIN, SEC) (G.M.T.)
A240-2	POSITION COORDINATES (ER) (X,Y,Z,)
A248-50	VELOCITY COORDINATES (ER/HR) (X,Y,Z)
A280	CURRENT WEIGHT (LB)

ADDITIONAL UPDATES

A150*	SET TO 1 ONLY IF THE ORBIT DIGITALS ARE TO BE BASED ON THE PRESENT VECTOR.
A648-9	SET TO THE PROPER TERMINATION INDEX AND VALUE, RESPECTIVELY, IF THE ORBIT DIGITALS ARE NOT TO BE BASED ON THE INPUT VECTOR.

PHASE 2 - COAST TO APOGEE OR PERIGEE

A86*	SET TO 1 TO SAVE VECTOR AT BEGINNING OF PHASE FOR FDO ORBIT DIGITALS SUMMARY SHEET.
A648-9*	TERMINATION INDEX AND VALUE, RESPECTIVELY (NORMALLY THE INDEX WILL BE 315. FLIGHT-PATH ANGLE AND THE VALUE WILL BE 0.)

PHASE 3 - COAST TO APOGEE OR PERIGEE

PHASE 4 - SHORT DURATION COAST

A648-9*	TERMINATION INDEX AND VALUE, RESPECTIVELY (NORMALLY THE INDEX WILL BE 123 PHASE TIME AND THE VALUE WILL BE 10.)
A142*	SET TO 1 TO CALL FDO ORBIT DIGITALS SUMMARY SHEET.

PHASE 5 - RUN TERMINATION

A139*	SET TO 1 TO TERMINATE RUN.

*THESE A-ARRAYS HAVE ALREADY BEEN SET TO THE CORRECT VALUE IN THE SPECIAL FDO ORBIT DIGITALS ON-LINE DECK.

2.4.8 RELATIVE MOTION PROCESSOR. - THIS PROCESSOR WILL BE USED TO COMPUTE THE RELATIVE MOTION OF TWO VEHICLES AND OUTPUT THE MOTION DIGITALS DISPLAY.

RELATIVE MOTION PROCESSOR

(FILE 4 UNIVAC 1108)

STANDARD GEMMV INPUT QUANTITIES FOR THE RELATIVE MOTION PROCESSOR ARE LISTED BELOW.

PHASE 1 - INITIAL COAST PHASE

	REFERENCE VEHICLE INITIALIZATION
A4871-3	VECTOR IDENTIFICATION
A368	REVOLUTION NUMBER
A93-5	LIFT-OFF TIME (HR, MIN, SEC) (G.M.T.)
A1138-40	VECTOR TIME (HR, MIN, SEC) (G.M.T.)
A240-2	POSITION COORDINATES (ER) (X, Y, Z)
A248-50	VELOCITY COORDINATES (ER/HR) (X, Y, Z)
A280	CURRENT WEIGHT (LB)
A293	CROSS SECTIONAL AREA OF THE REFERENCE VEHICLE
A1018-26	REFSMMAT STORED ROW-WISE

	RELATIVE VEHICLE INITIALIZATION
A1368	REVOLUTION NUMBER
A2138-40	VECTOR TIME (HR, MIN, SEC) (G.M.T.)
A1240-2	POSITION COORDINATES (ER) (X, Y, Z)
A1248-50	VELOCITY COORDINATES (ER/HR) (X, Y, Z)
A1280	CURRENT WEIGHT (LB)
A1293	CROSS SECTIONAL AREA OF THE RELATIVE VEHICLE

	ADDITIONAL UPDATES
A96	SET TO 1 IF THE RELATIVE VEHICLE VECTOR TIME IS PRIOR TO THE TIME RELATIVE MOTION DATA IS DESIRED.
A117	SET TO 2 (HIGHEST VEHICLE CAPABILITY BEING USED).
A114	SET TO 2 (FLAG TO CALL THE WRITE 2 - RELATIVE MOTION SUBROUTINE).
A111	SET TO 0 TO SPECIFY CONSTANT INTEGRATION STEP SIZE.
A120	SET TO DESIRED INTEGRATION STEP SIZE IN SECONDS (NORMALLY SET TO 1 IN THRUSTING PHASES AND 20 IN COASTING PHASES).
A4204	SET TO N.(OUTPUT WILL BE EVERY N INTEGRATION STEPS THIS VARIABLE SHOULD BE ADJUSTED WITH A120 TO ACHIEVE SOME SPECIFIED CONSTANT OUTPUT INTERVAL THROUGHOUT THE EXECUTION OF THE PROCESSOR.)

PHASE WHERE RELATIVE MOTION OUTPUT IS NOT DESIRED'

A42C4	SET TO C.(THIS MAY BE RESET TO N IN ANY PHASE WHERE RELATIVE MOTION OUTPUT IS AGAIN DESIRED.)

2.4.9 GROUND TRACK, CMC OR IU NAVIGATION UPDATE, AND PAD DATA CAPABILITIES.- IF IT IS DESIRED TO PRODUCE A GROUND TRACK, A NAVIGATION UPDATE, OR PAD DATA WITH ANY OF THE GEMMV PROCESSORS PREVIOUSLY DESCRIBED, THE FOLLOWING ADDITIONAL ON-LINE INPUTS WILL BE REQUIRED.

A. ADDITIONAL GEMMV INPUT QUANTITIES FOR GROUND TRACK DATA ARE LISTED BELOW:

PHASES WHERE GROUND TRACK IS TO BEGIN:

A114	SET TO 5 TO CALL WRITE 5 (GROUND TRACK SUBROUTINE).
A111	SET TO 0 TO SPECIFY CONSTANT INTEGRATION.
A120	SET TO DESIRED INTEGRATION STEP SIZE IN SECONDS. (NORMALLY SET TO 20 SECONDS IN COASTING PHASES AND TO 1 IN THRUSTING PHASES.)
A4213	SET TO N.(OUTPUT WILL BE EVERY N INTEGRATION STEPS THIS VARIABLE WILL BE ADJUSTED WITH A120 TO ACHIEVE SOME SPECIFIED CONSTANT OUTPUT FREQUENCY THROUGHOUT PROCESSOR EXECUTION.)
A4201	SET TO 0 TO SUPPRESS WRITE 1 OUTPUT.

PHASES WHERE GROUND TRACK IS NOT DESIRED:

A4213	SET TO 0.(THIS MAY BE RESET TO N IN ANY PHASE WHERE GROUND TRACK IS AGAIN DESIRED.)
A4201	SET TO 100000 TO ACTIVATE WRITE 1.

B. ADDITIONAL GEMMV INPUT QUANTITY FOR CMC NAVIGATION UPDATE DATA IS LISTED BELOW:

PHASE WHERE CMC NAVIGATION UPDATE IS DESIRED:

A4270	SET TO 1 TO CALL NAVIGATION UPDATE AT END OF A PHASE.

C. ADDITIONAL GEMMV INPUT QUANTITIES FOR IU NAVIGATION UPDATE DATA ARE LISTED BELOW:

PHASE WHERE IU NAVIGATION UPDATE IS DESIRED:

A152	SET TO 1 TO CALL IU NAVIGATION UPDATE AT END OF PHASE OR -1 AT BEGINNING OF PHASE
A153	SET TO GMTL/0 -GMTIUGRR (SEC).
A309	LAUNCH AZIMUTH

D. ADDITIONAL GEMMV INPUT QUANTITIES FOR PAO DATA ARE LISTED BELOW' PHASE WHERE PAO DATA IS DESIRED

A154	SET TO 1 TO CALL PAO SUMMARY SHEET AT END OF PHASE.
A158	PAO HEADER (STARTING IN COLUMN 8, SET TO BCD AND SET COLUMN 12 TO AN 8)

BOTH VEHICLES MUST HAVE SAME STOPS IN FIRST PHASE

3. OPERATING INSTRUCTIONS FOR THE GEMMV POST PROCESSORS

3.1 GENERAL

A GEMMV POST PROCESSOR IS A PROGRAM THAT IS AUTOMATICALLY EXECUTED AFTER THE GEMMV TRAJECTORY PROGRAM HAS GENERATED AND STORED THE NECESSARY INPUT DATA ON A TAPE. THERE ARE PRESENTLY FIVE POST PROCESSORS THE GUIDANCE OPTICAL SIGHTING TABLE (GOST), RADIATION, APOLLO REENTRY SIMULATION (ARS), EXTERNAL DELTA V AND STAR SIGHTING TABLE (SST).

3.2 THE GEMMV POST PROCESSORS

THIS SECTION PRESENTS A BRIEF DESCRIPTION OF THE GEMMV POST PROCESSORS ALONG WITH A LISTING OF THE CONTROL CARDS AND THE ON-LINE INPUT REQUIRED TO OPERATE EACH PROCESSOR.

3.2.1 GOST PROCESSOR. - THIS PROCESSOR WILL PRIMARILY BE USED TO VERIFY THE CM IMU STABLE MEMBER ALIGNMENT MADE BY USING THE ONBOARD OPTICAL SIGHTING EQUIPMENT CONSISTING OF A SCANNING TELESCOPE, A SEXTANT, AND A BORESIGHT. BY USING A CATALOG OF STAR AND EARTH FIXED LANDMARK LOCATIONS, THIS PROCESSOR WILL CALCULATE IMU GIMBAL ANGLES, REFSMMATS, AND THE SHAFT AND TRUNNION ANGLES OF THE OPTICAL EQUIPMENT. THE PROCESSOR HAS SEVERAL OPTIONS WHICH MAY BE USED TO DETERMINE THE POSITION OF STARS ON THE INSTRUMENT RETICLES, TO DETERMINE THE NECESSARY SPACECRAFT ATTITUDE FOR VIEWING A GROUND TARGET, TO DETERMINE REFSMMAT, AND TO DETERMINE IMU GIMBAL ANGLES.

ALTHOUGH THE GOST PROCESSOR CAN BE RUN WITH ANY GEMMV PROCESSOR, A SPECIAL DECK HAS BEEN SET UP USING FILE 4 OF THE MISSION DATA TAPE.

THE UNIVAC 1108 DATA PROCESSING SYSTEM CONTROL CARDS ARE LISTED BELOW*

```
COLUMN 1  4    8
      *   MSG                          COMMENTS
          ASG A = XXXX                 GEMMV PROGRAM (PCF) TAPE
                                       NUMBER
          ASG B = XXXX                 MISSION TABLE TAPE NUMBER
          ASG F = XXXX                 MISSION DATA TAPE NUMBER
          ASG G,N,V                    SCRATCH UNITS ON FASTRAND
          XQT CUR                      EXECUTE THE FOLLOWING
                                       INSTRUCTIONS
              TRW A,B,F,G,N,V          REWIND UNITS A,B,F,G,N,V
              IN A                     INPUT THE ENTIRE USER PCF
                                       FROM UNIT A
              .
              .                        SOURCE LANGUAGE CORREC
                                       TIONS
                                       (PATCHES)
              .
           N XQT GEMMV                 EXECUTE GEMMV PROGRAM
              .
              .                        GEMMV UPDATES
              .
          FILE                         LAST GEMMV DATA CARD
             XQT CUR                   EXECUTE THE FOLLOWING
                                       INSTRUCTIONS
              ERS                      ERASE LAST PROGRAM FROM
                                       MEMORY
              IN A                     INPUT THE ENTIRE USER PCF
                                       FROM UNIT A
             XQT DGOST                 EXECUTE GOST PROGRAM
              .
              .                        GOST DATA CARDS
              .
          FILE                         LAST GOST DATA CARD
            FOF                        END OF FILE
```

*INDICATES 7/8 OVERPUNCH IN COLUMN 1

GOST PROCESSOR

(SPECIAL GOST DECK FILE 4 UNIVAC 1108)

A. THE INPUT QUANTITIES FOR THE GEMMV PART OF THE PROCESSOR ARE THE SAME FOR ALL GOST OPTIONS (WITH TWO EXCEPTIONS WHICH ARE INDICATED). THE STANDARD INPUT QUANTITIES ARE LISTED BELOW:

PHASE 1 - COAST

A4871-3	VECTOR IDENTIFICATION
A368	REVOLUTION NUMBER
A93-5	LIFT-OFF TIME (HR, MIN, SEC)(G.M.T.)
A1138-40	VECTOR TIME (HR, MIN, SEC)(G.M.T.)
A240-2	POSITION COORDINATES (ER)(X, Y, Z)
A248-50	VELOCITY COORDINATES (ER/HR)(X, Y, Z)
A280	CURRENT WEIGHT (LB)
A1148-50	TIME OF GOST COMPUTATION (HR, MIN, SEC) (G.E.T.)
A1027-9	IMU ROLL, PITCH, YAW GIMBAL ANGLES, RESPECTIVELY (NOT NECESSARY FOR GOST OPTION 4 OR 14 AND 5 OR 15)
A1018-26	REFSMMAT STORED ROW-WISE (NOT NECESSARY FOR GOST OPTION 1 OR 11)
A225*	SET TO 6 TO OBTAIN CORRECT ATTITUTDE OPTION.
A79*	SET TO 2 TO WRITE 200 WORD-RECORD.
A80*	SET TO 2 TO CALL IN GOST PROGRAM FROM PCF TAPE.

*THESE A-ARRAYS HAVE ALREADY BEEN SET TO THE CORRECT VALUE IN THE SPECIAL GOST ON-LINE DECK.

B. THE OPTIONS OF THE GOST PART OF THE PROCESSOR AS WELL AS THE CARD FORMATS ARE LISTED BELOW. OPTION 1 OR 11 REQUIRES TWO INPUT CARDS WHILE OPTION 5 OR 15 REQUIRES FOUR INPUT CARDS. THE REMAINING OPTIONS EACH REQUIRE ONLY ONE CARD. ALL DATA PUNCHED IN COLUMNS 10 THROUGH 70 MUST HAVE DECIMAL POINTS. THE GOST INPUT CARDS ARE PLACED IN THE SPECIAL GOST ON-LINE DECK JUST AFTER THE 'XQT DGOST' CARD.

OPTION 1 OR 11

INPUT:	THE IDENTIFICATION OF TWO STARS AND THE SEXTANT SHAFT AND TRUNNION ANGLES FOR EACH STAR
COMPUTE:	REFSMMAT

OPTION 2 OR 12

INPUT:	NO INPUTS ARE NEEDED FOR OPTION 2 OR 12.
COMPUTE:	THE LOCATION OF TWO STARS WHICH ARE IN THE SCANNING TELESCOPE FIELD OF VIEW AT A SPECIFIED SPACECRAFT ATTITUDE AND IMU ALIGNMENT. THE TWO STARS MUST SATISFY THE CONDITION THAT ONE STAR LIES ON THE R-LINE AND THE OTHER STAR LIES AS CLOSE AS POSSIBLE TO THE M-LINE OF THE TELESCOPE RECTICLE PATTERN.

OPTION 3 OR 13

INPUT:	THE IDENTIFICATION OF TWO STARS
COMPUTE:	THE SEXTANT SHAFT AND TRUNNION ANGLES FOR EACH OF THE INPUT STARS

OPTION 4 OR 14

INPUT:	THE SPACECRAFT LVLH ROLL AND YAW ANGLES PLUS THE SPACECRAFT PITCH ANGLE TO THE HORIZON
COMPUTE:	GIMBAL ANGLES AND LVLH PITCH ANGLE

OPTION 5 OR 15

INPUT:	THIS OPTION IS THE SAME AS OPTION 1 OR 11 EXCEPT THE IMU GIMBAL ANGLES ARE INPUT IN THE GOST RATHER THAN THE GEMMV PROGRAM .
COMPUTE:	REFSMMAT

INPUT FORMAT

OPTION NUMBER	COLUMNS 1 - 2	10 - 25	30 - 45	50 - 65
1 OR 11	11	STAR NO. 1	SHAFT NC. 1	TRUNNION NO .1
	11	STAR NO. 2	SHAFT NC. 2	TRUNNION NO. 2
2 OR 12	12	*	*	*
3 OR 13	13	STAR NO. 1	STAR NO. 2	
4 OR 14	14	LVLH ROLL	**	LVLH YAW
	15	STAR NO. 1	SHAFT NC. 1	TRUNNION NO. 1
	15	STAR NO. 2	SHAFT NC. 2	TRUNNION NO. 2
5 OR 15				
	15	ROLL GA NO. 1	PITCH GA NO. 1	YAW GA NO. 1
	15	ROLL GA NO. 2	PITCH GA NO. 2	YAW GA NO. 2

*NORMALLY THESE COLUMNS SHOULD BE BLANK. IF NCN-BLANK, COLUMNS 10-25 SHOULD CONTAIN THE ROLL GIMBAL ANGLE, COLUMNS 30-45 SHOULD CONTAIN THE PITCH GIMBAL ANGLE, AND COLUMNS 50-65 SHOULD CONTAIN THE YAW GIMBAL ANGLE. IF ANY OF THESE ANGLES ARE ZERO, THEY MUST BE PUNCHED .00001.

**NORMALLY A BLANK OR 0. EITHER IS RECCGNIZED BY THE PROGRAM AS A 31.7-DEGREE PITCH BETWEEN THE X-BODY AXIS AND LINE OF SIGHT TO THE HORIZON. OTHERWISE, THE PITCH ANGLE (IF OTHER THAN 31.7 DEG) SHOULD BE INPUT.

3.2.2 RADIATION PROCESSOR. - THIS PROCESSOR WILL BE USED TO DETERMINE GEOMAGNETIC PARAMETERS AND THE RADIATION DOSE RATES IN THE COMMAND MODULE AT GIVEN INTERVALS ALONG A TRAJECTORY. IT WILL ALSO BE USED TO CALCULATE REM DOSE IN THE COMMAND MODULE OVER A PARTICULAR PORTION OF THE APOLLO 9 MISSION.

THE UNIVAC 1108 DATA PROCESSING SYSTEM CONTROL CARDS ARE LISTED BELOW

```
COLUMN 1  4    8
       *  MSG                          COMMENTS
          ASG A=XXXX                   GEMMV PROGRAM (PCF) TAPE
                                       NUMBER
          ASG B=XXXX                   MISSION TABLE TAPE NUMBER
          ASG F=XXXX                   MISSION DATA TAPE NUMBER
          ASG G,H,N,V                  SCRATCH UNITS ON FASTRAN
          XQT CUR                      EXECUTE THE FOLLOWING
                                       INSTRUCTIONS
              TRW A,B,G,N,V,F,H        REWIND A,B,G,N,V,F, AND
                                       H UNITS.
              IN A                     INPUT THE ENTIRE USER PCF
                                       FROM UNIT A
              .
              .
              .                        SOURCE LANGUAGE CORRECTIONS
              .
              .
           N XQT GEMMV                 START EXECUTION OF THE
                                       GEMMV PROGRAM.
              .
              .
              .                        GEMMV DATA CARDS
              .
              .
          FILE                         LAST GEMMV DATA CARD
             XQT CUR                   EXECUTE THE FOLLOWING
                                       INSTRUCTIONS
              ERS                      ERASE LAST PROGRAM FROM
                                       MEMORY.
              IN A                     INPUT THE ENTIRE USER PCF
                                       FROM UNIT A
           N XQT DECK1                 START EXECUTION OF RADIA-
                                       TION PROCESSOR.
          FILE                         LAST RADIATION DATA CARD
            EOF                        END OF FILE CARD
```

*INDICATES 7/8 OVERPUNCH IN COLUMN 1

RADIATION PROCESSOR

(ALL GEMMV FILES UNIVAC 1108)

ADDITIONAL GEMMV INPUT QUANTITIES FOR THE RADIATION PROCESSOR ARE LISTED BELOW

PHASE WHERE FIRST RADIATION OUTPUT IS DESIRED'

A114	SET TO 3 TO CALL WRITE 3 (RADIATION EPHEMERIS) SUBROUTINE.
A80	SET TO 3 TO CALL RADIATICN PROCESSOR FROM PCF TAPE.
A111	SET TO 0 TO SPECIFY CONSTANT INTEGRATION INTERVAL.
A120	SET TO DESIRED INTEGRATICN STEP SIZE (SEC).
A4207	SET TO N (OUTPUT WILL BE EVERY N INTEGRATION STEPS).

PHASE WHERE LAST RADIATION OUTPUT IS DESIRED

A4207	SET TO 0.

3.2.3 ARS PROCESSOR. - THE APOLLO REENTRY SIMULATION PROCESSOR WILL BE USED TO ACCEPT A STATE VECTOR AT 425,000 FEET AND COMPUTE THE NECESSARY GUIDED ENTRY PROFILE TO HIT A TARGET LATITUDE AND LONGITUDE. THE STATE VECTOR IS GENERATED BY ONE OF THE GEMMV DEORBIT PROCESSORS AND IS WRITTEN INTO A 200-WORD RECORD WHICH INTERFACES WITH THE ARS PROCESSOR. OPTIONS EXIST WITHIN THE PROCESSOR TO USE ONE OF SIX DIFFERENT ENTRY MODES WHICH ARE DESCRIBED BELOW.

MODE 1 - AUTOMATIC GUIDANCE AND NAVIGATION CONTROL

IN THIS STEERING MODE, THE ARS PROCESSOR USES THE CMC ENTRY LOGIC TO COMPUTE THE ENTRY STEERING COMMANDS AND TO SIMULATE THE ENTRY TRAJECTORY REQUIRED TO ACHIEVE THE TARGET LANDING POINT.

MODE 2 - OPEN LOOP FOLLOWED BY GUIDANCE AND NAVIGATION CONTROL

IN THIS ENTRY MODE, AN INITIAL BANK ANGLE IS MAINTAINED FROM 400,000 FEET TO A SPECIFIED G-LEVEL, AT WHICH TIME THE CM IS ROLLED TO A SECOND BANK ANGLE, DESIGNATED AS THE BACKUP BANK ANGLE. THIS ATTITUDE IS MAINTAINED UNTIL THE SECOND G-LEVEL IS REACHED. FROM THIS TIME UNTIL DROGUE CHUTE DEPLOYMENT, THE ARS PROCESSOR USES THE GUIDANCE AND NAVIGATION CONTROL LOGIC TO COMPUTE THE STEERING COMMANDS NECESSARY TO ACHIEVE THE TARGET LANDING POINT. THIS STEERING MODE REQUIRES THE INPUT OF AN INITIAL AND BACKUP BANK ANGLE AND TWO G-LEVELS.

MODE 3 - BANK/REVERSE-BANK

IN THIS ENTRY MODE, WHICH IS USED TO COMPUTE BACKUP GUIDANCE QUANTITIES, AN INITIAL BANK ANGLE IS MAINTAINED FROM 400,000 FEET TO A SPECIFIED G-LEVEL. IT IS THEN FOLLOWED BY A BACKUP BANK ANGLE TO A COMPUTED TIME TO REVERSE BANK, AND THE REVERSE BANK ANGLE IS FLOWN TO DROGUE CHUTE DEPLOYMENT. IN THIS STEERING MODE, THE INITIAL BANK ANGLE AND G-LEVEL ARE INPUT, AND THE BACKUP BANK ANGLE AND TIME TO REVERSE BANK ARE COMPUTED BY THE ARS PROCESSOR.

MODE 4 - COMBINED BANK/REVERSE-BANK AND GUIDANCE AND NAVIGATION CONTROL

THIS ENTRY MODE IS THE SAME AS THAT DESCRIBED IS THE SECOND STEERING MODE WITH THE EXCEPTION THAT THE PROCESSOR COMPUTES THE BACKUP BANK ANGLE. THE INPUTS CONSIST OF THE INITIAL BANK ANGLE AND THE TWO G-LEVELS.

MODE 5 - ROLLING

IN THIS ENTRY, AN INITIAL BANK ANGLE IS MAINTAINED FROM 400,000 FEET TO A SPECIFIED G-LEVEL FOLLOWED BY A CONSTANT ROLL RATE TO DROGUE CHUTE DEPLOYMENTC THIS MODE REQUIRES THE INPUT OF THE INITIAL BANK ANGLE, G-LEVEL, AND ROLL RATE.

MODE 6 - OPEN LOOP

THIS ENTRY CAN EITHER BE A BANK/REVERSE-BANK AS DESCRIBED IN THE THIRD STEERING MODE OR A CONSTANT BANK-ANGLE ENTRY FROM 400,000 FEET TO DROGUE CHUTE DEPLOYMENT. THE BANK/REVERSE-BANK OPTION OF THIS STEERING MODE REQUIRES THE INPUT OF THE INITIAL AND BACKUP BANK ANGLES, THE G-LEVEL, AND THE TIME TO REVERSE BANK. A CONSTANT BANK ANGLE ENTRY CAN BE SPECIFIED BY INPUTTING THE VALUE OF THE BANK ANGLE TO BE USED AS THE INITIAL BANK ANGLE AND INPUTTING THE G-LEVEL AND TIME TO REVERSE BANK AS LARGE VALUES.

THE UNIVAC 1108 DATA PROCESSING SYSTEM CONTROL CARDS ARE LISTED BELOW*

```
COLUMN 1  4    8
          MSG                          COMMENTS
          ASG A=XXXX                   GEMMV PROGRAM (PCF) TAPE
                                       NUMBER
          ASG B=XXXX                   MISSION TABLE TAPE NUMBER
          ASG F=XXXX                   MISSION DATA TAPE NUMBER
          ASG G,N,V,K                  SCRATCH UNITS ON FASTRAND
          XQT CUR                      EXECUTE THE FOLLOWING
                                       INSTRUCTIONS
              TRW A,B,G,N,V,F,K        REWIND A,B,G,N,V, AND F
                                       K UNITS
              IN A                     INPUT THE ENTIRE USER PCF
                                       FROM UNIT A
              .
              .
              .                        SOURCE LANGUAGE CORRECT-
                                       IONS
              .                        (PATCHES)
              .
       N  XQT GEMMV                    START EXECUTION OF THE
                                       GEMMV PROGRAM.
              .
              .
              .                        GEMMV DATA CARDS
              .
              .
       FILE                            LAST GEMMV DATA CARD
          XQT CUR                      EXECUTE THE FOLLOWING
                                       INSTRUCTIONS
              ERS                      ERASE LAST PROGRAM FROM
                                       MEMORY.
              IN A                     INPUT THE ENTIRE USER PCF
                                       FROM UNIT A
        N XQT COLSUS/XXX               EXECUTE ARS PROGRAM (SCS
                                       FOR BACKUP MODES AND DAP
                                       FOR G AND N ENTRIES
       IDFILE = 7
       ENDCAS                          LAST ARS INPUT CARD
       EOF                             END OF FILE CARD
```

*INDICATES 7/8 OVERPUNCH IN COLUMN 1

ARS PROCESSOR

(FILES 1, 2, AND 8 UNIVAC 1108)

ADDITIONAL GEMMV INPUT QUANTITIES FOR THE ARS PROCESSOR ARE LISTED BELOW:

PHASE 1

A83	SET TO 1 TO CALL ARS PROCESSOR.
A2918	SET TO 1 FOR AUTOMATIC GUIDANCE AND NAVIGATION ENTRY MODE. SET TO 2 FOR OPEN LOOP GUIDANCE AND NAVIGATION ENTRY MODE. SET TO 3 FOR BANK/REVERSE-BANK ENTRY MODE. SET TO 4 FOR COMBINED BLANK/REVERSE-BANK AND GUIDANCE AND NAVIGATION ENTRY MODE. SET TO 5 FOR ROLLING ENTRY MODE. SET TO 6 FOR OPEN LOOP CONSTANT BANK ANGLE OR BANK REVERSE ENTRY MODE.
A2914	G-LEVEL TO INITIATE BACKUP GUIDANCE MODE (SET WHEN A2918 EQUALS A 2 OR 4.)
A2915	TIME TO REVERSE BANK IN TOTAL SECONDS (G.E.T.) (SET WHEN A2918 EQUALS 6.)
A1929	DIRECTION TO BEGIN BANK =0 SOUTH THEN NORTH =1 NORTH THEN SOUTH

COAST TO 400K PHASE

A79	SET TO 2 TO WRITE 200-WORD RECORD AT END OF PHASE.
A649	SET TO 425,000.(TERMINATE ON AN ALTITUDE OF 425,000 FT)

3.2.4 EXTERNAL DELTA V AND REFSMMAT UPDATE PROCESSOR. - THIS PROCESSOR WILL BE USED TO CONVERT THE REFSMMAT AND EXTERNAL DELTA V QUANTITIES CALCULATED BY THE GEMMV PROGRAM TO THE CMC UPLINK FORMAT.

THE UNIVAC 1108 DATA PROCESSING SYSTEM CONTROL CARDS ARE LISTED BELOW*

```
COLUMN 1  4   8
       MSG                          COMMENTS
          ASG A = XXXX              GEMMV PROGRAM (PCF) TAPE
                                    NUMBER
          ASG B = XXXX              MISSION TABLE TAPE NUMBER
          ASG F = XXXX              MISSION DATA TAPE NUMBER
          ASG G,N,V                 SCRATCH UNITS ON FAST-
                                    RAND.
          XQT CUR                   EXECUTE THE FOLLOWING
                                    INSTRUCTIONS
              TRW A,B,F,G,N,V       REWIND UNITS A,B,F,G,N,
                                    AND V.
              IN A                  INPUT THE ENTIRE USER PCF
                                    FROM UNIT A
              .
              .
                                    SOURCE LANGUAGE CORRECT-
                                    IONS
              .                     (PATCHES)
              .
           N XQT GEMMV              EXECUTE GEMMV PROGRAM.
              .
                                    GEMMV UPDATES
              .
              .
       FILE                         LAST GEMMV DATA CARD
          XQT CUR                   EXECUTE THE FOLLOWING
                                    INSTRUCTIONS
              ERS                   ERASE LAST PROGRAM FROM
                                    MEMORY.
              IN A                  INPUT THE ENTIRE USER PCF
                                    FROM UNIT A
           N XQT DSKYUP             EXECUTE DSKYUP PROGRAM.
       FILE                         LAST DSKYUP DATA CARD
         EOF                        END OF FILE CARD
```

*INDICATES 7/8 OVERPUNCH IN COLUMN 1

EXTERNAL DELTA V AND REFSMMAT UPDATE PROCESSOR

(ALL GEMMV FILES UNIVAC 1108)

ADDITIONAL GEMMV INPUT QUANTITIES FOR THE EXTERNAL DELTA V AND REFSMMAT UPDATE PROCESSOR.

PHASE WHERE EXTERNAL DELTA V OR REFSMMAT UPDATE OUTPUT IS DESIRED.

A80	SET TO 6 TO CALL THE EXTERNAL DELTA V AND REFSMMAT UPDATE PROCESSOR.
A79	SET TO 2 TO WRITE THE 200 WORD-RECORD FOR DEORBIT.
	SET TO 5 TO WRITE THE 200 WORD-RECORD FOR ORBIT.

4. OPERATING INSTRUCTIONS FOR THE WORK SCHEDULE PROCESSOR

4.1 GENERAL

THIS SECTION PRESENTS THE ON-LINE INPUTS REQUIRED FOR EXECUTION OF THE WORK SCHEDULE PROCESSOR, A BRIEF DESCRIPTION OF THE PROCESSOR, THE TAPE SETUP, AND THE CONTROL CARDS USED IN CONJUNCTION WITH THE PROCESSOR.

4.2 PROGRAM DESCRIPTION

THE WORK SCHEDULE PROCESSOR IS DIVIDED INTO THREE SEPARATE MODULES. MODULE I (ANY GEMMV PROCESSOR) IS USED TO GENERATE AN EPHEMERIS TAPE WHICH BECOMES THE INPUT TO THE NEXT MODULE. THE EPHEMERIS TAPE CONTAINS ALL THE PERTINENT ORBIT AND MANEUVER DATA OVER A SPECIFIED TIME INTERVAL. MODULE II ACCEPTS THE EPHEMERIS TAPE AND GENERATES THAT EPHEMERIS AND TRACKING DATA REQUESTED AND OUTPUTS THEM ON THE APPROPRIATE SUMMARY SHEETS. THE DATA WHICH CAN BE OBTAINED FROM MODULE II INCLUDES THE FOLLOWING: SPACECRAFT DAYLIGHT-DARKNESS, SPACECRAFT MOON SIGHTING, COMPUTED EVENTS, LANDMARK SIGHTING, SPACECRAFT STAR SIGHTING, CLOSEST APPROACH, AND POINTING DATA. THESE DATA ARE ALSO SAVED ON AN INTERFACE TAPE WHICH SERVES AS THE INPUT TO MODULE III. THE PROCESSOR MAY BE TERMINATED AT THIS POINT IF ONLY THE EPHEMERIS AND TRACKING DATA ARE DESIRED. THE PROCESSOR OUTPUT THEN CONSISTS OF THE EPHEMERIS AND TRACKING DATA SUMMARY SHEETS.

THE EXECUTION OF MODULE III IS PERFORMED WHEN THE WORK SCHEDULE IS DESIRED. IT SORTS THE INFORMATION CONTAINED ON THE INTERFACE TAPE AND INPUT EVENT CARDS AND GENERATES A PLOT TAPE WHICH IS DELIVERED TO THE DD80 WHERE A FILM OF THE WORK SCHEDULE IS PRODUCED. HARD COPIES OF THE FILM ARE MADE AFTER FILM IS RETURNED TO BUILDING 45.

4.3 TAPE SETUP FOR THE UNIVAC 1108 DATA PROCESSING SYSTEM

TAPE UNIT	TAPE DESCRIPTION
A	GEMMV PROGRAM (PCF) TAPE
B	MISSION TABLE TAPE
F	MISSION DATA TAPE
I	EPHEMERIS TAPE (SYSTEM)
S	PLOT PACKAGE (SYSTEM)
T	SORT PACKAGE (SYSTEM)
Q	EPHEMERIS TAPE GENERATED BY MODULE I
R	DATA TAPE GENERATED BY MODULE II
J	SORTED TAPE FOR USE BY MODULE III
G	SCRATCH TAPE
N	SCRATCH TAPE
K	SCRATCH TAPE

4.4 CONTROL CARD LISTING FOR THE UNIVAC 1108 DATA PROCESSING SYSTEM

4.4.1 MODULE I

```
CCLUMN 1  4    8
          MSG                          COMMENTS
          ASG A = XXXX                 GEMMV PROGRAM PCF
                                       TAPE NUMBER
          ASG B = XXXX                 MISSION TABLE TAPE NUMBER
          ASG F = XXXX                 MISSION DATA TAPE NUMBER
          ASG I = $EPHEM               SUN, MOON, AND STAR
                                       EPHEMERIDES
          ASG S = $PLOTS               PLOT PACKAGE (SYSTEM)
          ASG T = $SORT                SORT PACKAGE (SYSTEM)
          ASG Q                        EPHEMERIS TAPE GENERATE
                                       BY MODULE I
          ASG R                        DATA TAPE GENERATED
                                       BY MODULE II
          ASG J = SAVE                 SORTED TAPE FOR USE BY
                                       BY MODULE III
                                       (SAVE FOR PLOTS)
          ASG G,N,K                    SCRATCH UNITS ON FASTRAND
          XQT CUR                      EXECUTE THE FOLLOWING
                                       INSTRUCTIONS
              TRW A,B,F,G,J,N,Q,R,I,   REWIND UNITS A,B,F,G,J,N,
                  S,T,K                Q,R,I,S,T, AND K
             IN A                      INPUT THE ENTIRE USER
                                       PCF FROM UNIT A
       N  XQT GEMMV                    EXECUTE THE GEMMV PROGRAM
              .
              .
              .                        MODULE I DATA CARD
              .                        (ANY STANDARD GEMMV
              .                        ON-LINE DECK)
              .
              .
        FILE                           END OF INPUT FOR MODULE I
```

4.4.2 MODULE II

```
CCLUMN 1  4    8
          XQT CUR                      EXECUTE THE FOLLOWING
                                       INSTRUCTIONS
              ERS                      ERASE LAST PROGRAM
                                       FROM MEMORY
             IN A                      INPUT THE ENTIRE USER
                                       PCF FROM UNIT A
              XQT MAIN                 EXECUTE MODULE II
                                       MODULE II DATA CARD
        FILE 5                         CALL MODULE III
```

4.4.3 MODULE III

```
COLUMN 1  4    8
          XQT CUR                EXECUTE THE FOLLOWING
                                 INSTRUCTIONS
              ERS                ERASE LAST PROGRAM
                                 FROM MEMORY
             IN A                INPUT THE ENTIRE USER
                                 PCF FROM UNIT A
             IN S                INPUT THE ENTIRE USER
                                 PCF FROM UNIT S
             IN T                INPUT THE ENTIRE USER
                                 PCF FROM UNIT T
          XQT MAIN 3             EXECUTE MODULE III
        .
        .
        .                        MODULE III DATA CARDS
        .
        .
        FILE                     END OF MODULE III INPUT
          EOF                    END OF FILE CARD
```

4.5 INPUTS TO THE WORK SCHEDULE PROCESSOR

4.5.1 INPUTS TO MODULE I. - THE FOLLOWING INPUTS ARE IN ADDITION TO ANY OF THE STANDARD GEMMV INPUT QUANTITIES AS DESCRIBED IN SECTION 2.

PHASE 1

A80	SET TO 4 TO CALL MODULE II AFTER GEMMV TERMINATION
A114	SET TO 4 TO CALL WRITE 4 SUBROUTINE (USED TO GENERATE THE TAPES FOR MODULE II)
A102	SET TO 20 (OUTPUT UNIT FOR WRITE 4).
A111	SET TO 0 TO SPECIFY CONSTANT INTEGRATION.
A120	SET TO DESIRED INTEGRATION INTERVAL(SEC).
A138	SET TO DAY OF YEAR OF LIFT-OFF.

PHASE WHERE WORK SCHEDULE OUTPUT IS DESIRED

A4210	SET TO N (OUTPUT WILL BE EVERY N INTEGRATION STEPS) A4210 IS USUALLY ADJUSTED SO THAT WRITE 4 WILL OUTPUT APPROXIMATELY EVERY 20 SECONDS OF ORBIT PROPAGATION TIME E.G., IF A120 IS SET TO 10 SEC, THEN A4210 WOULD BE SET TO 2.

PHASE AFTER LAST WORK SCHEDULE OUTPUT IS DESIRED

A648-9	TERMINATION INDEX AND VALUE, RESPECTIVELY (NORMALLY THE INDEX SHOULD BE A123 PHASE TIME, AND THE VALUE SHOULD BE 10 SEC)
A102	SET TO -20 (WRITES AN EOF ON TAPE UNIT 20)

THE LAST PHASE IN THE DECK SHOULD HAVE A139 SET TO 1 TO TERMINATE THE RUN.

4.5.2 INPUTS TO MODULE II

CARD 1 - THIS CARD IS USED TO SPECIFY THE TYPES OF DATA TO BE PROCESSED(I3).

COLUMNS	
2-4	NUMBER OF RADAR STATIONS TO BE PROCESSED (PRESENTLY 27)
6-8	NUMBER OF LANDMARKS TO BE PROCESSED (TYPE I CARDS)
10-12	NUMBER OF STARS TO BE PROCESSED (TYPE II CARDS)

14-16	NUMBER OF POINTING TARGETS TO BE PROCESSED (TYPE III CARDS)
18-20	NUMBER OF CLOSEST APPROACH TARGETS (TYPE IV CARDS)
22-24	FLAG FOR DAYLIGHT-DARKNESS COMPUTATION (IF = 0, DO NOT COMPUTE , IF GREATER THAN 0, COMPUTE)
26-28	FLAG FOR MOON SIGHTING COMPUTATION (IF = 0, DO NOT COMPUTE , IF GREATER THAN 0, COMPUTE)
30-32	FLAG TO COMPUTE EVENTS (APOGEE, PERIGEE, ASCENDING NODE, REVOLUTION NUMBER, ETC.) IF = 0, EVENTS WILL NOT BE COMPUTED IF GREATER THAN 0, THEY WILL BE COMPUTED.
34-36	NUMBER OF ACTIVE VEHICLES IN THE GEMMV RUN
38-40	MINIMUM ELEVATION ANGLE FOR RADAR STATIONS (0-90 DEGREES)
42-44	ANGLE FOR LANDMARK SIGHTINGS (0-90) DEGREES)
46-48	FLAG TO PRINT ALTITUDE AS A COMPUTED EVENT. THE NUMBER INPUT IN THIS FIELD IS THE T IN MINUTES AT WHICH ALTITUDE WILL BE PRINTED (I.E., A 15 WILL REQUEST ALTITUDE TO BE PRINTED EVERY 15 MINUTES OVER THE INTERVAL SPECIFIED IN THE FOLLOWING SIX FIELDS)
50-52	HR (G.E.T.)
54-56	MIN (G.E.T) START ALTITUDE PRINT (IF 46-48 GREATER THAN 0)
58-60	SEC (G.E.T.)
62-64	HR (G.E.T.)
66-68	MIN (G.E.T.) STOP ALTITUDE PRINT (IF 46-48 GREATER THAN 0)
70-72	SEC (G.E.T.)

CARD 2 - IF COLUMNS 2-64 OF THIS CARD ARE BLANK, THE ENTIRE TRAJECTORY GENERATED WILL BE PROCESSED. OTHERWISE COLUMNS 2-16 SPECIFY START TIME FOR VEHICLE 1, COLUMNS 18-32 SPECIFY STOP TIME FOR VEHICLE 1 LIKEWISE, COLUMNS 34-48 AND 50-64 SPECIFY START AND STOP TIMES FOR VEHICLE 2.

COLUMNS		
2-4	DAY (I3)	
6-8	HR (I3)	START TIME
10-12	MIN (I3)	VEHICLE 1 (G.E.T.)
14-16	SEC (I3)	
18-20	DAY (I3)	
22-24	HR (I3)	STOP TIME
26-28	MIN (I3)	VEHICLE 1 (G.E.T.)
30-32	SEC (I3)	
34-36	DAY (I3)	

38-40	HR (I3)	START TIME
42-44	MIN (I3)	VEHICLE 2 (G.E.T.)
46-48	SEC (I3)	
50-52	DAY (I3)	
54-56	HR (I3)	STOP TIME
58-60	MIN (I3)	VEHICLE 2 (G.E.T.)
62-64	SEC (I3)	
66-75	MINIMUM ECCENTRICITY FOR WHICH APOGEE AND PERIGEE WILL BE PRINTED (E10)	

DATA CARDS - IF USED, THESE CARDS MUST FOLLOW CARD 2.

TYPE I CARDS - THESE CARDS ARE USED ONLY IF LANDMARK DATA ARE TO BE PROCESSED ANY NUMBER OF CARDS MAY BE INPUT, BUT THEY MUST BE INPUT IN ASCENDING ORDER (I3).

COLUMNS	
2-4	I.D. NUMBER OF LANDMARK 1
6-8	I.D. NUMBER OF LANDMARK 2
10-12	I.D. NUMBER OF LANDMARK 3
. .	. . . .
. .	. . . .

TYPE II CARDS - THESE CARDS ARE USED ONLY IF STAR DATA ARE TO BE PROCESSED. ANY NUMBER OF CARDS MAY BE USED, BUT THEY MUST BE INPUT IN ASCENDING ORDER (I3).

COLUMNS	
2-4	I.D. NUMBER OF STAR 1
6-8	I.D. NUMBER OF STAR 2
10-12	I.D. NUMBER OF STAR 3
. .	. . . .
. .	. . . .

TYPE III CARDS - THESE CARDS ARE USED ONLY IF POINTING DATA ARE TO BE PROCESSED. EACH TARGET MUST BE SPECIFIED ON A SEPARATE CARD. UP TO 5 POINTING TARGET CARDS MAY BE PROCESSED.

COLUMNS	
1-12	I.D. OF POINTING TARGET (A12)
14-23	LATITUDE OF TARGET (DEG)(E10)
25-34	LONGITUDE OF TARGET (DEG)(E10)
36-44	ALTITUDE OF TARGET (FT)(E8)
45-48	ELEVATION ANGLE DESIRED (DEG)(E4)
50-51	FLAG FOR THE TYPE OF RANGE (A2) SET TO S- FOR SLANT RANGE (USED FOR WSRR TEST) LEAVE BLANK FOR GROUND RANGE

TYPE IV CARDS - THESE CARDS ARE USED ONLY IF 'CLOSEST APPROACH TARGET' DATA ARE TO BE PROCESSED. EACH TARGET MUST BE SPECIFIED ON A SEPARATE CARD. UP TO FIVE TARGET CARDS MAY BE PROCESSED.

COLUMNS	
1-12	I.D. OF TARGET (A12)
15-23	LATITUDE OF TARGET (DEG)(E9)
25-34	LONGITUDE OF TARGET (DEG)(E10)
40-49	ALTITUDE OF TARGET (FT)(E10)

4.5.3 INPUTS TO MODULE III

CARD 1 - THIS CARD DETERMINES IF THE PLOT TAPE FROM MODULE II IS TO BE SORTED.

COLUMNS	
1-4	SORT = SORT MODULE II TAPE.

CARD 2 - THIS CARD DETERMINES THE COLUMN ARRANGEMENT, TIME SCALES DESIRED, MISSION NAME, AND CURRENT DATE. EACH COLUMN ON THE CARD CORRESPONDS TO THE SAME NUMBERED COLUMNS OF THE PLOT. TO DELETE AN OPTION FROM THE PLOT, PUNCH AN 8 IN THE RESPECTIVE COLUMN.

COLUMNS	
1	SET TO 0 FOR GET (I1). SET TO 1 FOR RET (I1). SET TO 2 FOR GMT (I1). SET TO 3 FOR EST (I1).
2	SAME INPUT AS CCLUMN 1 (I1)
3	SAME INPUT AS CCLUMN 1 (I1)
4	SET TO 4 TO SPECIFY RADAR OUTPUT (I1)
5	SET TO 5 TO SPECIFY SUNRISE/SUNSET IN COLUMN 5 (I1)
6	SET TO 6 TO SPECIFY MOCNRISE/MOONSET IN COLUMN 6 (I1)
7	SET TO 7 TO SPECIFY COMPUTED EVENTS IN COLUMN 7 (I1)
10	DESIRED TIME SCALE (I1) 1 = 2 HOURS 2 = 15 MINUTES 3 = 1 HOUR 4 = 30 MINUTES 5 = 42 MINUTES
13-30	MISSION NAME (A18)
33-44	CURRENT DATE (A12)

CARD 3 - THIS CARD DETERMINES THE VEHICLE, TIME RANGE, AND VEHICLE NAME OF THE PLOT.

COLUMNS	
1-2	NUMBER OF VEHICLE (1 OR 2) TO BE PLOTTED (I2)
5-6	DAY (I2)
8-9	HR (I2) START TIME OF PLOT. IF ZEROES
11-12	MIN (I2) ARE INPUT, PLOT STARTS AT

14-15	SEC (I2)	BEGINNING OF TAPE (G.E.T.)
17-18	DAY (I2)	
20-21	HR (I2)	STOP TIME OF PLOT. IF ZEROES
23-24	MIN (I2)	ARE INPUT, PLOT STOPS AT END
26-27	SEC(I2)	OF TAPE (G.E.T.)
33-38	VEHICLE NAME (A6)	

CARD 4 - THESE CARDS ARE USED TO INPUT EVENTS AT THE TIME THEY OCCUR. USE ONE CARD PER EVENT, AND AS MANY CARDS AS ARE NECESSARY.

COLUMNS	
1-2	SET TO 11 TO INDICATE INPUT EVENT CARD (I2).
5-6	DAY (I2)
7-9	HR (I3) TIME OF INPUT EVENT IN G.E.T.
11-12	MIN (I2)
14-15	SEC (I2)
21-80	INPUT STATEMENT (A42)

IF ANOTHER VEHICLE IS DESIRED OR IF ANOTHER TIME RANGE IS DESIRED FOR THE SAME VEHICLE, INPUT A CARD (2 IN COLUMN 2) TO CALL THE SECOND VEHICLE OR A SECOND CASE, THEN ANOTHER CARD 3 IS INPUT WITH THE SAME FORMAT AS DESCRIBED ABOVE. FOLLOWING THIS CARD WILL BE THE INPUT EVENTS ASSOCIATED WITH THIS VEHICLE OR TIME RANGE.

IF ANOTHER COLUMN ARRANGEMENT OR ANOTHER TIME SCALE IS DESIRED, THE FOLLOWING CARD IS INPUT

CARD 5

COLUMNS	
1-2	SET TO 3 TO INDICATE THAT A CARD 2 IS TO BE READ NEXT (I2).

FOLLOWING THIS CARD, ANOTHER CARD 2 IS INPUT ALONG WITH THE CARDS 3 AND 4 ASSOCIATED WITH IT.

CARD 6

COLUMNS	
2	SET TO 6 TO INDICATE END OF RUN. MUST ALWAYS BE THE LAST CARD IN MODULE III (I1).

4.6 INPUTS FOR THE PREDICTED SITE ACQUISITION TABLE (PSAT) OPTION

IN ORDER TO GENERATE PSAT DATA, MODULES I AND II ONLY ARE USED. MODULE I INPUT IS IDENTICAL TO THAT DESCRIBED IN SECTION 4.4.1, AND MODULE II IS IDENTICAL TO THE INPUTS DESCRIBED IN SECTION 4.4.2, EXCEPT FOR THE FOLLOWING

CARD 1

COLUMNS	
2-4	SET TO 27 IF ALL 27 STATIONS ARE TO BE PROCESSED (I3).
34-36	1 OR 2 DEPENDING ON THE NUMBER OF VEHICLES WHICH ARE TO BE PROCESSED (I3)
38-40	MINIMUM ELEVATION ANGLE (I3)

CARD 2

COLUMNS	
1-64	BLANK IF THE ENTIRE TRAJECTORY IS TO BE PROCESSED FOR PSAT.

IF PORTIONS OF THE GENERATED TRAJECTORY ARE TO BE PROCESSED, SET THE FOLLOWING

2-4	DAY (I3)
6-8	HR (I3) START TIME
10-12	MIN (I3) VEHICLE 1 (G.E.T.)
14-16	SEC (I3)
18-20	DAY (I3)
22-24	HR (I3) STOP TIME
26-28	MIN (I3) VEHICLE 1 (G.E.T.)
30-32	SEC (I3)
34-36	DAY (I3)
38-40	HR (I3) START TIME
42-44	MIN (I3) VEHICLE 2 (G.E.T.)
46-48	SEC (I3)
50-52	DAY (I3)
54-56	HR (I3) STOP TIME
58-60	MIN (I3) VEHICLE 2 (G.E.T.)
62-64	SEC (I3)
66-75	MINIMUM ECCENTRICITY FOR WHICH APOGEE AND PERIGEE WILL BE PRINTED (E10)

REPLACE THE FILE 5 CARD IN MODULE II WITH A FILE CARD FOLLOWED BY AN EOF CARD

5. OPERATING INSTRUCTIONS FOR THE RTACF MONITOR SYSTEM PROCESSORS

5.1 GENERAL

THIS SECTION PRESENTS THE ON-LINE INPUTS REQUIRED FOR EXECUTING THE APOLLO 9 MONITOR SYSTEM PROCESSORS. A BRIEF DISCUSSION OF THE PURPOSE OF EACH PROCESSOR AND THE TAPE SETUPS AND CONTROL CARD LISTINGS REQUIRED TO OPERATE THIS GROUP OF PROCESSORS ON IBM 7094 AND UNIVAC 1108 DATA SYSTEMS.

5.2 TAPE SETUP FOR THE IBM 7094 DATA PROCESSING SYSTEM

TAPE UNIT	TAPE DESCRIPTION
A2	MONITOR SYSTEM DATA TAPE
A3	OFF-LINE OUTPUT (PCF) TAPE
B1	MONITOR SYSTEM PROGRAM TAPE
B5	ARSS DATA TAPE
A5	UPDATE ARRS DATA TAPE

5.3 TAPE SETUP FOR THE UNIVAC 1108 DATA PROCESSING SYSTEM

TAPE UNIT	TAPE DESCRIPTION
A	MONITOR PROGRAM TAPE
B	MISSION DATA TAPE

5.4 CONTROL CARD LISTING FOR THE IBM 7094 DATA PROCESSING SYSTEM

THERE ARE NO CONTROL CARDS REQUIRED TO EXECUTE MONITOR SYSTEM PROCESSORS ON THE IBM 7094 DATA PROCESSING SYSTEM.

5.5 CONTROL CARD LISTING FOR THE UNIVAC 1108 DATA PROCESSING SYSTEM

```
COLUMN 1   4    8
           MSG                          COMMENTS
           ASG  A = XXXX                PROGRAM (PCF) TAPE NUMBER
           ASG  B = XXXX                MISSION MONITOR DATA TAPE
           XQT  CUR                     EXECUTE THE FOLLOWING
                                        INSTRUCTIONS
                TRW A,B                 REWIND UNITS A AND B
                IN A                    INPUT THE ENTIRE USER PCF
                                        FROM UNIT A
         N XQT  OLPROC                  EXECUTE THE MISSION MONITOR
                                        (PROCES) PROGRAM
                .
                .                       MISSION MONITOR DATA CARDS
            .
          EOF                            END OF FILE CARD
```

5.6 INPUTS TO THE MONITOR SYSTEM PROCESSORS

THIS SECTION PRESENTS THE INPUTS REQUIRED TO OPERATE THE APOLLO 9 MISSION MONITOR SYSTEM PROCESSORS ALONG WITH BRIEF DESCRIPTION OF EACH PROCESSOR. EXCEPT FOR THE FIRST PROCESSOR WHICH USES SOME GEMMV TYPE INPUTS, ALL THE INPUTS HAVE FIELD SPECIFICATIONS INDICATED IN PARENTHESES AFTER THE CARD, IF ALL THE FIELDS ARE THE SAME, OR AFTER THE VARIABLE SPECIFICATIONS ARE NOT IN STRICT ACCORDANCE WITH THE PROCESSOR'S FORTRAN FORMAT STATEMENT, A BRIEF EXPLANATION IS GIVEN.

A FIELD SPECIFICATION CONSISTS OF THE FOLLOWING

- A LETTER (I,E,O,A) TO DESIGNATE THE KIND OF INPUT THE PROCESSOR WILL EXPECT.
- A NUMBER TO DESIGNATE THE MAXIMUM NUMBER OF COLUMNS ALLOWED FOR EACH INPUT.

THE LETTER I SPECIFIES INTEGER INPUT, RIGHT JUSTIFIED, AND NO DECIMAL POINT. THE LETTER E SPECIFIES DECIMAL INPUT, LEFT JUSTIFIED, AND A DECIMAL POINT. THE LETTER O SPECIFIES OCTAL INPUT, LEFT JUSTIFIED, AND NO DECIMAL POINT. THE LETTER A SPECIFIES LETTERS, DIGITS PUNCTUATION, AND BLANK INPUT, LEFT JUSTIFIED.

5.6.1 CHECKOUT MONITOR PROCESSOR. - THIS PROCESSOR WILL BE USED TO GENERATE THE RTCC CHECKOUT MONITOR DISPLAY, USING EITHER A S-IVB TELEMETRY, A CSM TELEMETRY, OR A RTCC TRACKING VECTOR. IT WILL ALSO BE USED TO STORE THESE VECTORS IN THE PROPER INPUT FORMAT FOR THE APOLLO REAL-TIME RENDEZVOUS SUPPORT AND GEMMV PROGRAMS.

CHECKOUT MONITOR PROCESSOR

(IBM 7094 AND UNIVAC 1108)

ON-LINE CARD INPUT

CARD 1 — FILE NUMBER

COLUMNS	
1-2	01

CARD 2

INPUT IS THE SAME FORMAT AS THE GEMMV PROGRAM AND THE CARDS MAY BE IN ANY ORDER.

A124	GREENWICH HOUR ANGLE
A4871-3	VECTOR IDENTIFICATION
A368	REVOLUTION NUMBER
A93-5	LIFT-OFF TIME (HR, MIN, SEC) (GMT)
A1138-40	VECTOR TIME (HR, MIN, SEC) (GMT)
A240-2	POSITION COORDINATES (FT, KM, OR ER) (X, Y, Z)
A248-50	VELOCITY COORDINATES (FT/SEC, M/SEC, OR ER/HR) (X, Y, Z)
A280	CURRENT WEIGHT (LB)
A309	LAUNCH AZIMUTH
A211	SET TO 0 TO INPUT A GREENWICH ECI VECTOR. SET TO 1 TO INPUT A BESSELIAN ECI VECTOR. SET TO 3 TO INPUT AN IU TELEMETRY VECTOR.
A70-78	P05 MATRIX ONLY IF A BESSELIAN VECTOR IS INPUT (INPUT THE P05 MATRIX ROW-WISE.)
BTEM31	SET TO 0 IF THE INPUT VECTOR UNITS ARE KM-M/SEC OR ER-ER/HR. SET TO 1 IF THE INPUT VECTOR UNITS ARE FT-FT/SEC.
BTEM32	SET TO GMTIUGRR-GMTL/0 IN SEC ONLY IF AN IU VECTOR IS INPUT.
BTEM33	SET TO 1 TO GENERATE UPDATED ARRS INPUT DECK FOR TRACKING.

TRA CARD — TERMINATES THE INPUT FOR A CASE.

COLUMNS	
8-10	TRA (A3)
12-14	2,4 (A3)

NOTE - ADDITIONAL CASES ARE INPUT BY REPEATING CARDS 2 THROUGH THE TRA CARD.

5.6.2 AERODYNAMICS AND MASS PROPERTIES PROCESSOR - THE AERODYNAMICS AND MASS PROPERTIES PROCESSOR WILL BE USED TO DETERMINE THE CM ENTRY AERODYNAMICS AS WELL AS THE CSM CENTER OF GRAVITY LOCATION, MOMENTS OF INERTIA, PRODUCT MOMENTS OF INERTIA, AND ENGINE TRIM ANGLES AT ANY TIME DURING THE MISSION. THE PROCESSOR IS COMPOSED OF FOUR OPTIONS FROM WHICH THE CSM TRIM AERODYNAMICS, CSM CENTER OF GRAVITY LOCATION, MASS PROPERTIES TABLE, AND DIGITAL AUTOPILOT COMMAND LOAD CAN BE GENERATED.

AERODYNAMICS AND MASS PROPERTIES PROCESSOR

(IBM 7094 AND UNIVAC 1108)

ON-LINE CARD INPUT

CARD 1 — FILE NUMBER

COLUMNS	
1-2	02

CARD 2 — CALCULATION OPTION (I3)

COLUMNS	
3	1 GENERATE THE AERODYNAMICS TABLE OF THE PRESENT VEHICLE. 2 DETERMINE THE NEW CENTER OF GRAVITY LOCATION OF THE VEHICLE AFTER ADDING OR SUBTRACTING THE DESIGNATED MODULES. 3 GENERATE THE MASS PROPERTIES TABLE. 4 GENERATE THE DIGITAL AUTOPILOT LOAD.

OPTION 1

CARD 3 — PARAMETERS OF PRESENT VEHICLE

COLUMNS	
1-7	WEIGHT OF PRESENT VEHICLE (F7.2)
8-14	XCG - X STATION OF CENTER OF GRAVITY (F7.2)
15-21	YCG - Y STATION OF CENTER OF GRAVITY (F7.2)
22-28	ZCG - Z STATION OF CENTER OF GRAVITY (F7.2)
29-40	COMMENTS (2A6)

OPTION 2

CARD 3

COLUMNS	
1-3	NUMBER OF MODULES TO BE INPUT FOR A RUN (I3)

CARD 4 — PARAMETERS OF THE MODULES

COLUMNS	
4-11	WEIGHT OF MODULE PLUS IF IT IS TO BE ADDED OR MINUS IF IT IS TO BE SUBTRACTED (F8.3)
12-18	XCG - X STATION OF CENTER OF GRAVITY OF MODULE (F7.3)

19-24	YCG - Y STATION OF CENTER OF GRAVITY OF MODULE (F6.2)
25-30	ZCG - Z STATION OF CENTER OF GRAVITY OF MODULE (F6.2)

THE FOLLOWING INPUTS ARE NEEDED ON CARD 4 IF NEW SPACECRAFT MOMENTS OF INERTIA ARE TO BE CALCULATED

COLUMNS	
31-37	IXX - MOMENT OF INERTIA OF THE MODULE ABOUT THE X-AXIS (F7.0)
38-44	IYY - MOMENT OF INERTIA OF THE MODULE ABOUT THE Y-AXIS (F7.0)
45-51	IZZ - MOMENTS OF INERTIA OF THE MODULE ABOUT THE Z-AXIS (F7.0)

THE FOLLOWING INPUTS ARE NEEDED ON CARD 4 IF NEW SPACECRAFT PRODUCT MOMENTS OF INERTIA ARE TO BE CALCULATED

COLUMNS	
52-58	IXY - PRODUCT MOMENT OF INERTIA (F7.2)
59-65	IXZ - PRODUCT MOMENT OF INERTIA (F7.2)
66-72	IYZ - PRODUCT MOMENT OF INERTIA (F7.2)

CARD 5 OPTIONS FOR EACH CASE IN THE RUN

COLUMNS	
1-3	NUMBER OF MODULES FOR A CASE (I3)
4-6	1 COMPUTE AERODYNAMICS (I3). 0 DO NOT COMPUTE AERODYNAMICS (I3).
7-9	1 USE ONLY THOSE MODULES SPECIFIED ON CARD 6 FOR A CASE (I3). 0 USE THE FIRST N MODULES FOR A CASE WHERE N IS THE NUMBER IN COL. 1-3 AND CARD 6 IS NOT INCLUDED FOR THE CASE (I3).
11-22	COMMENTS (A12)

CARD 6 MODULES TO BE USED FOR A CASE (18I3)

COLUMNS	
1-3	EACH NUMBER IN FIELDS 1-3, 4-6, ETC., CORRESPONDS TO THE ORDER IN WHICH THE MODULE WERE INPUT (E.G. TO USE THE SECOND AND FOURTH OF THE INPUT MODULES FOR A CASE (COL. 1-3)=002, (COL. 4-6)=004 AND (COL. 7-76)=BLANK.
4-6	
.	
.	
74-76	(COL. 7-76)=BLANK).

OPTION 3 AND 4.

CARD 3

	COLUMNS	
	1-7	OPTION 3 - INPUT SPS MIXTURE RATIO (F7.2)
		OPTION 4 - INPUT THRUST LEVEL (LB) (F7.2)
	10	OPTION 3 - CONFIGURATION FLAG =1 GENERATE TOTAL MASS PROPERTIES =2 GENERATE MASS PROPERTIES FOR SPS BOTTOM, LM TOP, APS TOP =3 GENERATE MASS PROPERTIES FOR SPS TOP, LM BOTTOM
	12-23	OPTION 3 - COMMENTS (2A6)
MODULE 1		COMMAND MODULE
	COLUMNS	
	1-7	WEIGHT OF MODULE (F7.2)
	8-14	XCG - X STATION OF CENTER OF GRAVITY OF MODULE (F7.2)
	15-21	YCG - Y STATION OF CENTER OF GRAVITY OF MODULE (F7.2)
	22-28	ZCG - Z STATION OF CENTER OF GRAVITY OF MODULE (F7.2)
	29-35	IXX - MOMENT OF INERTIA OF THE MODULE ABOUT THE X-AXIS (F7.2)
	36-42	IYY MOMENT OF INERTIA OF THE MODULE ABOUT THE Y-AXIS (F7.2)
	43-49	IZZ MOMENT OF INERTIA OF THE MODULE ABOUT THE Z-AXIS (F7.2)
	50-56	IXY - PRODUCT MOMENT OF INERTIA (F7.2)
	57-63	IXZ - PRODUCT MOMENT OF INERTIA (F7.2)
	64-70	IYZ - PRODUCT MOMENT OF INERTIA (F7.2)
MODULE 2		SERVICE MODULE (SAME FORMAT AS CARD 4)
MODULE 3		RCS QUAD A
	COLUMNS	
	1-7	WEIGHT (LB) (F7.2)
MODULE 4		RCS QUAD B (F7.2)
MODULE 5		RCS QUAD C (F7.2)
MODULE 6		RCS QUAD D (F7.2)
MODULE 7		SPS FUEL (F7.2)
MODULE 9		SPS OXID (F7.2)

MODULE 11 PRIMARY H2 (F7.2)

MODULE 12 SECONDARY H2 (F7.2)

MODULE 13 PRIMARY O2 (F7.2)

MODULE 14 SECONDARY O2 (F7.2)

MODULE 15 POTABLE WATER (F7.2)

MODULE 16 WASTE WATER (F7.2)

MODULE 17-25 THESE ARE OPTION CARDS FOR INPUTTING ADDITIONAL MODULES AND ARE THE SAME FORMAT AS MODULE 3. IT IS ONLY NECESSARY TO INPUT AS MANY CARDS AS THERE ARE ADDITIONAL MODULES.

CONTROL CARD FOLLOWS LAST MISC CARD (F7.2)

COLUMN

1 0.

TO DELETE THE CSM MASS PROPERTIES CALCULATIONS SET THE MIXTURE RATIO OR THRUST (CARD 3) TO ZERO. THE FOLLOWING INPUTS ARE NEEDED IF MASS PROPERTIES FOR THE ASCENT STAGE ARE TO BE CALCULATED.

CARD

COLUMNS

1-7 OPTION 3 - APS MIXTURE RATIO (F7.2)

1-7 OPTION 4 - APS MIXTURE RATIO (F7.2)

12-23 OPTION 3 - COMMENT (2A6)

8-14 OPTION 4 - DOCKING ANGLE (F7.2)

MODULE 27 ASCENT STAGE

COLUMNS

1-7 WEIGHT OF MODULE (F7.2)

8-14 XCG - X STATION OF CENTER OF GRAVITY OF MODULE (F7.2)

15-21 YCG - Y STATION OF CENTER OF GRAVITY OF MODULE (F7.2)

22-28 ZCG - Z STATION OF CENTER OF GRAVITY OF MODULE (F7.2)

29-35 IXX - MOMENT OF INERTIA OF THE MODULE ABOUT THE X-AXIS (F7.2)

	36-42	IYY MOMENT OF INERTIA OF THE MODULE ABOUT THE Y-AXIS (F7.2)
	43-49	IZZ MOMENT OF INERTIA OF THE MODULE ABOUT THE Z-AXIS (F7.2)
	50-56	IXY - PRODUCT MOMENT OF INERTIA (F7.2)
	57-63	IXZ - PRODUCT MOMENT OF INERTIA (F7.2)
	64-70	IYZ - PRODUCT MOMENT OF INERTIA (F7.2)
MODULE 28		APS FUEL
	COLUMNS	
	1-7	WEIGHT (LB) (F7.2)
MODULE 29		APS OXIDIZER (F7.2)
MODULE 30		RCS FUEL A (F7.2)
MODULE 31		RCS FUEL B (F7.2)
MODULE 32		RCS OXID A (F7.2)
MODULE 33		RCS OXID B (F7.2)
MODULE 34		ASC O2 1 (F7.2)
MODULE 35		ASC O2 2 (F7.2)
MODULE 36		ASC H20 1 (F7.2)
MODULE 37		ASC H20 2 (F7.2)
MODULE 38		LM MISC (F7.2)
MODULE 39		LM MISC (F7.2)
MODULE 40		LM MISC (F7.2)
MODULE 41		LM MISC (F7.2)
MODULE 42		LM MISC (F7.2)
MODULE 43		LM MISC (F7.2)
MODULE 44		LM MISC (F7.2)
MODULE 45		LM MISC (F7.2)
MODULE 46		LM MISC (F7.2)
CONTROL CARD		FOLLOWS LAST MISC CARD (F7.2)
	COLUMN	
	1	0.

TO DELETE THE ASCENT STAGE MASS PROPERTIES CALCULATIONS SET THE MIXTURE RATIO TO ZERO. THE FOLLOWING INPUTS ARE NEEDED IF MASS PROPERTIES FOR THE DESCENT STAGE ARE TO BE CALCULATED.

CARD

COLUMNS	
1-7	OPTION 3 - DPS MIXTURE RATIO (F7.2)
1-7	OPTION 4 - DPS MIXTURE RATIO (F7.2)
12-23	OPTION 3 - COMMENT (2A6)

MODULE 48 DESCENT STAGE

COLUMNS	
1-7	WEIGHT OF MODULE (F7.2)
8-14	XCG - X STATION OF CENTER OF GRAVITY OF MODULE (F7.2)
15-21	YCG - Y STATION OF CENTER OF GRAVITY OF MODULE (F7.2)
22-28	ZCG - Z STATION OF CENTER OF GRAVITY OF MODULE (F7.2)
29-35	IXX - MOMENT OF INERTIA OF THE MODULE ABOUT THE X-AXIS (F7.2)
36-42	IYY MOMENT OF INERTIA OF THE MODULE ABOUT THE Y-AXIS (F7.2)
43-49	IZZ MOMENT OF INERTIA OF THE MODULE ABOUT THE Z-AXIS (F7.2)
50-56	IXY - PRODUCT MOMENT OF INERTIA (F7.2)
57-63	IXZ - PRODUCT MOMENT OF INERTIA (F7.2)
64-70	IYZ - PRODUCT MOMENT OF INERTIA (F7.2)

MODULE 49 DPS FUEL 1 (F7.2)

COLUMNS	
1-7	WEIGHT OF MODULE (F7.2)

MODULE 50 DPS FUEL 2 (F7.2)

MODULE 51 DPS OXID 1 (F7.2)

MODULE 52 DPS OXID 2 (F7.2)

MODULE 53 DESCENT O2 (F7.2)

MODULE 54 DESCENT H2O (F7.2)

CONTROL CARD FOLLOWS LAST MISC CARD (F7.2)

COLUMN

1	0.

CONTROL CARD

COLUMN

1	0.

TO DELETE MASS PROPERTIES CALCULATIONS FOR THE DESCENT STAGE SET THE MIXTURE RATIO TO ZERO.

5.6.3 COMMAND FORMATTING AND GENERAL CONVERSION PROCESSOR.- THIS PROCESSOR CONTAINS TEN OPTIONS IN WHICH DATA IN ENGINEERING UNITS ARE CONVERTED TO OCTAL OR DATA IN OCTAL ARE CONVERTED TO ENGINEERING UNITS. NINE OF THE OPTIONS ARE CONCERNED WITH UP-LINKED OR DOWN-LINKED CMC QUANTITIES AND POSSESS FIXED FORMATS, SCALE FACTORS, AND OCTAL PRECISIONS. THE SEVENTH OPTION IS FOR GENERAL CONVERSION FROM ENGINEERING UNITS TO OCTAL, OR VICE VERSA, GIVEN THE NUMBER, SCALE FACTORS, PRECISION, AND MULTI-PLIERS IF NECESSARY.

COMMAND FORMATTING AND GENERAL CONVERSION PROCESSOR

(IBM 7094 AND UNIVAC 1108)

ON-LINE CARD INPUT

CARD 1 FILE NUMBER

COLUMNS	
1-2	03

CARD 2 PROCESSOR AND CONVERSION OPTIONS

COLUMNS		
1	1	NAVIGATION UPDATE
	2	ORBIT EXTERNAL DELTA V
	3	DEORBIT EXTERNAL DELTA V
	4	REFSMMAT
	5	RTCC RESTART VECTOR (NUMERIC)
	6	RTCC RESTART VECTOR (ALPHANUMERIC)
	7	GENERAL CONVERSION
2	0	DECIMAL TO OCTAL CONVERSION (FOR PRO-OPTION 6, THIS IS ALPHANUMERIC TO OCTAL CONVERSION.)
	1	OCTAL TO DECIMAL CONVERSION (FOR PROCESSOR OPTION 6, THIS IS OCTAL TO ALPHANUMERIC CONVERSION.)

PROCESSOR OPTION 1, 5, FOR DECIMAL TO OCTAL CONVERSION

CARD 3

COLUMNS		
1-20	X	POSITION COORDINATE (FT) (E20)

CARD 4 Y POSITION COORDINATE (FT) (E20)

CARD 5 Z POSITION COORDINATE (FT) (E20)

CARD 6 X VELOCITY COORDINATE (FT/SEC) (E20)

CARD 7 Y VELOCITY COORDINATE (FT/SEC) (E20)

CARD 8 Z VELOCITY COORDINATE (FT/SEC) (E20)

CARD 9 VECTOR TIME (G.M.T.)

COLUMNS
1-3 HOURS (I3)
4-5 MINUTES (I2)
6-10 SECONDS (E5)

PROCESSOR OPTION 1, 5, FOR OCTAL TO DECIMAL CONVERSION, OR
PROCESSOR OPTION 6 FOR OCTAL TO ALPHANUMERIS.

CARD 3

COLUMNS
1-10 X POSITION COORDINATE (KM) (O10)

CARD 4 Y POSITION COORDINATE (KM) (O10)

CARD 5 Z POSITION COORDINATE (KM) (O10)

CARD 6 X VELOCITY COORDINATE (M/CS) (O10)

CARD 7 Y VELOCITY COORDINATE (M/CS) (O10)

CARD 8 Z VELOCITY COORDINATE (M/CS) (O10)

CARD 9 VECTOR TIME (CS) (O1C)

PROCESSOR OPTION 2 WITH DECIMAL TO OCTAL CONVERSIONS'
CARD 3 IGNITION TIME (G.E.T.)

COLUMNS
1-3 HOURS (I3)
4-5 MINUTES (I2)
6-10 SECONDS (E5)

CARD 4

COLUMNS
1-20 EXTERNAL DELTA VX COMPONENT (FT/SEC) (E20)

CARD 5 EXTERNAL DELTA VY COMPONENT (FT/SEC)(E20)

CARD 6 EXTERNAL DELTA VZ COMPONENT (FT/SEC)(E20)
PROCESSOR OPTION 2 WITH OCTAL TO DECIMAL CONVERSION'

CARD 3

COLUMNS
1-10 IGNITION TIME (SEC) (O10)

CARD 4 EXTERNAL DELTA VX COMPONENT (M/CS) (O10)

CARD 5 EXTERNAL DELTA VY COMPONENT (M/CS) (O10)

CARD 6 EXTERNAL DELTA VZ COMPONENT (M/CS) (O10)
PROCESSOR OPTION 3 WITH DECIMAL TO OCTAL CONVERSION'

CARD 3

COLUMNS	
1-20	LATITUDE OF IGNITION (DEG) (E20)

CARD 4 — LONGITUDE OF IGNITION (DEG) (O10)

CARD 5 — IGNITION TIME (G.E.T.)

COLUMNS	
1-3	HOURS (I3)
4-5	MINUTES (I2)
6-10	SECONDS (E5)

CARD 6 — EXTERNAL DELTA VX COMPONENT (FT/SEC)(O10)

CARD 7 — EXTERNAL DELTA VY COMPONENT (FT/SEC)(O10)

CARD 8 — EXTERNAL DELTA VZ COMPONENT (FT/SEC)(O10)

PROCESSOR OPTION 3 WITH OCTAL TO DECIMAL CONVERSION*

CARD 3

COLUMNS	
1-10	LATITUDE OF IGNITION (DEG) 0-360 DEGREES (O10)

CARD 4 — LONGITUDE OF IGNITION (DEG) 0-360 DEGREES (O10)

CARD 5 — IGNITION TIME (CS) (C10)

CARD 6 — EXTERNAL DELTA VX COMPONENT (M/CS) (O10)
CARD 7 — EXTERNAL DELTA VY COMPONENT (M/CS) (O10)
CARD 8 — EXTERNAL DELTA VZ COMPONENT (M/CS) (O10)

PROCESSOR OPTION 4 WITH DECIMAL TO OCTAL CONVERSION*

CARD 3

COLUMNS	
1-20	FIRST ELEMENT OF REFSMMAT (E20)

CARDS 4-11 — ELEMENTS OF REFSMMAT INPUT ROW-WISE (E20)

PROCESSOR OPTION 4 WITH OCTAL TO DECIMAL CONVERSION*

CARD 3

COLUMNS	
1-10	FIRST ELEMENT OF REFSMMAT (O10)

CARD 4-11 ELEMENTS OF REFSMMAT INPUT ROW-WISE (O10)

PROCESSOR OPTION 6 WITH ALPHANUMERIC TO OCTAL CONVERSION*

CARD 3 X POSITION COMPONENT (KM)

COLUMNS
1-4 MOST SIGNIFICANT DIGITS (A4)
6-9 LEAST SIGNIFICANT DIGITS (A4)

CARD 4 Y POSITION COORDINATE (KM) (A4)

CARD 5 Z POSITION COORDINATE (KM) (A4)

CARD 6 X VELOCITY COORDINATE (M/CS) (A4)

CARD 7 Y VELOCITY COORDINATE (M/CS) (A4)

CARD 8 Z VELOCITY COORDINATE (M/CS) (A4)

CARD 9 VECTOR TIME (CS) (A4)

PROCESSOR OPTION 7 WITH DECIMAL TO OCTAL CONVERSION*

CARD 3

COLUMNS
1-20 DECIMAL NUMBER TO BE CONVERTED TO OCTAL (E20)
24-25 SCALE FACTOR (I2)
29-30 PRECISION (I2)
31-50 MULTIPLIER OF THE NUMBER TO BE CONVERTED (E20)
55-72 COMMENTS (3A6)

PROCESSOR OPTION 7 WITH OCTAL TO DECIMAL CONVERSION*

CARD3

COLUMNS
1-15 OCTAL NUMBER TO BE CONVERTED TO DECIMAL (O15)
24-25 SCALE FACTOR (I2)
29-30 PRECISION (I2)
31-50 DIVISOR OF THE NUMBER TO BE CONVERTED (E20)
55-72 COMMENTS (3A6)
55-72 COMMENTS (3A6)

PROCESSOR OPTION 9 WITH OCTAL TO DECIMAL CONVERSION*

CARD 3

	COLUMNS	
	1-5	OCTAL NUMBER TO BE CONVERTED (O5)
CARDS	4-N	OCTAL NUMBER TO BE CONVERTED (O5)
CARDS	N+1 1-5	99999

NOTE: PROGRAM CANNOT BE RECYCLED AFTER EXECUTING OPTION 9

PROCESSOR OPTION 10 WITH DECIMAL TO OCTAL CONVERSION:

CARD 3

COLUMNS	
1-20	PITCH TRIM ANGLE (DEG) (E20)

CARD 4	YAW TRIM ANGLE (DEG) (E20)
CARD 5	VEHICLE WEIGHT (LB) (E20)

PROCESSOR OPTION 10 WITH OCTAL TO DECIMAL CONVERSION:

CARD 3

COLUMNS	
1-5	PITCH TRIM ANGLE (CDU PULSES/SEC) (O5)

CARD 4	YAW TRIM ANGLE (CDU PULSES/SEC) (O5)
CARD 5	VEHICLE WEIGHT (LB) (E20)

5.6.4 K-FACTOR PROCESSOR - THIS PROCESSOR WILL BE USED TO COMPUTE THE ATMOSPHERIC DENSITY K-FACTOR FOR THE RTCC. THE K-FACTOR VALUE IS DETERMINED BY PROPAGATING ONE INPUT STATE VECTOR TO THE TIME OF A LATER INPUT STATE VECTOR. THE VALUE OF THE ATMOSPHERIC DENSITY MULTIPLIER IS ADJUSTED UNTIL THE PROPAGATED VECTOR AND THE SECOND STATE VECTOR AGREE TO SOME SPECIFIED ACCURACY.

K-FACTOR PROCESSOR

(IBM 7094 AND UNIVAC 1108)

ON-LINE CARD INPUT

CARD 1 — FILE NUMBER

COLUMNS	
1-2	04

CARD 2 — COMPARISON OPTION

COLUMN	
1	1 COMPARE EACH VECTOR TO THE FIRST VECTOR. 2 COMPARE EACH VECTOR TO THE PRECEEDING VECTOR.

CARD 3

COLUMNS	
1-10	VEHICLE WEIGHT (LB) (E10)
11-20	VEHICLE REFERENCE AREA (FT2) (E10)
21-30	DRAG COEFFICIENT (E10)

CARD 4 — VECTOR OPTION

COLUMN	
1	1 VECTOR IS TO BE INPUT IN DECIMAL RECTANGULAR COORDINATES (ER, ER/HR) (X, Y, Z, XDOT, YDOT, ZDOT). 2 VECTOR IS TO BE INPUT IN DECIMAL RECTANGULAR COORDINATES (FT, FT/SEC) (X, Y, Z, XDOT, YDOT, ZDOT). 3 VECTOR IS TO BE INPUT IN GEODETIC SPHERICAL COORDINATES (FT, FT/SEC, DEG) V, , , H, ,). 4 VECTOR IS TO BE INPUT IN GEOCENTRIC SPHERICAL COORDINATES (FT, FT/SEC, DEG) (V, , , R, , ,). 5 VECTOR IS TO BE INPUT IN CLASSICAL ORBITAL ELEMENTS (FT, FT/SEC, DEG) (A, E, I, G, H, L). 6 VECTOR IS TO BE INPUT IN OCTAL RECTANGULAR COORDINATES (ER, ER/HR) (X, Y, Z, XDOT, YDOT, ZDOT).
11-20	K1-GUESS K-FACTOR (E10) MUST BE INPUT
21-30	K2-GUESS K-FACTOR (E10) AND BE
31-40	K3-GUESS K-FACTOR (E10) REASONABLE VALUES.

CARD 5

COLUMNS	
13-16	VECTOR IDENTIFICATION (A4)

CARD 6 — VECTOR TIME (G.M.T.)

COLUMNS	
12-15	HOURS (E4)
17-19	MINUTES (E3)
21-25	SECONDS (E5)

CARD 7 — LIFT-OFF TIME (G.M.T.) (NOTE THAT THIS FOLLOWS VECTOR TIME).

COLUMNS	
12-15	HOURS (E4)
17-19	MINUTES (E3)
21-25	SECONDS (E5)

CARD 8

COLUMNS	
12-14	REVOLUTION NUMBER (I3)

FOR VECTOR OPTION 1, 2, 3, 4, 5'

CARD 9

COLUMNS						
1-20	X	XDOT	V	V	A	(E20)
21-40	Y	YDOT			E	(E20)
41-60	Z	ZDOT			I	(E20)

CARD 10

COLUMNS						
1-20	X	XDOT	H	R	G	(E20)
21-40	Y	YDOT			H	(E20)
41-60	Z	ZDOT	D	C	L	(E20)

FOR VECTOR OPTION 6'

CARD 9

COLUMNS	
12-23	X(012)
25-36	Y(012)
38-51	Z(012)

CARD 10

COLUMNS	
12-23	X(DOT)
25-36	Y(DOT)
38-51	Z(DOT)

NOTE - ADDITIONAL VECTORS ARE INPUT BY REPEATING CARDS 5-10. PLACE AN END-OF-FILE CARD AT THE END OF THE ON-LINE DECK TO TERMINATE THE INPUT.

5.6.5 PVT EQUATION PROCESSOR - THIS PROCESSOR WILL BE USED TO DETERMINE THE AMOUNT OF OXIDIZER AND FUEL REMAINING IN EACH TANK AND HOW MUCH OF THIS CAN BE CONSIDERED USEFUL PROPELLANT. USING ONBOARD VALUES OF HELIUM TEMPERATURE AND PRESSURE, THE PROCESSOR EMPLOYS THE REAL GAS EQUATION TO DETERMINE THE VOLUME OF HELIUM USED TO PRESSURIZE THE FUEL OXIDIZER SYSTEM. ONCE THE VOLUME OF HELIUM IS DETERMINED IN EACH TANK, THE AMOUNT OF FUEL OR OXIDIZER IS COMPUTED FROM THE KNOWN TOTAL VOLUME OF EACH TANK. THE AMOUNT OF USEABLE PROPELLANT IS THEN DETERMINED FROM THE FUEL TO OXIDIZER MIXTURE RATIO BEING USED AND THE ABILITY (EFFICIENCY) OF EACH TANK TC EXPEL ALL ITS CONTENTS.

PVT EQUATION PROCESSOR

(IBM 7094 AND UNIVAC 1108)

ON-LINE CARD INPUT

CARD 1 — FILE NUMBER

COLUMNS	
1-2	05

CARD 2 — TANK LOGIC FOR EACH QUAD (E10)

COLUMNS	
1-10	QUAD A
11-20	QUAD B
21-30	QUAD C
31-40	QUAD D
31-40	QUAD D

CARD 3 — SOURCE PRESSURE (LB/IN**2) (E10)

CARD 4 — TEMPERATURE (DEG) (E10)

CARD 5 — DELTA TEMPERATURE (DEG) (E10)

CARD 6 — OXIDIZER PRESSURE (LB/IN2) (E10)

CARD 7 — FUEL PRESSURE (LB/IN2) (E10)

CARD 8 — MIXTURE RATIO 1 (E10)

CARD 9 — MIXTURE RATIO 2 (E10)

CARD 10 — OXIDIZER REMAINING (LB) (E10)

CARD 11 — FUEL REMAINING (LB) (E10)

NOTE: PLACE TWO BLANK CARDS AT THE END OF THE ON-LINE DECK TO TERMINATE THE INPUT.

5.6.6 REFSMMAT PROCESSOR. - THIS PROCESSOR WILL COMPUTE THE REFSMMAT THAT WILL BE USED FROM LIFT-OFF UNTIL THE IMU IS RE-ALIGNED IN ORBIT. THE REFSMMAT IS COMPUTED FROM THE LAUNCH PAD LOCATION, FLIGHT AZIMUTH, TIME OF GUIDANCE REFERENCE RELEASE (GRR), AND THE VALUES OF THE PRECESSION AND NUTATION ANGLES.

REFSMMAT PROCESSOR

(IBM 7094)

ON-LINE INPUT

CARD 1 — FILE NUMBER

COLUMNS	
1-2	C6

CARD 2

COLUMNS	
1-20	LONGITUDE OF PAD 0-360 DEG (E20)
21-40	LATITUDE OF PAD 0-90 DEG (E20)
41-60	ALTITUDE OF PAD (M) (E20)

CARD 3

COLUMNS	
1-20	AXO* IS THE ANGULAR ROTATION ABOUT +X (RAD) (E20)
21-40	AYO* IS THE ANGULAR ROTATION ABOUT -Y (RAD) (E20)
41-60	CAZ IS FLIGHT AZIMUTH 0-360 DEG (E20)

CARD 4

COLUMNS	
1-20	TEPHEM IS THE TIME FROM BESSELIAN REFERENCE TO MIDNIGHT PRIOR TC LAUNCH (SEC) (E20).
21-40	TGRR IS THE TIME FRCM MIDNIGHT PRIOR TO LAUNCH TO GUIDANCE REFERENCE RELEASE (SEC) (E20).
41-60	CAZO IS THE GREENWICH HOUR ANGLE, OR ROTATION ABOUT Z BETWEEN +X AND THE GREENWICH MERIDIAN AT MIDNIGHT PRIOR TO JULY 1 CAZO=0-360 DEG (E20).

AXO AND AYO ARE THE PRECESSION AND NUTATION ANGLES AND THE VALUES MAY BE OBTAINED FROM NASA-FAB.

5.6.7 SPACECRAFT-TO-SUN ALIGNMENT PROCESSOR. - THE SPACECRAFT-TO-SUN ALIGNMENT PROCESSOR WILL BE USED TC DETERMINE THE IMU GIMBAL ANGLES REQUIRED TO ORIENT THE CSM SO THAT A GIVEN LOCATION ON THE SPACECRAFT BODY WILL BE POINTED AT THE SUN. THIS LOCATION IS SPECIFIED BY PITCH AND YAW ANGLES FROM THE SPACECRAFT X-AXIS.

SPACECRAFT-TO-SUN ALIGNMENT PROCESSOR

(IBM 7094 AND UNIVAC 1108)

ON-LINE CARD INPUT

CARD 1 — FILE NUMBER

COLUMNS	
1-2	07

CARD 2 — COORDINATES OF THE SUN (E5)

COLUMNS	
1-5	RIGHT ASCENSION OF THE SUN (HR)
6-10	RIGHT ASCENSION OF THE SUN (MIN)
11-15	RIGHT ASCENSION OF THE SUN (SEC)
16-20	DECLINATION OF THE SUN (DEG)
21-25	DECLINATION OF THE SUN (MIN)
26-30	DECLINATION OF THE SUN (SEC)

CARD 3 — REFSMMAT INPUT ROW-WISE (E10)

COLUMNS	
12-20	REFSMMAT (1,1)
22-30	REFSMMAT (1,2)
32-40	REFSMMAT (1,3)

CARD 4 — REFSMMAT (2,1), (2,2), (2,3) (E10)

CARD 5 — REFSMMAT (3,1), (3,2), (3,3) (E10)

CARD 6 — ANGLES USED TO LOCATE THE POSITION ON THE SPACECRAFT TO BE DIRECTED TOWARDS THE SUN (E10)

COLUMNS	
1-10	YAW FROM SPACECRAFT X-AXIS (DEG)
11-20	PITCH FROM SPACECRAFT X-AXIS (DEG)

CARD 7

COLUMNS	
21-23	END

NOTE: ADDITIONAL CASES ARE INPUT BY REPEATING CARD 6

5.6.8 GIMBAL AND FLIGHT DIRECTOR ATTITUDE INDICATOR (FDAI) ANGLES CONVERSION PROCESSOR. - THIS PROCESSOR WILL BE USED TO CONVERT FDAI ANGLES TO IMU GIMBALS, OR GIMBALS TO FDAI ANGLES.

GIMBAL AND FDAI ANGLES CONVERSION PROCESSOR

(IBM 7094 AND UNIVAC 1108)

CARD 1 — FILE NUMBER

COLUMN	
2	8

CARD 2 — INPUT PARAMETERS

COLUMN	
1	ANGLES TO BE CONVERTED = 1 GIMBAL ANGLES TO FDAI ANGLES = 2 FDAI ANGLES TO GIMBAL ANGLES
10-19	I.G.A. OR FDAI ROLL ANGLE
20-29	M.G.A. OR FDAI PITCH ANGLE
30-39	O.G.A. OR FDAI YAW ANGLE

NOTE - ADDITIONAL CASES CAN BE RUN BY REPEATING CARD 2. A BLANK CARD WILL TERMINATE THE RUN.

5.6.9 GIMANG PROCESSOR. -
DATA NOT AVAILABLE AT THIS TIME

5.6.10 BESSELIAN AND STABLE MEMBER VECTOR CONVERSION PROCESSOR. - THIS PROCESSOR WILL CONVERT BESSELIAN TO STABLE MEMBER VECTORS, OR STABLE MEMBER TO BESSELIAN BY ROTATING THROUGH AN INPUT REFSMMAT.

BESSELIAN AND STABLE MEMBER VECTOR CONVERSION PROCESSOR

(IBM 7094 AND UNIVAC 1108)

CARD 1

COLUMN	
1	IF SET TO 1, REFSMMAT IS TO BE INPUT ON THE NEXT THREE CARDS

CARD 2-4 REFSMMAT INPUT ROW-WISE (E9)

COLUMN	
12-20	REFSMMAT (N,M)
22-30	REFSMMAT (N,M+1)
32-40	REFSMMAT (N,M+2)

CARD 5

COLUMN	
1	VECTOR TO BE CONVERTED = 2 BESSELIAN = 3 STABLE MEMBER

CARD 6

COLUMN	
1	INPUT VECTOR TYPE = 0 OCTAL VECTOR = 1 DECIMAL VECTOR

CARD 7 POSITION COORDINATES

COLUMNS	
12-23	X
25-36	Y
38-49	Z

CARD 8 VELOCITY COORDINATES

COLUMNS	
12-23	X-DOT
25-36	Y-DOT
38-49	Z-DOT

NOTE - ADDITIONAL CONVERSIONS CAN BE MADE BY REPEATING THE NECESSARY CARDS. A BLANK CARD WILL TERMINATE THE RUN.

5.6.11 EXTRAVEHICULAR MOBILITY UNIT WATER USAGE PROCESSOR. - THIS PROCESSOR COMPUTES THE RATE OF LOSS OF COOLANT WATER DURING EXTRAVEHICULAR ACTIVITY.

EMU WATER USAGE PROCESSOR

(IBM 7094 AND UNIVAC 1108)

ON-LINE CARD INPUT

CARD 1 — FILE NUMBER

COLUMNS	
1-2	11

CARD 2 — COMMENT CARD

COLUMNS	
2-7	TRACKING STATION I.D. (REQUIRED)
8-19	TIME THE DATA WAS READ (HR, MIN, SEC)
20-63	ADDITIONAL COMMENTS

CARD 3 — INPUT PARAMETERS

COLUMNS	
6-15	PLSS PRIMARY OXYGEN SUBSYSTEM DECAY RATE (LB/HR)
21-30	EMU LEAK RATE (LB/HR)
36-45	HEAT FROM EQUIMENT OPERATION (BTU/HR)
51-60	HEAT FROM ENVIRONMENT
66-75	HEAT LEAK FROM SUIT ENVIRONMENT

CARD 4 — INPUT PARAMETERS

COLUMNS	
6-15	HEAT FROM BODY FUNCTIONS (BTU/HR)
21-30	SUBLIMATOR LOOP MASS FLOW RATE (LB/HR)
36-45	LCG WATER INLET TEMPERATURE (DEG)
51-60	LCG WATER OUTLET TEMPERATURE (DEG)
66-75	TOTAL WATER TRANSPORT LOOP MASS FLOW RATE (LB/HR)

CARD 5 — INPUT PARAMETERS

COLUMNS	
6-15	EFFICIENCY NUMBER
21-30	HEAT OUTPUT FROM THE REACTION OF CARBON DIOXIDE WITH LITHIUM HYDROXIDE (BTU/HR)
36-45	FEED WATER PRESSURE

NOTE - ADDITIONAL CASES CAN BE RUN BY REPEATING CARDS 2-5. A BLANK CARD WILL TERMINATE THE RUN.

5.6.12 LM DIAGNOSTIC PROGRAM. - THIS PROGRAM WILL BE USED TO ASSIST THE LM SYSTEMS PERSONNEL IN THE REAL-TIME EVALUATION OF VEHICLE FAILURS. THE ONLY INPUTS NECESSARY ARE A LIST OF THE SENSORS WHICH HAVE DETECTED FAILURES. THE OUTPUT WILL BE A SUMMARY REPORT DESIGNATING THE COMMON FAILURE MODE OF THE GROUP OF INPUT PARAMETERS.

LM DIAGNOSTIC PROGRAM

(UNIVAC 1108)

CARD 1		FILE NUMBER
	COLUMNS 1-2	12
CARD 2		LIST OF SENSORS (A6)
	COLUMNS 1-6	PARAMETER NUMBER
•		
•		
•		
CARD N		NTH PARAMETER NUMBER
CARD N+1		RETURN TO SYSTEM MONITOR
	COLUMNS 1-6	999999

6. OPERATING INSTRUCTICNS FCR THE RTACF ORBITAL LIFETIME PROGRAM

6.1 GENERAL

THIS SECTION PRESENTS THE ON-LINE INPUTS TO THE APOLLO 9 ORBITAL LIFETIME PROGRAM, A BRIEF DISCUSSION OF THE PURPOSE OF THE PROGRAM, AND THE TAPE SETUP AND CONTROL CARDS REQUIRED TO OPERATE THE PROGRAM ON THE IBM 7094 DATA PROCESSING SYSTEM.

6.2 PROGRAM DESCRIPTION

THIS PROGRAM WILL BE USED TO COMPUTE THE PREDICTED ORBITAL LIFETIME OF A SPACE VEHICLE GIVEN A STATE VECTOR, THE AERODYNAMIC CHARACTERISTICS OF THE VEHICLE, AND THE MODEL ATMOSPHERE TC BE USED.

6.3 TAPE SETUP FOR THE IBM 7094 DATA PROCESSING SYSTEM

TAPE UNIT	TAPE DESCRIPTION
A1	MSFC SYSTEM TAPE
B1	PROGRAM TAPE
A3	OUTPUT TAPE
A4	SCRATCH TAPE
B3	SCRATCH TAPE
B4	SCRATCH TAPE

6.4 INPUTS TO THE ORBITAL LIFETIME PROGRAM

THE INPUTS TO THE ORBITAL LIFETIME PROGRAM ARE GIVEN ON THE FOLLOWING PAGES.

ORBITAL LIFETIME PROGRAM
(SPECIAL TAPE - IBM 7094 ONLY)

CARD 1 VECTOR INPUT OPTION

COLUMNS	
2	0 VECTOR WILL BE IN OCTAL (I1). 1 VECTOR WILL BE IN DECIMAL (I1).
5	0 UNITS OF THE VECTOR (ER, ER/HR) (I1) 1 UNITS OF THE VECTOR (FT, FT/SEC) (I1)
7-12	ATMOSPHERE OPTION - FORMAT (A6) SPECUS SPECIAL 1962 U.S. STANDARD ATMOSPHERE ARDC 1959 ARDC ATMOSPHERE USSTD 1962 U.S. STANDARD ATMOSPHERE POE POE ATMOSPHERE SMALL H. SMALL ATMOSPHERE SPECAR SPECIAL 1959 ARDC ATMOSPHERE

CARD 2 VECTOR IDENTIFICATION

COLUMNS	
13-31	THREE SIX-CHARACTER WORDS (A18)

CARD 3 LIFT-OFF TIME (G.M.T.)

COLUMNS	
12-15	HOURS (E3)
17-19	MINUTES (E3)
21-25	SECONDS (E4)
27-29	MONTH (E3)
31-33	DAY (E3)
35-39	YEAR (E5)

CARD 4 VECTOR TIME (G.M.T.)

COLUMNS	
12-15	HOURS (E4) (MUST BE LESS THAN 24)
17-19	MINUTES (E3)
21-25	SECONDS (E4)
27-29	MONTH (E3)
31-38	DAY (E3) (MUST BE ACTUAL DAY OF VECTOR)
35-39	YEAR (E5)

CARD 5

COLUMNS	
1-10	VEHICLE WEIGHT (LB)
11-20	VEHICLE REFERENCE AREA (SQ FT)
21-30	VEHICLE DRAG COEFFICIENT IF NOT EQUAL TO +2.0

CARD 6 — STOP TIME FOR DENSITY K-FACTORY COMPUTATION (HR,MIN,SEC) (G.E.T.). USE BLANK CARD IF NO DENSITY K-FACTOR IS TO BE COMPUTED.

COLUMNS	
1-4	HOURS (F5)
5-7	MINUTES (F3)
8-10	SECONDS (F3)

CARD 7 — POSITION COORDINATES

COLUMNS	
12-31	X (E20)
33-52	Y (E20)
54-73	Z (E20)

CARD 8 — VELOCITY COORDINATES

COLUMNS	
12-31	XDOT (E20)
33-52	YDOT (E20)
54-73	ZDOT (E20)

OCTAL VECTOR OPTION

CARD 7 — POSITION COORDINATES

COLUMNS	
12-23	X (O12)
25-36	Y (O12)
38-51	Z (O12)

CARD 8 — VELOCITY COORDINATES

COLUMNS	
12-23	XDOT (O12)
25-36	YDOT (O12)
38-51	ZDOT (O12)

7. OPERATING INSTRUCTIONS FOR THE APOLLO REAL-TIME RENDEZVOUS SUPPORT (ARRS) PROGRAM (MONSTER)

7.1 GENERAL

THIS SECTION PRESENTS A DESCRIPTION OF THE ARRS PROGRAM, THE TAPE SETUP AND CONTROL CARDS REQUIRED TO OPERATE THE ARRS AS AN ON-LINE PROGRAM ON THE UNIVAC 1108 DATA PROCESSING SYSTEMS.

7.2 PROGRAM DESCRIPTION

ARRS IS COMPOSED OF A NUMBER OF PROCESSORS AND ROUTINES REQUIRED TO SUPPORT A RENDEZVOUS MISSION. THOSE WHICH WILL BE OF CONCERN TO THE APOLLO 9 MISSION ARE DESCRIBED BELOW.

THE GENERAL PURPOSE MANEUVER PROCESSOR (GPMP) IS USED TO COMPUTE IMPULSIVE MANEUVERS AT A SPECIFIED POINT IN AN ORBIT TO ACHIEVE DESIRED ORBITAL CONDITIONS.

THE TWO-IMPULSE AND TERMINAL PHASE PROCESSOR COMPUTES A SET OF TWO MANEUVERS BY SPECIFYING WHEN THEY SHOULD BE PERFORMED AND BY SPECIFYING THE CONDITION, SUCH AS PHASE AND HEIGHT OFFSETS, AFTER THE FINAL MANEUVER POINT.

THE MISSION PLAN TABLE (MPT) PROCESSOR ACCEPTS VECTORS BEFORE AND AFTER IMPULSIVE MANEUVERS AND COMPUTES THE REQUIRED FINITE BURN QUANTITIES NECESSARY TO ACHIEVE THE ORBIT AFTER THE MANEUVER.

THE RELATIVE PRINT ROUTINE COMPUTES RELATIVE QUANTITIES, SUCH AS RANGE RANGE RATE, AND LOOK ANGLES, BETWEEN TWO ORBITING VEHICLES.

THE TRACKING ROUTINE COMPUTES THE TRACKING STATION COVERAGE OF A VEHICLE FROM THE INITIAL VECTOR THROUGH ALL THE MANEUVERS IN THE MISSION PLAN TABLE.

THE CONCENTRIC RENDEZVOUS PROCESSOR COMPUTES A RENDEZVOUS PLAN BY USING CONCENTRIC FLIGHT PLAN LOGIC. THIS PROCESSOR MAY BE USED TO COMPUTE THE SECOND MANEUVER OF THE TWO IMPULSE RENDEZVOUS PLAN AFTER THE FIRST MANEUVER HAS BEEN EXECUTED BY THE SPACECRAFT, A CAPABILITY NON-EXISTENT IN THE TWO-IMPULSE AND TERMINAL PHASE PROCESSOR.

THE CONVERSION ROUTINE CONVERTS VECTORS FROM ONE COORDINATE SYSTEM TO A NUMBER OF OTHER COORDINATE SYSTEMS.

THE ORBIT DIGITALS ROUTINE OUTPUTS ORBITAL PARAMETERS ASSOCIATED WITH A GIVEN VECTOR AT TWO INDEPENDENT TIMES.

DAYLIGHT/DARKNESS PROCESSORS, WHICH WAS DESIGNED TO COMPUTE A TABLE OF LIGHTING CONDITICNS ASSOCIATED WITH A GIVEN ORBIT.

7.3 TAPE SETUP FOR THE UNIVAC 1108 PROCESSING SYSTEM

TAPE UNIT	TAPE DESCRIPTION
A	ARRS PROGRAM TAPE
I	EPHEMERIS TAPE
K	SCRATCH TAPE
L	DATA TAPE

7.4 CONTROL CARD LISTING FOR THE UNIVAC 1108 DATA PROCESSING SYSTEM

```
COLUMN 1  4  8
          MSG                        COMMENTS
          ASG A= XXXX                ARRS PROGRAM (PCF) TAPE
          ASG I= $EPHEM              EPHEMERIS TAPE UNIT
          ASG K= XXXX                OUTPUT UNIT FOR MPT TABLE
          ASG L= XXXX                MISSICN DATA TAPE
          XQT CUR                    EXECUTE THE FOLLOWING
                                     INSTRUCTICNS
              TRW A,I,L,K            REWIND A,I,L, AND K
              IN A                   INPUT THE ENTIRE USER PCF
                                     FROM UNIT A

        N XQT ARRS                   EXECUTE ARRS PROGRAM
              .
              .                      ARRS DATA CARDS
              .
           EOF                       END OF FILE
```

7.5 INPUTS TO THE ARRS PROGRAM

THE INPUTS FOR THIS PROGRAM WERE NOT AVAILABLE AT THE TIME OF THIS WRITING AND WILL BE PUBLISHED AT A LATER DATE.

8. OPERATING INSTRUCTION FOR THE APOLLO BLOCK DATA PROGRAM

8.1 GENERAL

THIS SECTION PRESENTS A BRIEF DESCRIPTION OF PROGRAM, THE TAPE SETUP AND THE CONTROL CARD LISTING REQUIRED FOR OPERATING THE PROGRAM ON THE UNIVAC 1108 DATA PROCESSING SYSTEM. THE ON-LINE INPUTS AND DETAILED DISCUSSION OF THIS PROGRAM ARE AVAILABLE IN THE APOLLO BLOCK DATA PROGRAM USER'S MANUAL (REFERENCE 3,4).

8.2 PROGRAM DESCRIPTION

THE APOLLO BLOCK DATA PROGRAM (ABDP) HAS THE CAPABILITY OF PERFORMING FOUR BASIC SIMULATIONS. ORBIT PROPOGATION, ORBIT MANEUVERS, DEORBIT MANEUVERS AND ATMOSPHERIC ENTRY. DATA FOR DIFFERENT TYPES OF DEORBITS WILL BE COMPUTED BY THE ABDP FOR EACH REVOLUTION DURING THE EARTH ORBITAL PORTIONS OF MANNED APOLLO MISSIONS. THESE DATA WILL BE MADE AVAILABLE TO THE FLIGHT CREW IN BLOCKS OF SIX REVOLUTIONS AND WILL BE USED TO DEORBIT THE SPACECRAFT IN THE EVENT OF A CONTINGENCY WHICH NECESSITATES RAPID MISSION TERMINATION.

8.3 TAPE SETUP FOR THE UNIVAC 1108 DATA PROCESSING SYSTEM

TAPE UNIT	TAPE DESCRIPTION
C	OFF-LINE OUTPUT TAPE
D	SCRATCH TAPE
H	DATA TAPE (OPTIONAL)
J	SCRATCH TAPE
X	ABDP PROGRAM (PCF) TAPE

8.4 CONTROL CARD LISTING FOR THE UNIVAC 1108 DATA PROCESSING SYSTEM

```
COLUMN 1  4    8
          MSG                    COMMENTS
          ASG C,D,J              SCRATCH UNITS ON FASTRAND
          ASG = XXXX             DATA TAPE NUMBER
          ASG = XXXX             ADBP PROGRAM (PCF) TAPE
                                 NUMBER
          XQT CUR                EXECUTE THE FOLLOWING
                                 INSTRUCTIONS
              TRW X              REWIND TAPE X
              IN X               INPUT THE ENTIRE USER PCF
                                 FROM UNIT X
              TRI X              REWIND TAPE X WITH
                                 INTERLOCK
           N XQT CUR             EXECUTE ABDP
          .
          .
          .                      ABDP DATA CARDS
          .
          .
          END OF DATA            LAST CARD OF ABDP
                                 DATA CARDS
            EOF                  END OF FILE CARD
```

8.5 INPUTS TO THE APOLLO BLOCK DATA PROGRAM

THE INPUTS TO THE APOLLO BLOCK DATA PROGRAM ARE PRESENTED IN THE APOLLO BLOCK DATA PROGRAM USER'S MANUAL (REFERENCE 3,4).

9. OPERATING INSTRUCTIONS FOR RTACF APOLLO REFERENCE MISSION PROGRAM (ARMACR) PROCESSOR

9.1 GENERAL

THIS SECTION PRESENTS THE TAPE SETUP AND THE CONTROL CARDS REQUIRED TO OPERATE THE ARMACR PROCESSORS ON THE UNIVAC 1108 COMPUTER, ALONG WITH THE ON-LINE INPUTS REQUIRED FOR THEIR OPERATION. THE ARMACR PROGRAM IS DESCRIBED IN DETAIL IN REFERENCE 5.

9.2 TAPE SETUP FOR THE UNIVAC 1108 DATA PROCESSING SYSTEM

TAPE UNIT	TAPE DESCRIPTION
I	EPHEMERIS TAPE UNIT
R	ARMACR PROGRAM (PCF) TAPE
U	MISSION DATA TAPE
Q	OUTPUT UNIT FOR EPHEMERIS GENERATOR

9.3 CONTROL CARD LISTING AND ON-LINE DECK SETUP FOR THE UNIVAC 1108 DATA PROCESSING SYSTEM

```
COLUMN 1  4    8
      *   MSG                          COMMENTS
          ASG I = $EPHEM               EPHEMERIS TAPE UNIT
          ASG R = XXXX                 ARMACR PROGRAM (PCF) TAPE
                                       NUMBER
          ASG U = XXXX                 MISSION DATA TAPE NUMBER
          ASG Q = SCRATCH OR           OUTPUT UNIT FOR EPHEMERIS
                  SAVE                 GENERATOR. NOT NECESSARY
                                       IF NO EPHEMERIS IS DESIRED
          XQT CUR                      EXECUTE THE FOLLOWING
                                       INSTUCTIONS
              TRW R                    REWIND UNIT R
              IN R                     INPUT THE ENTIRE USER PCF
                                       FROM UNIT R
              TRI R                    REWIND UNIT R WITH
                                       INTERLOCK
           N XQT ARMACR                EXECUTE ARMACR PROGRAM
          PHASE (M,N,O,P)              M IS THE PHASE NUMBER
                                       N IS THE PHASE TYPE
                                       O IS THE DATA UPDATE
                                         NUMBER
                                       P IS THE FILE NUMBER OF
                                         THE DATA TAPE
             .
             .                         ARMACR UPDATES FOR PHASE 1
             .
CCLUMN 1
          PHASE (M,N)
             .
             .                         ARMACR UPDATES FOR PHASE M
             .
          ENDRUN                       LAST CARD IN THE ARMACR
                                       PHASE UPDATES
             .
             .                         INPUT OCTAL VECTOR FROM
             .                         1C04
             .                         INPUT REFSMMAT FROM 1004
            EOF                        END OF FILE CARD
```

*INDICATES 7/8 OVERPUNCH IN COLUMN 1

9.4 THE ARMACR PROCESSORS

THIS SECTION PRESENTS A BRIEF DESCRIPTION OF THE ARMACR PROCESSORS AND THE ON-LINE INPUTS REQUIRED TO OPERATE EACH PROCESSOR

9.4.1 CSM EXTERNAL DELTA V MANEUVER PROCESSOR. - THIS PROCESSOR WILL BE USED TO SIMULATE ANY SPS OR RCS MANEUVER FOR WHICH THE BURN QUANITIES HAVE PREVIOUSLY BEEN DETERMINED.

EXTERNAL DELTA V MANEUVER PROCESSOR

(FILE 2, UNIVAC 1108)

A. STANDARD ARMACR INPUT QUANTITIES FOR THE EXTERNAL DELTA V MANEUVER PROCESSOR ARE LISTED BELOW

PHASE (1,0,3,2) = EXTERNAL DELTA V MANEUVER FILE, INITIAL COAST PHASE

IVECT	I	OCTAL VECTOR INPUT FLAG =0 OCTAL VECTOR WILL NOT BE INPUT =1 ONE OCTAL VECTOR IN BESSELIAN COORDINATES =2 TWO OCTAL VECTORS IN BESSELIAN COORDINATES
IREFM	I	INPUT REFSMMAT FLAG =0 REFSMMAT WILL NOT BE INPUT =1 ONE REFSMMAT WILL BE INPUT =2 TWO REFSMMATS WILL BE INPUT
CDRAG1	(FP)	COEFFICIENT OF DRAG (SET 2.0 ON TAPE)
AREA	(FP)	VEHICLE REFERENCE AREA (SET TO 239.9 ON TAPE)
GETHRS	(FP)	TIME OF RCR IGNITION IN HR,MIN,SEC (G.E.T.)

PHASE (2,2) = PRECOMPUTE PHASE

G002	I	EXTERNAL DELTA V FLAG (SET TO 2 ON. TAPE) =2 INPUT P-30'S IN LVLH =3 INPUT P-40'S IN LVLH =4 INPUT VELOCITY INCREMENT IN ECI OR MCI =5 INPUT VELOCITY TO-BE-GAINED ECI OR MCI
G006	I	NUMBER OF RCS JETS DURING ULLAGE (SET TO 4 ON TAPE)
G025	(FP)	NUMBER OF SECONDS OF RCS ULLAGE MINUS RCS ULLAGE OVERLAP TIME (SET TO 14. ON TAPE)
G037	(FP)	EXTERNAL DELTA V TARGET INPUTS. DELTA

```
                              VX, DELTA VY, DELTA VZ, RESPECTIVELY

   SPSIGN     (FP)          TIME OF SPS IGNITION IN HR,MIN,SEC,
                            (G.E.T.)
    DVRES        (FP)       DELTA V RESIDUALS

   GARES      (FP)          GIMBAL ANGLES AT WHICH RESIDUALS ARE
                            READ

PHASE (3,2) = ATTITUDE ORIENTATION/IMU ALIGNMENT PHASE

   ZDIR         I           Z-AXIS DIRECTION (PRESET TO -1 IN
                            PROGRAM)
                             =-1 Z-AXIS DOWN AND ASTRONAUT'S
                                 HEADS UP
                             = 0 Z-AXIS UP AND ASTRONAUT'S HEADS
                                 DOWN

PHASE (4,1) = RCS ULLAGE

    ITYPE       I          OPEN LOOP GUIDANCE (SET TO 11 ON
                           TAPE)
                            =C FOR NO RCS ULLAGE
                            =11 FOR RCS ULLAGE

   IRCS         I          NUMBER OF QUADS FOR RCS ULLAGE (SET
                           TO 3 ON TAPE)
                            =1 RCS JETS IN QUADS A AND C ARE ON
                            =2 RCS JETS IN QUADS B AND D ARE ON
                            =3 RCS JETS IN QUADS A,B,C AND D
                               ARE ON

    TTRHRS     (FP)         RCS ULLAGE MINUS RCS ULLAGE OVERLAP IN
                           HR,MIN,SEC (SET TO C.,0.,14. CN TAPE)

PHASE (5,2) = SPS BUILDUP PLUS STEADY STATE

PHASE (6,2) = SPS TAILOFF

PHASE (7,1) = COAST AFTER SPS MANEUVER

PHASE (8,2) = COAST TO RUN TERMINATION

ENDRUN

INPUT OCTAL VECTOR FROM 1004

INPUT REFSMMAT FROM 1004

   EOF                     END OF FILE CARD
```

B. IF THE MANEUVER IS PERFORMED WITHOUT AN ULLAGE, INPUT THE FOLLOWING ADDITIONAL QUANTITIES

PHASE (1,0,3,2) = EXTERNAL DELTA V MANEUVER FILE, INITIAL COAST PHASE

GETHRS	(FP)	TIME OF SPS IGNITION IN HR,MIN,SEC (G.E.T.)

PHASE (2,2) = PRECOMPUTE PHASE

G006	0	NUMBER OF RCS JETS DURING ULLAGE
G025	0.	NUMBER OF SECONDS OF RCS ULLAGE

PHASE (4,1) = RCS ULLAGE PHASE

ITYPE	0	NO RCS ULLAGE
TTRHRS	(FP)	RCS ULLAGE PHASE ELAPSE TIME IN HR, MIN,SEC (SET TO 0.,0.,0.)

C. IF THE MANEUVER IS PERFORMED WITH THE SM RCS THRUSTERS, INPUT THE FOLLOWING QUANTITIES

PHASE (2,2) = PRECOMPUTE PHASE

G005	0	PERFORM RCS SHORT BURN TEST
G006	0	NUMBER OF RCS JETS USED DURING ULLAGE
G023	(FP)	ONBOARD VALUE OF RCS THRUST (100 LBS/JET)
G025	0.	NUMBER OF SECONDS OF RCS ULLAGE
G041	0.	ONBOARD VALUE OF SPS TAILOFF
SPSIGN	(FP)	TIME OF SPS IGNITION IN HR,MIN,SEC (G.E.T.)

PHASE (3,2) = ATTITUDE ORIENTATION/IMU ALIGNMENT PHASE

ENDFP1	BCD	SET TO 'DELETE' TO CANCEL PITCH TRIM TABLE
ENDFY1	BCD	SET TO 'DELETE' TO CANCEL YAW TRIM TABLE

PHASE (4,1) = RCS ULLAGE

ITYPE	0	NO RCS THRUST

TTRHRS	(FP)	PHASE ELAPSE TIME IN HR,MIN,SEC (SET TO 0.,0.,0.)

PHASE (5,2) = SPS BUILDUP PLUS STEADY STATE

G024	(FP)	ONBOARD VALUE OF RCS ISP
ENDFP1	BCD	SET TO 'DELETE' TO CANCEL PITCH TRIM TABLE
ENDFY1	BCD	SET TO 'DELETE' TO CANCEL YAW TRIM TABLE
TTABLE	(FP)	TOTAL RCS THRUST
WRTABL	(FP)	TOTAL WEIGHT FLOW

PHASE (6,2) = SPS TAILOFF

ITYPE	0	NO SPS TAILOFF THRUST
TTRHRS	(FP)	PHASE ELAPSE TIME IN HR,MIN,SEC (SET TO 0.,0.,0.)

9.4.? LM EXTERNAL DELTA V MANEUVER PROCESSOR. - THIS PROCESSOR WILL BE USED TO SIMULATE ANY DPS, APS, OR RCS MANEUVER FOR WHICH THE BURN QUANITIES HAVE PREVIOUSLY BEEN DETERMINED.

LM EXTERNAL DELTA V MANEUVER PROCESSOR

(FILE 6, UNIVAC 1108)

A. STANDARD ARMACR INPUT QUANTITIES FOR THE EXTERNAL DELTA V MANEUVER PROCESSOR ARE LISTED BELOW

PHASE (1,0,3,2) = EXTERNAL DELTA V MANEUVER FILE, INITIAL COAST PHASE

IVECT	I	OCTAL VECTOR INPUT FLAG =0 OCTAL VECTOR WILL NOT BE INPUT =1 ONE OCTAL VECTOR IN BESSELIAN COORDINATES =2 TWO OCTAL VECTORS IN BESSELIAN COORDINATES
IREFM	I	INPUT REFSMMAT FLAG =0 REFSMMAT WILL NOT BE INPUT =1 ONE REFSMMAT WILL BE INPUT =2 TWO REFSMMATS WILL BE INPUT
NV	I	NUMBER OF VEHICLES (SET TO 2.0 ON TAPE
CDRAG2	(FP)	COEFFICIENT OF DRAG (SET 2.0 ON TAPE)
AREA(2)	(FP)	VEHICLE REFERENCE AREA (SET TO 129.4 ON TAPE)
GETHRS	(FP)	TIME OF RCR IGNITION IN HR,MIN,SEC (G.E.T.)

PHASE (2,2) = PRECOMPUTE PHASE

G002	I	EXTERNAL DELTA V FLAG (SET TO 2 ON. TAPE) =2 INPUT P-30'S IN LVLH =3 INPUT P-40'S IN LVLH =4 INPUT VELOCITY INCREMENT IN ECI OR MCI =5 INPUT VELOCITY TO-BE-GAINED ECI OR MCI
G006	I	NUMBER OF RCS JETS DURING ULLAGE (SET TO 4 ON TAPE)
G025	(FP)	NUMBER OF SECONDS OF RCS ULLAGE MINUS RCS ULLAGE OVERLAP TIME (SET TO 14. ON TAPE)

G037	(FP)	EXTERNAL DELTA V TARGET INPUTS. DELTA VX, DELTA VY, DELTA VZ, RESPECTIVELY
SPSIGN	(FP)	TIME OF SPS IGNITION IN HR,MIN,SEC, (G.E.T.)
DVRES	(FP)	DELTA V RESIDUALS
GARES	(FP)	GIMBAL ANGLES AT WHICH RESIDUALS ARE READ (PITCH,YAW,ROLL)

PHASE (3,2) = ATTITUDE ORIENTATION/IMU ALIGNMENT PHASE

ZDIR	I	Z-AXIS DIRECTION (PRESET TO -1 IN PROGRAM) =-1 Z-AXIS DOWN AND ASTRONAUT'S FACE UP = 0 Z-AXIS UP AND ASTRONAUT'S FACE DOWN

PHASE (4,1) = RCS ULLAGE

ITYPE	1	OPEN LOOP GUIDANCE (SET TO 11 ON TAPE) =0 FOR NO RCS ULLAGE =11 FOR RCS ULLAGE
IRCS	I	NUMBER OF QUADS FOR RCS ULLAGE (SET TO 3 ON TAPE) =1 RCS JETS IN QUADS A AND C ARE ON =2 RCS JETS IN QUADS B AND D ARE ON =3 RCS JETS IN QUADS A,B,C AND D ARE ON
TTRHRS	(FP)	RCS ULLAGE MINUS RCS ULLAGE OVERLAP IN HR,MIN,SEC (SET TO 0.,0.,14. ON TAPE)

PHASE (5,2) = DPS BUILDUP PLUS STEADY STATE

PHASE (6,2) = DPS TAILOFF

PHASE (7,1) = COAST AFTER SPS MANEUVER

PHASE (8,2) = COAST TO RUN TERMINATION

PHASE (9,2) = COAST AFTER LM MANEUVER

PHASE (10,2) = COAST AFTER LM MANEUVER

ENDRUN

INPUT OCTAL VECTOR FROM 1004

INPUT REFSMMAT FROM 1004

EOF		END OF FILE CARD

B. IF THE MANEUVER IS PERFORMED WITHOUT AN ULLAGE, INPUT THE FOLLOWING ADDITIONAL QUANTITIES

PHASE (1,0,3,2) = EXTERNAL DELTA V MANEUVER FILE, INITIAL COAST PHASE

GETHRS	(FP)	TIME OF DPS IGNITION IN HR,MIN,SEC (G.E.T.)

PHASE (2,2) = PRECOMPUTE PHASE

G006	0.	NUMBER OF RCS JETS DURING ULLAGE
G025	0.	NUMBER OF SECONDS OF RCS ULLAGE

PHASE (4,1) = RCS ULLAGE PHASE

ITYPE	0.	NO RCS ULLAGE
TTRHRS	(FP)	RCS ULLAGE PHASE ELAPSE TIME IN HR, MIN,SEC (SET TO 0.,0.,0.)

C. IF THE MANEUVER IS PERFORMED WITH THE SM RCS THRUSTERS, INPUT THE FOLLOWING QUANTITIES

PHASE (2,2) = PRECOMPUTE PHASE

G005	0.	PERFORM RCS SHORT BURN TEST
G006	0.	NUMBER OF RCS JETS USED DURING ULLAGE
G023	(FP)	ONBOARD VALUE OF RCS THRUST (100 LBS/JET)
G025	0.	NUMBER OF SECONDS OF RCS ULLAGE
G041	0.	ONBOARD VALUE OF SPS TAILOFF
SPSIGN	(FP)	TIME OF SPS IGNITION IN HR,MIN,SEC (G.E.T.)

PHASE (3,2) = ATTITUDE ORIENTATION/IMU ALIGNMENT PHASE

ENDFP1	BCD	SET TO 'DELETE' TO CANCEL PITCH TRIM TABLE
ENDFY1	BCD	SET TO 'DELETE' TO CANCEL YAW TRIM TABLE

PHASE (4,1) = RCS ULLAGE

ITYPE	0.	NO RCS THRUST
TTRHRS	(FP)	PHASE ELAPSE TIME IN HR,MIN,SEC (SET TO 0.,0.,0.)

PHASE (5,2) = SPS BUILDUP PLUS STEADY STATE

G024	(FP)	ONBOARD VALUE OF RCS ISP
ENDFP1	BCD	SET TO 'DELETE' TO CANCEL PITCH TRIM TABLE
ENDFY1	BCD	SET TO 'DELETE' TO CANCEL YAW TRIM TABLE
TTABLE	(FP)	TOTAL RCS THRUST
WRTABL	(FP)	TOTAL WEIGHT FLOW

PHASE (6,2) = SPS TAILOFF

ITYPE	0.	NO SPS TAILOFF THRUST
TTRHRS	(FP)	PHASE ELAPSE TIME IN HR,MIN,SEC (SET TO 0.,0.,0.)

9.4.3 GENERAL MANEUVER PROCESSOR
DATA NOT AVAILABLE AT THIS TIME

9.4.4 MANEUVER EVALUATION PROCESSOR. - THE ARMACR MANEUVER EVALUATION PROCESSOR COASTS A PRE-BURN VECTOR TO THE IMPULSIVE MANEUVER TIME. THE 200/WORD RECORD IS WRITTEN AND IS USED BY THE MONSTER MPT PROCESSOR TO CALCULATE THE P30 DELTA V BURNED DURING THE MANEUVER.

MANEUVER EVALUATION FILE

(FILE 1, UNIVAC 1108)

```
PHASE (1,0,3,1) = MANEUVER EVALUATICN, PREBURN COAST PHASE
   GETHRS    (FP)      G.E.T. OF THE POST BURN VECTOR TIME
  *IVECT      1        INPUT VECTOR FOR CSM VEHICLE
PHASE (2,2) = COAST TO IMPULSIVE MANEUVER POINT
   GETHRS    (FP)      G.E.T. OF IMPULSIVE MANEUVER TIME
  *NV         2        TWO VEHICLES
  *IVECT      1        INPUT VECTOR FOR S-IVB (LM) VEHICLE
  *DIREC     -1.       COAST BACKWARD
  *IINTFC     1        WRITE 200-WORD RECORD
  *TOTOLP    -17.      SUPPRESS PRINT GROUPS 1-17
  *HARS(142) BCD       MANEUVER I.D.
PHASE (3,2) = THIRD COAST PHASE
  *NTAPE      0        TERMINATE PRINT
  *DIREC      1.       COAST FORWARD
PHASE (4,2) = FOURTH COAST PHASE
.
.
PHASE (7,2  = SEVENTH COAST PHASE
ENDRUN
   INPUT PREBURN OCTAL VECTOR FRCM 1004
   INPUT POSTBURN OCTAL VECTOR FROM 10C4
   EOF                  END OF FILE
```

*INDICATES THESE VALUES ARE PRESET IN THE MANEUVER EVALUATION DECK.

9.4.5 CONTINGENCY LANDING AREA (CLA) PROCESSOR. - THIS PROCESSOR WILL BE USED TO DETERMINE THE ORBIT MANEUVER IGNITION TIME REQUIRED TO ACHIEVE A TARGET LONGITUDE WHICH IS NORMALLY LOCATED IN A CONTINGENCY LANDING AREA.

CONTINGENCY LANDING AREA PROCESSOR

(FILE 7, UNIVAC 1108)

A. STANDARD ARMACR INPUT QUANTITIES ARE LISTED BELOW

PHASE (1,0,2) = CLA FILE, INITIAL COAST PHASE

IVECT	I	OCTAL VECTOR INPUT FLAG = 0 OCTAL VECTOR WILL NOT BE INPUT = 1 ONE OCTAL VECTOR IN BESSELIAN COORDINATES = 2 TWO OCTAL VECTORS IN BESSELIAN COORDINATES
IREFM	I	INPUT REFSMMAT FLAG = 0 REFSMMAT W NOT BE INPUT = 1 ONE REFSMMAT WILL BE INPUT = 2 TWO REFSMMAT WILL BE INPUT

PHASE (2,2) = COAST TO SPS IGNITION

PHASE (3,2) = COAST BACK TO RCS ULLAGE

PHASE (4,2) = RCS ULLAGE

PHASE (5,2) = SPS BUILDUP PLUS STEADY STATE

PHASE (6,2) = SPS TAILOFF

PHASE (7,2) = COAST AFTER SPS CUTOFF

PHASE (8,2) = COAST TO SPS IGNITION

*LOOP	1	ITERATION LOOP NUMBER
*SELMAT	2	MAX NUMBER OF PARTIAL DERIVATIVE MATRICES TO BE COMPUTED
*INDEPV		INDEPENDENT VARIABLE IN ITERATION LOOP (GETHRS, PHASE 8)
*DEPV		DEPENDENT VARIABLE IN ITERATION LOOP (LONGITUDE, PHASE 17)
TARGET	(FP)	LONGITUDE TARGET
GETHRS	(FP)	TIME OF SPS IGNITION IN HRS,MIN,SEC (G.E.T.)

PHASE (9,2) = COAST BACK TO RCS ULLAGE

TTRHRS	(FP)	ULLAGE TIME-1SEC (-SEC)

ROLL1	(FP)	CSM ATTITUDES
ATYPE	I	ATTITUDE OPTION = 3 LVLH ATTITUDES = 10 GIMBAL ANGLES = 14 HORIZON MONITOR
IPTYPE	3	REALIGN IMU (SET ONLY IF REFSMMAT IS COMPUTED)
G012	10	REALIGN IMU TO ATTAIN GIMBAL ANGLES IN G057 (SET ONLY IF REFSMMAT IS COMPUTED)
G057	(FP)	PITCH, YAW, ROLL, GIMBAL ANGLES

PHASE (10,2) = RCS ULLAGE

IRCS	I	NUMBER OF JETS FOR RCS ULLAGE (SET TO 3 ON TAPE) = 1 RCS JETS IN QUADS A AND C ARE ON = 2 RCS JETS IN QUADS B AND D ARE ON = 3 RCS JETS IN QUADS A, B, C AND D ARE ON
TTRHRS	(FP)	RCS ULLAGE MINUS OVERLAP IN HR, MIN, SEC (SET TO 0.,0.,14. ON TAPE)

PHASE (11,2) = SPS BUILDUP PLUS STEADY STATE

TXMTOV	(FP)	TOTAL DELT V GAINED

PHASE (12,2) = SPS TAILOFF

PHASE (13,2) = COAST AFTER SPS CUTOFF

PHASE (14,2) = COAST TO 425K

PHASE (15,2) = COAST TO 400K

PHASE (16,2) = COAST TO XG'S

BKANG	(FP)	BANK ANGLE FLOW TO SPECIFIED G-LEVEL (SET TO 0 ON TAPE)
GLEVEL	(FP)	G-LEVEL TERMINATION (SET TO .2 ON TAPE)
IMASS	(FP)	ENTRY WEIGHT

PHASE (17,2) = COAST TO 23.3K

FMLT	(FP)	ENTRY LIFT MULTIPLIER (SET TO .57358 ON TAPE)

B. IF A FIXED TIME RCS SEPARATION OR MANEUVER IS REQUIRED, SET IN ADDITION THE FOLLOWING INDICES

PHASE (2,2) = COAST TO SPS IGNITION

NTAPE	6	PRINT THE FOLLOWING PHASES
GETHRS	(FP)	TIME OF RCS IGNITION IN HR, MIN, SEC (G.E.T.)

PHASE (4,2) = RCS ULLAGE

IRCS	I	NUMBER OF JETS FOR RCS ULLAGE (SET TO 3 ON TAPE) = 1 RCS JETS IN QUADS A AND C ARE ON = 2 RCS JETS IN QUADS B AND D ARE ON = 3 RCS JETS IN QUADS A, B, C AND D ARE ON
XMTOV	(FP)	TOTAL DELTA V FOR THE PHASE
ROLL1	(FP)	CSM ATTITUDES
ATYPE	I	ATTITUDE OPTION = 3 LVLH ATTITUDES = 10 GIMBAL ANGLES = 14 HORIZON MONITOR
IMASS	(FP)	ENTRY WEIGHT

C. IF A FIXED TIME SPS SEPARATION OR MANEUVER IS REQUIRED, SET IN ADDITION THE FOLLOWING INDICES

PHASE (2,2) = COAST TO SPS IGNITION

NTAPE	6	PRINT THE FOLLOWING PHASES
GETHRS	(FP)	TIME OF SPS IGNITION IN HRS,MIN,SEC (G.E.T.)

PHASE (3,2) = COAST BACK TO RCS ULLAGE

TTRHRS	(FP)	ULLAGE TIME-1SEC (-SEC)
ROLL1	(FP)	CSM ATTITUDES
ATYPE	I	ATTITUDE OPTION = 3 LVLH ATTITUDES = 10 GIMBAL ANGLES = 14 HORIZON MONITOR

IMASS	(FP)	ENTRY WEIGHT

PHASE (4,2) = RCS ULLAGE

IRCS	I	NUMBER OF JETS FOR RCS ULLAGE (SET TO 3 ON TAPE) = 1 RCS JETS IN QUADS A AND C ARE ON = 2 RCS JETS IN QUADS B AND D ARE ON = 3 RCS JETS IN QUADS A, B, C AND D ARE ON
TTRHRS	(FP)	RCS ULLAGE MINUS OVERLAP IN HR, MIN, SEC (SET TO 0.,0.,14. ON TAPE)

PHASE (5,2) = SPS BUILDUP PLUS STEADY STATE

XMTOV	(FP)	TOTAL DELTA V FOR THE PHASE
TSTOP	0	THIS ALLOWS A DELTA V TERMINATION

PHASE (6,2) = SPS TAILOFF

TTRHRS	(FP)	TAILOFF DELTA T

C. IF A FIXED DELTA T RCS SEPARATION OR MANEUVER IS REQUIRED, SET IN ADDITION THE FOLLOWING INDICES

PHASE (2,2) = COAST TO SPS IGNTIION

*LOOP	1	ITERATION LOOP NUMBER
*SELMAT	2	MAX NUMBER OF PARTIAL DERIVATIVE MATRICES TO BE COMPUTED
*INDEPV		INDEPENDENT VARIABLE IN ITERATION LOOP (GETHRS, PHASE 2)
*DEPV		DEPENDENT VARIABLE IN ITERATION LOOP (LONGITUDE, PHASE 17)
TARGET	(FP)	LONGITUDE TARGET
GETHRS	(FP)	TIME OF SPS IGNITION IN HRS,MIN,SEC (G.E.T.)

PHASE (4,2) = RCS ULLAGE

IRCS	I	NUMBER OF JETS FOR RCS ULLAGE (SET TO 3 ON TAPE) = 1 RCS JETS IN QUADS A AND C ARE ON = 2 RCS JETS IN QUADS B AND D ARE ON = 3 RCS JETS IN QUADS A, B, C AND D ARE ON

XMTOV	(FP)	TOTAL DELTA V FOR THE PHASE
ROLL1	(FP)	CSM ATTITUDES
ATYPE	I	ATTITUDE OPTION = 3 LVLH ATTITUDES = 10 GIMBAL ANGLES = 14 HORIZON MONITOR
IMASS	(FP)	ENTRY WEIGHT

PHASE (8,2) = COAST TO SPS IGNITION

*TSTOP	31	SET TO TERMINATE ON A TIME (TTF) AFTER SEP MANEUVER

E. IF A FIXED DELTA T SPS SEPARATION OR MANEUVER IS REQUIRED, SET IN ADDITION THE FOLLOWING INDICES

PHASE (2,2) = COAST TO SPS IGNITION

*LOOP	1	ITERATION LOOP NUMBER
*SELMAT	2	MAX NUMBER OF PARTIAL DERIVATIVE MATRICES TO BE COMPUTED
*INDEPV		INDEPENDENT VARIABLE IN ITERATION LOOP (GETHRS, PHASE 2)
*DEPV		DEPENDENT VARIABLE IN ITERATION LOOP (LONGITUDE, PHASE 17)
TARGET	(FP)	LONGITUDE TARGET
GETHRS	(FP)	TIME OF SPS IGNITION IN HRS,MIN,SEC (G.E.T.)

PHASE (3,2) = COAST BACK TO RCS ULLAGE

TTPHRS	(FP)	RCS ULLAGE MINUS OVERLAP IN HR, MIN, SEC (SET TO 0.,0.,14. ON TAPE)
ROLL1	(FP)	CSM ATTITUDES
ATYPE	I	ATTITUDE OPTION = 3 LVLH ATTITUDES = 10 GIMBAL ANGLES = 14 HORIZON MONITOR
IMASS	(FP)	ENTRY WEIGHT

PHASE (4,2) = RCS ULLAGE

IRCS	I	NUMBER OF JETS FOR RCS ULLAGE (SET TO 3 ON TAPE) = 1 RCS JETS IN QUADS A AND C ARE ON = 2 RCS JETS IN QUADS B AND D ARE ON = 3 RCS JETS IN QUADS A, B, C AND D ARE ON
TTHRS	(FP)	RCS ULLAGE MINUS OVERLAP IN HR,MIN, SEC (SET TO 0.,0.,14. ON TAPE)

PHASE (5,2) = SPS BUILDUP PLUS STEADY STATE

XMTOV	(FP)	TOTAL DELTA V FOR THE PHASE
TSTOP	0	THIS ALLOWS A DELTA V TERMINATION

PHASE (6,2) = SPS TAILOFF

TTRHRS	(FP)	TAILOFF DELTA T

*NOTE - THESE CARDS ARE PROVIDED IN THE ON-LINE TRAY.

9.4.6 CHECKOUT MONITOR, CMC, LGC, AGS, AND IU NAVIGATION UPDATES OR LIFTOFF REFSMMAT CAPABILITIES. IF IT IS DESIRED TO PRODUCE A CHECKOUT MONITOR, A CMC, AGS, OR IU NAVIGATION UPDATE OR LIFTOFF REFSMMAT WITH ANY OF THE ARMACR PROCESSORS PREVIOUSLY DESCRIBED, THE FOLLOWING ON-LINE INPUTS WILL BE REQUIRED.

A. ADDITIONAL ARMACR INPUT QUANTITIES FOR THE CHECKOUT MONITOR DATA ARE LISTED BELOW

PHASE WHERE CHECKOUT MONITOR IS DESIRED

PHASE (N,M) = ANY PHASE

ICOM	I	FLAG TO CALL FOR THE CHECKOUT MONITOR = 1 VEHICLE 1 = 2 VEHICLE 2 = 3 BOTH VEHICLES
ICOMPR	I	TIME DURING A PHASE AT WHICH THE CHECKOUT MONITOR IS DESIRED = 1 AT THE END OF A PHASE (PRESET IN PROGRAM TO 1) = 2 AT THE BEGINNING OF A PHASE = 3 AT THE BEGINNING AND END OF A PHASE

B. ADDITIONAL ARMACR INPUT QUANTITIES FOR THE NAVIGATION UPDATE DATA ARE LISTED BELOW

PHASE WHERE NAVIGATION UPDATE IS DESIRED

PHASE (M,M) = ANY PHASE

NAVUPD	I	FLAG TO CALL FOR NAVIGATION UPDATE DISPLAY = 0 NAVIGATION UPDATE DISPLAY WILL NOT BE GENERATED = 1 NAVIGATION UPDATE DISPLAY WILL BE GENERATED AT THE TERMINAL POINT OF EACH PHASE IN WHICH NAVUPD IS INPUT = 2 LGC NAVIGATION UPDATE DISPLAY WILL BE GENERATED AT THE POINT OF EACH PHASE IN WHICH NAVUPD IS INPUT = 3 AGS NAVIGATION UPDATE DISPLAY WILL BE GENERATED AT THE TERMINAL OF EACH PHASE IN WHICH NAVUPD IS INPUT

= 4 CSM AND LGC NAVIGATION UPDATE DISPLAY WILL BE GENERATED AT THE TERMINAL POINT OF EACH PHASE

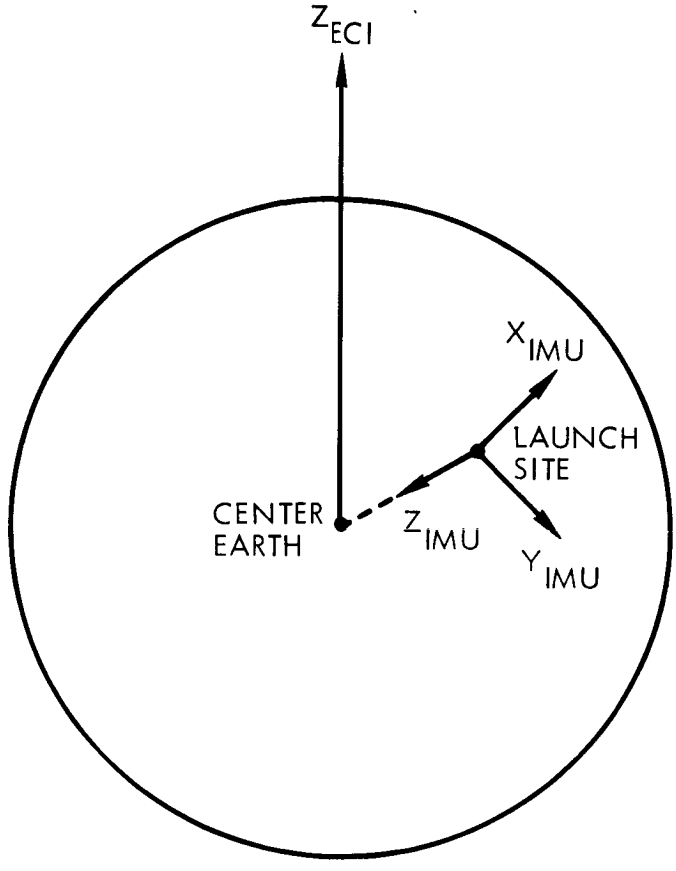
= 5 CSM AND AGS NAVIGATION UPDATE DISPLAY WILL BE GENERATED AT THE TERMINAL POINT OF EACH PHASE

GETK	(FP)	ZERO REFERENCE TIME OF THE AGS COMPUTER (HR,MIN,SEC)
IUNAV	1	IU TELEMETRY UPDATE DISPLAY WILL BE GENERATED AT THE TERMINAL POINT OF EACH PHASE IN WHICH IUNAV IS INPUT
DTGRR	(FP)	GUIDANCE REFERENCE RELEASE IN SEC (REQUIRED TO COMPUTE IUNAV)
PHI	(FP)	GOED LATITUDE OF LAUNCH PAD (REQUIRED TC COMPUTE IUNAV)
LAMBDA	(FP)	LONGITUDE OF LAUNCH PAD (REQUIRED TO COMPUTE IUNAV)
LAZ	(FP)	LAUNCH AZIMUTH (REQUIRED TO COMPUTE IUNAV)

IF VENTING IS TO BE CONSIDERED, INCLUDE THE FOLLOWING QUANTITIES.

ITURN	2	MAINTAIN THE VEHICLE LVLH ATTITUDE SPECIFIED IN THE ALIGNMENT OPTION
ATYPE	3	ALIGN VEHICLE 1 FROM THE LVLH PLANE
ITYPE	11	OPEN LOOP STEERING
TCINT	(FP)	THRUST PHASE INTEGRATION STEP-SIZE (SET TO 0.0041666 HRS)
TTABLE	(FP)	TABULAR VALUES OF VENTING THRUST
SITABL	(FP)	CONSTANT VALUE OF SPECIFIC IMPULSE

C. THE FOLLOWING ADDITIONAL INPUT QUANTITIES ARE REQUIRED TO COMPUTE THE LIFTOFF REFSMMAT THAT WILL BE USED FROM LIFTOFF UNTIL THE IMU IS REALIGNED IN ORBIT. THE FOLLOWING FIGURE IS THE IU PAD ALIGNMENT.



IMU PAD ALIGNMENT

THE ZIMU-AXIS IS ALIGNED WITH THE GEOCENTRIC RADIUS VECTOR OF THE LAUNCH SITE, THE XIMU-AXIS IS ALIGNED WITH THE LAUNCH AZIMUTH VECTOR, AND THE YIMU-AXIS COMPLETES THE RIGHT-HAND COORDINATE SYSTEM.

THE LIFTOFF REFSMMAT BASED ON THE IMU ALIGNMENT AT LIFTOFF WILL BE COMPUTED IN PHASE ONE. THE FOLLOWING ARE REQUIRED.

ATYPE(3)	5	COMPUTE LIFTOFF REFSMMAT
ROLL3	(FP)	IMU ALIGNMENT AT LIFTOFF (SET TO 0.,-90.,0.)
LAZ	(FP)	FLIGHT AZIMUTH
GETVEC	(FP)	TIME OF LIFTOFF IN HR,MIN,SEC (G.E.T.)
HRS	(FP)	HOUR OF LIFTOFF (G.M.T.)
MINS	(FP)	MINUTES OF LIFTOFF (G.M.T.)
SECS	(FP)	SECONDS OF LIFTOFF (G.M.T.)

9.4.7 IU TELEMETRY VECTOR CONVERSICN PROCESSOR. - THIS PROCESSOR WILL CONVERT AN INPUT VECTOR IN IU TELEMETRY PLATFORM COORDINATES TO ECI BESSELIAN COORDINATES EITHER AT THE INPUT VECTOR TIME OR PROPAGATE TO A POINT. THE OUTPUT WILL BE IN THE FORM OF A CHECKOUT MONITOR SUMMERY SHEET.

IU TELEMETRY VECTOR CONVERSION

(FILE 1, UNIVAC 1108)

A. STANDARD ARMACR INPUTS TO CONVERT AN IU TELEMETRY VECTOR TO ECI ARE AS FOLLOWS

PHASE (1,0,3,1) = GENERAL PURPOSE FILE, INITIAL COAST PHASE

ISCALE	1	INPUT UNITS ARE IN KM AND KM/SEC
OSCALE	4	OUTPUT UNITS ARE FEET AND FEET PER SEC
INJECT	41	VECTOR INPUT FLAG (IU PLATFORM STABLE
GMTVEC	(FP)	INPUT VECTOR TIME IN HR,MIN,SEC (G.M.T.)
XPL	(FP)	POSITION VECTOR IN KILOMETERS (X,Y,Z)
YPT	(FP)	
ZPL	(FP)	
DXPL	(FP)	VELOCITY VECTOR IN KM/SEC (DX,DY,DZ)
DYPL	(FP)	
DZPL	(FP)	
IMASS	(FP)	VEHICLE WEIGHT IN LBS
LAZ	(FP)	LAUNCH AZIMUTH IN DEGREES
ICOM	1	CALL CHECKOUT MONITOR FOR VEHICLE 1
ICOMPR	2	CHECKOUT MONITOR AT START OF PHASE
DTLANC	(FP)	GMTZS-GMTIUGRR IN HRS POSITIVE NUMBER

B. IF THE INPUT VECTOR IS PROPAGATED TO A TIME, INPUT THE ADDITIONAL FOLLOWING INSTRUCTIONS

GETHRS	(FP)	TERMINATION TIME IN HR,MIN,SEC (G.E.T.)
AREA	(FP)	REFERENCE AREA IN FEET SQUARED
ICOMPR	3	OUTPUT CHECKOUT MONITOR AT BEGINNING AND END OF PHASE

9.4.8 RADAR TRACKING AND SUMMARY. - THIS PROCESSOR GENERATES RADAR TRACKING DATA FOR EACH SPECIFIED RADAR STATION AT EVERY PRINT POINT. AFTER ALL TRACKING DATA HAS BEEN GENERATED, SUMMARY OF ACQUISITION AND LOSS OF DATA FOR EACH RADAR STATION CAN BE GENERATED.

A. ADDITION ARMACR INPUT QUANTITIES FOR RADAR TRACKING ARE LISTED BELOW

PHASE (1,0,3,1) = GENERAL PURPOSE FILE

IVECT	I	OCTAL VECTOR INPUT FLAG
IREFM	I	INPUT REFSMMAT FLAG

PHASE (N,M) = PHASE WHERE RADAR TRACKING DATA IS GENERATED

NODRUM	1	ASSIGN INTERNAL PRINT UNIT TO UNIT Y
TOTALP	-17.	SUPPRESS PRINT GROUPS 1-17
TITLE	-1.	SUPPRESS IML PRINT BLOCK
IPRINT	I	PRINT FREQUENCY OF RADAR TRACKING
ITHPR	I	PRINT FREQUENCY OF RADAR TRACKING
TCINT	(FP)	INTEGRATION STEP SIZE FOR THRUSTING PHASE (HR)
CINE	(FP)	INTEGRATION STEP SIZE FOR NEAR EARTH COASTING PHASE (HR)
CINNE	(FP)	INTEGRATION STEP SIZE FOR FAR EARTH COASTING PHASE (HR)
CINL	(FP)	INTEGRATION STEP SIZE FOR NEAR MOON COASTING PHASE (HR)
CINNL	(FP)	INTEGRATION STEP SIZE FOR FAR MOON COASTING PHASE (HR)
RADPRT	(FP)	RADAR OUTPUT INDICATOR = 1. PRINTS RADAR TRACKING DATA FOR ALL VISIBLE STATIONS AT PRINT POINTS = 2. PRINTS RADAR ACQUISITION AND TERMINATION EVENTS AND TIME OF OCCURENCE

= 3. PRINTS RADAR OUTPUT AND RADAR EVENTS (OPTICNS 1+2)
= 4. PRINTS RADAR OUTPUT AND RADAR EVENTS (OPTICN 1+2) PLUS VEHICLE STATE VECTOR AT EVENT POINTS (PRINT GROUPS MUST BE SET)
= 5. PRINTS RADAR OUTPUT, RADAR EVENTS, VEHICLE STATE VECTOR AT EVENTS, AND ACQUISITION TERMINATION SUMMARY IF PRRAD IS SET

PRRAD	2.	RADAR SUMMARY PRINT AND TAPE ARE GENERATED FROM DATA COMPUTED FOR EACH RADAR STATION THAT IS TRACKING AND TERMINATES
RADAR	1	NUMBER OF RADAR STATION STORED ON PCF TAPE OR STATICN NAME AND CHARCTERISTICS IF STATIONS ARE INPUT MANUALLY

B. IF THE PRINT TAPE CONTAINING THE RADAR TRACK DATA IS TO BE SAVED FOR FURTHER PROCESSING BY ANOTHER PROGRAM, INCLUDING THE FOLLOWING INPUT QUANTITIES

ASG L = SAVE	RADAR TRACKING TAPE
ASG Y = Y	ASSIGN TO TAPE UNIT

PHASE (N,M) = PHASE WHERE RADAR TRACKING DATA IS GENERATED

RADAR	I	STATION NUMBERS DESIRED ON TAPE
RADPRT	5.	PRINT RADAR TRACKING AND ACQ-LOSS SUMMARY GENERATE RADAR SUMMARY TAPE
PRRAD	2.	GENERATE RADAR SUMMARY TAPE

9.4.9 EPHEMERIS TAPE GENERATOR. - THIS PROCESSOR WILL BE USED TO GENERATE AN EPHEMERIS TAPE FOR USE BY THE APOLLO GENERALIZED OPTICS PROGRAM AND THE WORK SCHEDULE PROCESSOR. THE STANDARD OUTPUT UNIT FOR THIS EPHEMERIS IS Q (20). THE TAPE MAY BE GENERATED IN CONJUNCTION WITH ANY ARMACR RUN BY SETTING THE APPROPRIATE FLAGS.

A. ADDITIONAL ARMACR INPUT QUANTITIES FOR THE EMPHERIS TAPE GENERATOR ARE LISTED BELOW

PHASE WHERE EPHEMERIS OUTPUT IS DESIRED

PHASE (N,M) = ANY PHASE

IEPHEM	1	TURN ON EPHEMERIS GENERATOR
CINE	I	*DEPENDING ON THE PROXIMITY OF THE
CINNE		*EARTH OR MOON ALL OF THESE SHOULD
		*BE SET TO THE DESIRED INTEGRATION
CINNL	I	*STEP SIZE, SINCE ARMACR OUTPUTS A
CINL	I	*POINT FOR EACH STEP.

PHASE WHERE NO EPHEMERIS OUTPUT IS DESIRED

PHASE (N,M) = ANY PHASE

IEPHEM	0	TURN OFF EPHEMERIS OUTPUT

B. *NOTE IEPHEM REMAINS ON OR OFF UNTIL RESET

9.4.10 POSTFLIGHT EPHEMERIS TAPE GENERATOR. - THIS PROCESSOR WILL BE USED TO GENERATE AN EPHEMERIS TAPE FOR USE IN POSTFLIGT ANALYSIS. THE PROCESSOR GENERATES THE VARIABLE FORMAT TAPE WHICH IS THEN REPROCESSED BY A POST PROCESSOR TO PLACE THE VARIABLES IN THE FORMAT SPECIFIED FOR POSTFLIGHT ANALYSIS.

A. ADDITIONAL ARMACR INPUT QUANTITIES FOR THE EPHEMERIS TAPE GENERATOR ARE LISTED BELOW

ASG Y = Y	ASSIGN TO TAPE UNIT
ASG F = SAVE	POST FLIGHT EPHEMERIS TAPE

PHASE(1,0,3,1) = GENERAL PURPOSE FILE

IVECT	I	OCTAL VECTOR INPUT FLAG
IREFM	I	INPUT REFSMMAT FLAG

PHASE (N,M) = EVERY PHASE WHERE POSTFLIGHT EPHEMERIS IS GENERATED

NODRUM	1	ASSIGN INTERNAL PRINT UNIT TO UNIT Y
OSCALE	4	OUTPUT UNITS ARE FEET AND FT/SEC
VLIST	(BCD)	VARIABLES TO BE WRITTEN ON THE VARIABLE FORMAT TAPE (MUST BE INPUT IN EVERY PHASE WHERE TAPE IS DESIRED)
IPRINT	I	PRINT FREQUENCY OF VARIABLE FORMAT TAPE
TOTALP	-17.	SUPPRESS PRINT GROUPS 1-17
TITLE	-1.	SUPPRESS IML PRINT BLOCK
ITHPR	I	PRINT FREQUENCY OF VARIABLE FORMAT TAPE FOR THRUSTING PHASES
TCINT	(FP)	INTEGRATION STEP SIZE FOR THRUSTING PHASE (HR)
CINE	(FP)	INTEGRATION STEP SIZE FOR NEAR EARTH COASTING PHASE (HR)
CINNE	(FP)	INTEGRATION STEP SIZE FOR FAR EARTH COASTING PHASE (HR)

CINL	(FP)	INTEGRATION STEP SIZE FOR NEAR MOON COASTING PHASE (HR)
CINNL	(FP)	INTEGRATION STEP SIZE FOR FAR MOON COASTING PHASE (HR)

9.5 INPUT VARIABLE DESCRIPTIONS

ATTITUDE OPTIONS

1. ALIGN FORM THE LOCAL HORIZONTAL

ATYPE	3	ALIGN VEHICLE 1 FRCM THE LVLH PLANE
ROLL(1)	(FP)	YAW ANGLE FROM THE VELOCITY VECTOR PROJECTION IN THE LVLH PLANE
ROLL(2)	(FP)	PITCH ANGLE FRCM THE LVLH PLANE
ROLL(3)	(FP)	ROLL ANGLE ABOUT THE RESULTANT X-AXIS

2. ALIGN USING REFSMMAT AND GIMBAL ANGLES

ATYPE	10	ALIGN VEHICLE BASE CN IMU ALIGNMENT
ROLL(1)	(FP)	PITCH GIMBAL ANGLE (INNER)
ROLL(2)	(FP)	YAW GIMBAL ANGLE (MIDDLE)
ROLL(3)	(FP)	RCLL GIMBAL ANGLE (CUTER)
IREFM	1	INPUT REFSMMAT IN GEMMV FORMAT AFTER ENDRUN CARD

IF REFSMMAT IS INPUT IN STANDARD ARMACR FORMAT, INCLUDE THE FOLLOWING VARIABLES IN PLACE OF IREFM

ATYPE3	2	REALIGN IMU TO INPUT REFSMMAT
RAXIS3	(FP)	FIRST ROW OF REFSMMAT (THREE QUANTITIES SEPARATED BY CCMMAS)
PAXIS3	(FP)	SECOND ROW OF REFSMMAT (THREE QUANTITIES SEPARATED BY COMMAS)
YAXIS3	(FP)	THIRD ROW OF REFSMMAT (THREE QUANTITIES SEPARATED BY CCMMAS)

3. ALIGN FROM THE LINE-OF-SIGHT TO THE HORIZON

ATYPE	14	ALIGN VEHICLE 1 FROM THE LINE-OF-SIGHT TO THE HORIZON
BMODEL	0	SPHERICAL EARTH MODEL (NOMINAL VALUE)
	1	OBLATE EARTH MODEL
LKDIR	1	ALIGN TO HORIZON FORWARD (NOMINAL VALUE)
	-1	ALIGN TO HORIZON AFT
ROLL(1)	(FP)	YAW ANGLE FROM ORBITAL PLANE
ROLL(2)	(FP)	PITCH ANGLE FROM LINE-OF-SIGHT TO HORIZON
ROLL(3)	(FP)	ROLL ANGLE ABOUT LINE-OF-SIGHT TO HORIZON

4. ALIGN THE THRUST VECTOR USING LVLH ATTITUDES, GIMBAL ANGLES, AND ENGINE TRIM ANGLES (COMPUTE REFSMMAT)

ATYPE	3	ALIGN VEHICLE 1 FROM LVLH PLANE
ROLL(1)	(FP)	YAW ANGLE FROM THE VELOCITY VECTOR PROJECTION IN THE LVLH PLANE
ROLL(2)	(FP)	PITCH ANGLE FROM THE LVLH PLANE
ROLL(3)	(FP)	ROLL ANGLE ABOUT THE RESULTANT X-AXIS
IPTYPE	3	REALIGN THE IMU
GC12	10	ALIGN THE IMU SO THAT THE GIMBAL ANGLES SPECIFIED IN G057 ARE ATTAINED
G057	(FP)	PITCH, YAW, AND ROLL GIMBAL ANGLES DESIRED AFTER REALIGNMENT OF THE IMU (THREE QUANTITIES SEPARATED BY COMMAS)
IALGN	0	DEFLECT THE VEHICLE FROM THE THRUST VECTOR BY THE ENGINE DEFLECTION ANGLES
ENDFPA	(FP)	ENGINE PITCH TRIM ANGLE (CONSTANT VALUE)

ENDEYA	(FP)	ENGINE YAW TRIM ANGLE (CONSTANT VALUE)

GUIDANCE OPTIONS

1. EXTERNAL DELTA V

IPTYPE	2	EXTERNAL DELTA V (INPUT) TARGETING (USED IN PRECOMPUTE PHASE PRIOR TO AN EXTERNAL DELTA V MANEUVER
G002	I	EXTERNAL DELTA V FLAG = 2 INPUT P-30'S IN LVLH = 3 INPUT P-40'S IN LVLH = 4 INPUT VELOCITY INCREMENT IN ECI OR MCI = 5 INPUT VELOCITY-TO-BE-GAINED ECI OR MCI
G022	0	CROSS PRODUCT STEERING CONSTANT
G023	(FP)	SPS THRUST MAGNITUDE USED IN THE ONBOARD GUIDANCE LOGIC
G027	(FP)	TIME OF SPS IGNITION IN HRS (G.E.T.)
G037	(FP)	EXTERNAL DELTA V COMPONENTS (VX,VY,VZ)
INAV	1	AVERAGE-G INTEGRATION ROUTINE, INITIALIZING TO ACTUAL STATE VECTOR

2. ORBITAL RATE

ITURN	2	MAINTAIN THE VEHICLE LVLH ATTITUDE SPECIFIED IN THE ALIGNMENT OPTION

3. OPEN LOOP

ITYPE	11	CALLS OPEN LOOP STEERING
TTR	(FP)	THRUST DURATION IN SECONDS
XMTOV	(FP)	TOTAL DELTA V GAINED IN A PARTICULAR PHASE
TXMTOV	(FP)	TOTAL DELTA V GAINED DURING A SUCCESSION OF THREE THRUSTING PHASES (ULLAGE + STEADY STATE + TAILOFF). IN SPS STEADY STATE PHASE INCLUDE G023 AND G025.

IDELVX	1	TERMINATE THRUSTING WHEN DELTA V ALONG X-AXIS EQUALS XMTOV
	0	TERMINATE THRUSTING WHEN DELTA V ALONG VELOCITY VECTOR EQUALS XMTOV

PRIMARY PHASE TERMINATIONS

TYPE OF TERMINATION	VALUE OF TSTOP	MOON OR EARTH REF	ADDITIONAL VARIABLES REQUIRED
ORBIT COUNT	2	MOON	OMAX - PHASE ORBIT COUNT OR
	13	EARTH	TOMAX - TOTAL ORBIT COUNT
CENTRAL BODY LONGITUDE	4	MOON	OMAX - ORBIT NO OF LONG TERMINATION
	14	EARTH	LONSTP - DESIRED TERMINAL LONGITUDE
ALTITUDE	7	MOON	RALTFT - ALTITUDE ABOVE A SPHERICAL MOON OR OBLATE EARTH
	17	EARTH	ISCALE - UNITS OF ALTITUDE
			MUP - ASCENT OR DESCENT TERMINATION =0 DESCENDING (NOMINAL VALUE) =1 ASCENDING
INERTIAL FLIGHT-PATH ANGLE	8	MOON	GAMLUN - DESIRED SELENOCENTRIC FLIGHT PATH-ANGLE (DEG)
	18	EARTH	GAMETH - DESIRED GEOCENTRIC FLIGHT-PATH ANGLE (DEG)
PERIAPSIS	8	MOON	GAMLUN = 0. INERTIAL FLIGHT PATH-ANGLE AT PERILUNE
	18	EARTH	GAMETH = 0. INERTIAL FLIGHT-PATH ANGLE AT PERIGEE
APOAPSIS	1	MOON	GAMLUN = 0. INERTIAL FLIGHT-PATH ANGLE AT APOLUNE
	11	EARTH	GAMETH = 0. INERTIAL FLIGHT-PATH ANGLE AT APOGEE
PHASE TIME LAPSE	--	MOON	TTR - PHASE TIME LAPSE (HRS FOR COAST, SEC FOR THRUST PHASE)
	--	EARTH	

			TTRHRS - PHASE TIME LAPSE IN HRS,MINS, SECS (POSITIVE FOR INTEGRATION FORWARD, NEGATIVE FOR INTEGRATION BACKWARD)
			GETHRS - TOTAL ELAPSED TIME (G.E.T.) IN HRS, MINS, SECS (PROGRAM WILL AUTOMATICALLY SET INTEGRATION DIRECTION)
GEOGRAPHIC FLIGHT PATH ANGLE	19	EARTH	GAMETH - DESIRED EARTH RELATIVE FLIGHT PATH ANGLE (DEG)
ZERO PHASE TIME LAPSE	23 23	MOON EARTH	TTR = 0. ZERO PHASE TIME LAPSE

UNITS OF INPUT AND OUTPUT QUANTITIES

ISCALE I — CONTROLS THE UNITS OF INPUT QUANTITIES. DISTANCE IS MEASURED IN THE UNITS BELOW, AND VELOCITY IN THOSE UNITS PER SECOND

= 1 KILOMETERS

= 2 INTERNATICNAL STATUTE MILES

= 3 U.S. NAUTICAL MILES

= 4 INTERNATICNAL FEET

= 5 DISTANCE IS MEASURED IN EARTH RADII AND VELOCITY IN EARTH RADII PER HOUR.

= 6 DISTANCE IS MEASURED IN INTERNATIONAL STATUTE MILES AND VELOCITY IN INTERNATIONAL FEET PER SECOND.

= 7 DISTANCE IS MEASURE IN U.S. NAUTICAL MILES AND VELOCITY IN INTERNATICNAL FEET PER SECOND.

OSCALE	I	CONTROLS THE UNITS OF OUTPUT QUANTITIES. DISTANCE IS MEASURED IN THE UNITS BELOW, AND VELOCITY IN THOSE UNITS PER SECOND. = 1 KILOMETERS = 2 INTERNATIONAL STATUTE MILES = 3 U.S. NAUTICAL MILES = 4 INTERNATIONAL FEET = 5 DISTANCE IS MEASURED IN EARTH RADII AND VELOCITY IN EARTH RADII PER HOUR. = 6 DISTANCE IS MEASURED IN INTERNATIONAL STATUTE MILES AND VELOCITY IN INTERNATIONAL FEET PER SECOND. = 7 DISTANCE IS MEASURE IN U.S. NAUTICAL MILES AND VELOCITY IN INTERNATIONAL FEET PER SECOND.

EARTH AND MOON REFERENCE OPTIONS

INJECT	I	SPECIFIES REFERENCE BODY AND INPUT COORDINATE SYSTEM = 10 INERTIAL GEOCENTRIC CARTESIAN RESTART COORDINATES RXYZ = X,Y,Z COMPONENTS OF RESTART POSITION IN UNITS OF EARTH RADII (DOUBLE PRECISION) RDXYZ = X,Y,Z COMPONENTS OF RESTART VELOCITY IN UNITS OF EARTH RADII PER HOUR (DOUBLE PRECISION) = 11 INERTIAL GEOCENTRIC CARTESIAN COORDINATES. ISCALE CONTROL

INPUT UNITS.
X = X COMPONENT OF POSITION
Y = Y COMPONENT OF POSITION
Z = Z COMPONENT OF POSITION
DX = X COMPONENT OF VELOCITY
DY = Y COMPONENT OF VELOCITY
DZ = Z COMPONENT OF VELOCITY

= 20 INERTIAL SELENOCENTRIC CARTESIAN RESTART COORDINATES
RXYZ = X,Y,Z COMPONENTS OF RESTART POSITION IN UNITS OF EARTH RADII (DOUBLE PRECISION)
RDXYZ = X,Y,Z COMPONENTS OF RESTART VELOCITY IN UNITS OF EARTH RADII PER HOUR (DOUBLE PRECISION)

= 21 INERTIAL SELENOCENTRIC CARTESIAN COORDINATES. ISCALE CONTROLS INPUT UNITS.
XL = X COMPONENT OF POSITION
YL = Y COMPONENT OF POSITION
ZL = Z COMPONENT OF POSITION
DXL = X COMPONENT OF VELOCITY
DYL = Y COMPONENT OF VELOCITY
DZL = Z COMPONENT OF VELOCITY

10. OPERATING INSTRUCTIONS FOR THE APOLLO REFERENCE MISSION PROGRAM (ARMACR) POST PROCESSORS.

10.1 GENERAL

THE ARMACR POST PROCESSOR IS A PROGRAM THAT IS AUTOMATICALLY EXECUTED AFTER THE ARMACR TRAJECTORY PROGRAM HAS GENERATED AND STORED THE NECESSARY INPUT DATA ON A TAPE. THERE ARE PRESENTLY THREE POST PROCESSORS REPORT GENERATOR (GROUND TRACK, RELATIVE MOTION, REFSMMAT TO REFSMMAT, DOCKED ALIGNMENT, OPEN HATCH THERMAL CONTROL), APOLLO REENTRY SIMULATION (ARS), AND THE GUIDANCE OPTICAL SIGHTING TABLE (GOST).

10.2 THE ARMACR POST PROCESSORS

THIS SECTION PRESENTS A BRIEF DESCRIPTION OF THE ARMACR POST PROCESSORS ALONG WITH A LISTING OF THE CONTROL CARDS AND THE ON-LINE INPUTS REQUIRED TO OPERATE EACH PROCESSOR.

10.2.1 REPORT GENERATOR PROCESSOR. - THIS PROCESSOR IS USED TO OUTPUT TABULAR DATA IN A DESIRED FORMAT. THE DATA, A MAXIMUM OF 13 VARIABLES PER TABLE, ARE OBTAINED FROM THE VARIABLE FORMAT TAPE GENERATED BY ARMACR AND OUTPUT IN THE FORMAT SPECIFIED IN THE REPORT GENERATOR.

A. TAPE SETUP FOR THE UNIVAC 1108 PROCESSING SYSTEM

TAPE UNIT	TAPE DESCRIPTION
A	REPORT GENERATOR (PCF) PROGRAM TAPE
F	SCRATCH TAPE
I	EPHEMERIS TAPE
R	ARMACR PROGRAM (PCF) TAPE
U	DATA TAPE
Y	SCRATCH TAPE

B. CONTROL CARD LISTING FOR THE UNIVAC 1108 DATA PROCESSING SYSTEM

```
COLUMN 1  4    8
          MSG                        COMMENTS
          ASG A=XXXX                 REPORT GENERATOR PROGRAM
                                     (PCF) TAPE
          ASG F                      SCRATCH TAPE
          ASG I=$EPHEM               SINGLE PRECISION EPHEMERIS
                                     TAPE
          ASG R=XXXX                 ARMACR PROGRAM (PCF) TAPE
          ASG U=XXXX                 ARMACR DATA TAPE
          ASG Y                      SCRATCH TAPE
          XQT CUR                    EXECUTE THE FOLLOWING
                                     INSTRUCTIONS
              TRW R                  REWIND UNIT R
              IN R                   INPUT THE ENTIRE USER PCF
                                     FROM UNIT R
        EN XQT ARMACR
                                     SOURCE LANGUAGE CORRECTIONS
                                     (PATCHES)
          .
          .                          ARMACR DATA CARDS
          .
        ENDRUN                       END OF ARMACR DATA
          XQT CUR                    EXECUTE THE FOLLOWING
                                     INSTRUCTIONS
              ERS                    ERASE LAST PROGRAM FROM
                                     MEMORY
              TRW A                  REWIND UNIT A
              IN A                   INPUT THE ENTIRE USER PCF
                                     FROM UNIT A
              TRI A                  REWIND UNIT A WITH
                                     INTERLOCK
        N XQT REPORT                 EXECUTE REPORT GENERATOR
              .
              .                      REPORT GENERATOR DATA CARDS
              .
        EOF                          END OF FILE CARD
```

C. INPUTS TO THE REPORT GENERATOR PROCESSOR. THE FOUR OPTION CARDS ARE LISTED BELOW WITH THE REMAINING FORMAT CARDS CONTAINED IN THE ON-LINE DECKS.

	COLUMN	
CARD 1	1-3	NUMBER OF CASES (INTEGER)
	4-6	OPTION TO START PROCESSING THE NTH RECORD INSTEAD OF THE FIRST RECORD (USED IN CONJUNCTION WITH CARD 4) AND TO CREATE ONLY ONE TABLE FOR MULTIPLE PHASES. = 0 NO OPTION = 1 BEGIN PROCESSING WITH THE NTH RECORD, AND CREATE ONLY ONE TABLE PER CASE = 2 BEGIN PROCESSING WITH THE NTH RECORD, BUT BEGIN TABLE HEADINGS ON A NEW PAGE FOR EACH PHASE
	7-9	FILE NUMBER ON THE DATA TAPE IN WHICH CARDS 5-40 ARE LOCATED. =N FILE NUMBER =0 CARDS 5-40 ARE READ FROM CARD READER
CARD 2	1-3	NUMBER OF TABLES (INTEGER)
	4-6	TOTAL NUMBER OF PHASES (INTEGER) POSITIVE NUMBER = PHASE TO BE PROCESSED ARE LISTED ON CARD 3 NEGATIVE NUMBER = ABSOLUTE VALUE IS NUMBER OF CONSECUTIVE PHASES TO BE PROCESSED STARTING WITH PHASE SPECIFIED IN COL 1-2 OF CARD 3.
CARD 3	1-2 3-4 5-6	FIRST PHASE TO BE PROCESSED SUCCESSIVE PHASES TO BE PROCESSED IF THE NUMBER IN COLUMNS 4-6 OF CARD 2 IS POSITIVE
CARD 4	1-3	DATA RECORDS TO BE USED FOR EACH PHASE = POSITIVE OR ZERO, THE DATA RECORD TO BE USED FOR ADDITIONAL PHASES MUST BE SPECIFIED IN COL 4-73. = -1, SAME DATA RECORD OPTION FOR ALL PHASE = -2,-3,-4,ETC, EVERY 2ND,3RD,4TH, ETC., DATA RECORD WILL BE USED TO GENERATE THE TABLE

CARD	5-N	THE FORMAT CARDS ARE SET IN THE APPROPRIATE ON-LINE DECKS.
CARD 40	1-6 7-12	THE FOLLOWING CONVERSION OPTIONS AVAILABLE IN ADDITION TO THOSE LISTED ON 15-30

D. INPUTS TO GROUND TRACK PROCESSOR (ARMACR) ARE LISTED BELOW

PHASE(N,M) = PHASE WHERE GROUND TRACK IS CALLED

TCINT	(FP)	INTEGRATION STEP SIZE FOR THRUSTING PHASE (SEC)
CINE	(FP)	INTEGRATION STEP SIZE FOR NEAR-EARTH COASTING PHASE (HR)
CINNE	(FP)	INTEGRATION STEP SIZE FOR FAR-EARTH COASTING PHASE (HR)
CINL	(FP)	INTEGRATION STEP SIZE FOR NEAR-MOON COASTING PHASE (HR)
CINNL	(FP)	INTEGRATION STEP SIZE FOR FAR-MOON COASTING PHASE (HR)
IPRINT	I	PRINT FREQUENCY MULTIPLIER
OSCALE	7	OUTPUT UNITS ARE N MI AND FPS
TOTALP	-17.	SUPPRESS ARMACR PRINT
TITLE	-1.	SUPPRESS ARMACR PRINT
VLIST1	(BCD)	VARIABLE TO BE WRITTEN ON THE VARIABLE FORMAT TAPE =T,KDAYS,KHRS,KMINS,SEC,LAT,LON, ALT,AZ,ENDLST

E. INPUTS TO THE RELATIVE MOTION PROCESSOR (ARMACR). THIS PROCESSOR WILL BE USED TO COMPUTE THE RELATIVE MOTION OF TWO VEHICLES AND OUTPUT THE RELATIVE MOTION DIGITALS DISPLAY. THE INPUTS ARE LISTED BELOW.

PHASE(N,M) = PHASE WHERE RELATIVE MOTION IS CALLED

TCINT	(FP)	INTEGRATION STEP SIZE FOR THRUSTING PHASE (SEC)
CINE	(FP)	INTEGRATION STEP SIZE FOR NEAR-EARTH COASTING PHASE (HR)

CINNE	(FP)	INTEGRATION STEP SIZE FOR FAR-EARTH COASTING PHASE (HR)
CINL	(FP)	INTEGRATION STEP SIZE FOR NEAR-MOON COASTING PHASE (HR)
CINNL	(FP)	INTEGRATION STEP SIZE FOR FAR-MOON COASTING PHASE (HR)
IPRINT	I	PRINT FREQUENCY MULTIPLIER
OSCALE	7	OUTPUT UNITS ARE N MI AND FPS
TOTALP	-17.	SUPPRESS ARMACR PRINT
TITLE	-1.	SUPPRESS ARMACR PRINT
VLIST1	(BCD)	VARIABLES TO BE WRITTEN ON THE VARIABLE FORMAT TAPE =T,RANGE,RRATE,RCZ,RCX,RCY,ENDLST

F. INPUTS (ARMACR) TO THE REFSMMAT TO REFSMMAT PROCESSOR. THIS PROCESSOR COMPUTES A LVLH SPACECRAFT (CSM AND/OR LM) ATTITUDE BASED ON A PREFERRED REFSMMAT AND 0,0,0 GIMBAL ANGLES. THIS LVLH ATTITUDE AND A NEW INPUT REFSMMAT ARE USED TO COMPUTE THE CORRESPONDING GIMBAL ANGLES.

PHASE (N,M) = ALIGN TC PREFERRED LVLH ATTITUDE

*ATYPE(I)	10	ALIGN SPACECRAFT BASED ON REFSMMAT AND GIMBAL ANGLES
IVECT	I	READ STATE VECTOR IN 1004 FORMAT =1 INPUT ONE VECTOR =2 INPUT TWO VECTORS
ROLL1	(FP)	GIMBAL ANGLES SET TC 0.,0.,0. (IGA,MGA,OGA)
IREFM	I	INPUT PREFERRED REFSMMAT IN 1004 FORMAT = 1 ONE REFSMMAT WILL BE INPUT = 2 TWO REFSMMATS WILL BE INPUT
GETHRS	(FP)	TIME (HR,MIN,SEC) AT WHICH GIMBAL ANGLE COMPUTATION IS DESIRED
BGEND	1	PRINT FIRST AND LAST POINT IN EACH PHASE
NV	I	NUMBER OF VEHICLES
VLIST1	(BCD)	VARIABLES TO BE WRITTEN ON THE VARIABLE FORMAT TAPE FOR VEHICLE 1 =IGA,MGA,OGA,RFID11,RFID12,ENDLST*

```
      VLIST2     (BCD)      VARIABLES TO BE WRITTEN ON THE VARI-
                            ABLE FORMAT TAPE FOR VEHICLE 2
                            =IGA,MGA,OGA,RFID21,RFID22,ENDLST*

   PHASE (N+1,M) = COMPUTE IMU GIMBAL ANGLES BASED ON NEW INPUT
                   REFSMMAT

     *ATYPE(I+2)  2         ALIGN IMU BASED ON INPUT REFSMMAT

      IREFM       I         INPUT PREFERRED REFSMMAT IN 1004
                            FORMAT
                            = 1 ONE REFSMMAT WILL BE INPUT
                            = 2 TWO REFSMMATS WILL BE INPUT

      VLIST1     (BCD)      VARIABLES TO BE WRITTEN ON THE VARI-
                            ABLE FORMAT TAPE FOR VEHICLE 1
                            =IGA,MGA,OGA,RFID11,RFID12,ENDLST*

      VLIST2     (BCD)      VARIABLES TO BE WRITTEN ON THE VARI-
                            ABLE FORMAT TAPE FOR VEHICLE 2
                            =IGA,MGA,OGA,RFID21,RFID22,ENDLST*
   PHASE (N+2,M) = TERMINATE RUN

      NTAPE       0         FLAG TO TERMINATE RUN

   ENDRUN

      VECTOR FOR VEHICLE ONE

      VECTOR FOR VEHICLE TWO

      PREFERRED REFSMMAT ONE

      PREFERRED REFSMMAT TWO

      NEW REFSMMAT ONE

      NEW REFSMMAT TWO

*NOTE - THE LETTER I IS THE NUMBER OF THE VEHICLE. (I=1 FOR
       CSM, AND 2 FOR LM)

**NOTE - IF TWO VEHICLES ARE INPUT AND THE VECTORS ARE NOT AT
         THE SAME TIME, A PHASE MUST BE INCLUDED, PRIOR TO THE
         LVLH ALIGNMENT PHASE, IN WHICH THE EARLIER VECTOR IS
         COASTED UP TO THE TIME OF THE LATER VECTOR.
```

G. INPUTS (ARMACR) TO THE DOCKING ALIGNMENT PROCESSOR. THIS PROCESSOR WILL BE USED TO COMPUTE EITHER LM IMU GIMBAL ANGLES AND FDAI ANGLES, A LM REFSMMAT, OR CSM IMU GIMBAL ANGLES WHILE IN A DOCKED CONFIGURATION. THE IMU GIMBAL ANGLES OF ONE VEHICLE CAN BE COMPUTED FROM THE GIMBAL ANGLES AND REFSMMAT OF THE SECOND VEHICLE AND THE REFSMMAT OF THE FIRST VEHICLE. IN ADDITION, A LM REFSMMAT CAN BE COMPUTED FROM THE LM GIMBAL ANGLES AND THE CSM GIMBAL ANGLES AND REFSMMAT.

LM GIMBAL ANGLE COMPUTATION

PHASE (1,0,3,1) = FIRST COAST PHASE

ROLL1	(FP)	CSM IMU GIMBAL ANGLES (IGA,MGA,OGA)
*TOTALP	-17.	SUPPRESS ARMACR PRINT
*IREFM	1	INPUT CSM REFSMMAT IN 1004 FORMAT

PHASE (2,2) = SECOND COAST PHASE

*INJECT	31	DOCKED VEHICLE CONFIGURATION
*ATYPE(2)	2	ALIGN LM TO NOMINAL DOCKED CONFIGURATION
*ROLL2	(FP)	NOMINAL DOCKED CONFIGURATION (SET TO 180.,0.,120.)
*IMASS(2)	999.	VEHICLE TWO DUMMY WEIGHT

PHASE (3,2) = THIRD COAST PHASE

ROLL(6)	(FP)	NEGATIVE OF ROLL DOCKING ANGLE OFFSET
*ATYPE(2)	2	ALIGN LM TO DOCKING ANGLES

PHASE (4,2) = FOURTH COAST PHASE

*IREFM	1	INPUT LM REFSMMAT IN 1004 FORMAT
*VLIST1	(BCD)	VARIABLES TO BE WRITTEN ON THE VARIABLE FORMAT TAPE
*VLIST2	(BCD)	VARIABLES TO BE WRITTEN ON THE =IGA,MGA,OGA,RFID11,RFID12,ENDLST* VARIABLE FORMAT TAPE =IGA,MGA,OGA,RFID21,RFID22,ENDLST*

```
PHASE (5,2) = FIFTH COAST PHASE

  *NTAPE       0          TERMINATE RUN

ENDRUN

  CSM 1004 REFSMMAT

  LM 1004 REFSMMAT

   LM REFSMMAT COMPUTATION

PHASE (1,0,3,1) = FIRST COAST PHASE

   ROLL1      (FP)        CSM IMU GIMBAL ANGLES (IGA,MGA,OGA)

  *TOTALP     -17.        SUPPRESS ARMACR PRINT

  *IREFM       1          INPUT CSM REFSMMAT IN 1004 FORMAT

PHASE (2,2) = SECOND COAST PHASE

  *INJECT      31         DOCKED VEHICLE CONFIGURATION

  *ATYPE(2)    2          ALIGN LM TO NOMINAL DOCKED CONFIG-
                          URATION

  *ROLL2     (FP)         NOMINAL DOCKED CONFIGURATION (SET
                          TO 180.,0.,120.)

  *IMASS(2)    999.       VEHICLE TWO DUMMY WEIGHT

PHASE (3,2) = THIRD COAST PHASE

   ROLL(6)   (FP)         NEGATIVE OF ROLL DOCKING ANGLE
                          OFFSET

  *ATYPE(2)    2          ALIGN LM TO DOCKING ANGLES

PHASE (4,2) = FOURTH COAST PHASE

   G057      (FP)         LM IMU GIMBAL ANGLES (IGA,MGA,OGA)

  *IPTYPE      3          IMU ALIGNMENT
```

```
  *G008        1          ALIGN IMU ONLY

  *G012        -10        CALCULATE REFSMMAT

  *VLIST1      (BCD)      VARIABLES TO BE WRITTEN ON THE
                          VARIABLE FORMAT TAPE
                          =IGA,MGA,OGA,RFID11,RFID12,ENDLST*
  *VLIST2      (BCD)      VARIABLES TO BE WRITTEN ON THE
                          VARIABLE FORMAT TAPE
                          =IGA,MGA,OGA,RFID21,RFID22,XIMUX2,
                           XIMUY2,XIMUZ2,YIMUX2,YIMUY2,
                           YIMUZ2,ZIMUX2,ZIMUY2,ZIMUZ2,ENDLST*

PHASE (5,2) = FIFTH COAST PHASE

  *NTAPE       0          TERMINATE RUN

ENDRUN

  CSM 1004 REFSMMAT

   CSM GIMBAL ANGLE COMPUTATION

PHASE (1,C,3,1) = FIRST COAST PHASE

  *TOTALP      -17.       SUPPRESS ARMACR PRINT

PHASE (2,2) = SECOND COAST PHASE

  *INJECT      31         DOCKED VEHICLE CONFIGURATION

  *IMASS(2)    999.       VEHICLE TWO DUMMY WEIGHT

PHASE (3,2) = THIRD COAST PHASE

   ROLL2       (FP)       LM IMU GIMBAL ANGLES (IGA,MGA,OGA)

  *IREFM       1          INPUT LM REFSMMAT IN 1004 FORMAT

  *ATYPE(2)    10         ALIGN LM TO REFSMMAT AND IMU
                          GIMBAL ANGLES
```

```
PHASE (4,2) = FOURTH COAST PHASE

  *INJECT      30        ALIGN CSM TO LM
  *ATYPE       2         ALIGN CSM TO NOMINAL DOCKED CONFIG-
                         URATION.
  *ROLL        (FP)      NOMINAL DOCKED CONFIGURATION (SET TO
                         180.,0.,120.)
PHASE (5,2) = FIFTH COAST PHASE

   ROLL(3)     (FP)      NEGATIVE OF ROLL DOCKING ANGLE
                         OFFSET
  *ATYPE       2         ALIGN WITH DOCKING ANGLES
PHASE (6,2) = SIXTH COAST PHASE

   ROLL2       (FP)      LM IMU GIMBAL ANGLES (IGA,MGA,OGA)
  *INJECT      31        DOCKED VEHICLE CONFIGURATION
  *IREFM       2         INPUT LM AND CSM REFSMMAT IN 1004
  *ATYPE(2)    10        ALIGN LM TO REFSMMAT AND IMU
                         GIMBAL ANGLES
  *VLIST1      (BCD)     VARIABLES TO BE WRITTEN ON THE
                         VARIABLE FORMAT TAPE
                         =IGA,MGA,OGA,RFID11,RFID12,ENDLST*
  *VLIST2      (BCD)     VARIABLES TO BE WRITTEN ON THE
                         VARIABLE FORMAT TAPE
                         =IGA,MGA,OGA,RFID21,RFID22,ENDLST*
PHASE (7,2) = SEVENTH COAST PHASE

  *NTAPE       0         TERMINATE RUN
ENDRUN

  LM 1004 REFSMMAT

  CSM 1004 REFSMMAT

  LM 1004 REFSMMAT
```

*NOTE - THESE INPUTS ARE ALREADY SET IN THE ON-LINE DECKS.

H. INPUTS (ARMACR) TO THE OPEN HATCH THERMAL CONTROL PROCESSOR ARE NOT AVAILABLE AT THIS TIME.

10.2.2 ARS PROCESSOR. - THE APOLLO REENTRY SIMULATION PROCESSOR WILL BE USED TO ACCEPT A STATE VECTOR AT 425,000 FEET AND COMPUTE THE NECESSARY GUIDED ENTRY PROFILE TO HIT A TARGET LATITUDE AND LONGITUDE. THE STATE VECTOR IS GENERATED BY ONE OF THE ARMACR PROCESSORS AND IS WRITTEN INTO A 200-WORD RECORD WHICH INTERFACES WITH THE ARS PROCESSOR. OPTIONS EXIST WITHIN THE PROCESSOR TO USE ONE OF SIX DIFFERENT ENTRY MODES WHICH ARE DESCRIBED BELOW.

MODE 1 - AUTOMATIC GUIDANCE AND NAVIGATION CONTROL

IN THIS STEERING MODE, THE ARS PROCESSOR USES THE CMC ENTRY LOGIC TO COMPUTE THE ENTRY STEERING COMMANDS AND TO SIMULATE THE ENTRY TRAJECTORY REQUIRED TO ACHIEVE THE TARGET LANDING POINT.

MODE 2 - OPEN LOOP FOLLOWED BY GUIDANCE AND NAVIGATION CONTROL

IN THIS ENTRY MODE, AN INITIAL BANK ANGLE IS MAINTAINED FROM 400,000 FEET TO A SPECIFIED G-LEVEL, AT WHICH TIME THE CM IS ROLLED TO A SECOND BANK ANGLE, DESIGNATED AS THE BACKUP BANK ANGLE. THIS ATTITUDE IS MAINTAINED UNTIL THE SECOND G-LEVEL IS REACHED. FROM THIS TIME UNTIL DROGUE CHUTE DEPLOYMENT, THE ARS PROCESSOR USES THE GUIDANCE AND NAVIGATION CONTROL LOGIC TO COMPUTE THE STEERING COMMANDS NECESSARY TO ACHIEVE THE TARGET LANDING POINT. THIS STEERING MODE REQUIRES THE INPUT OF AN INITIAL AND BACKUP BANK ANGLE AND TWO G-LEVELS.

MODE 3 - BANK/REVERSE-BANK

IN THIS ENTRY MODE, WHICH IS USED TO COMPUTE BACKUP GUIDANCE QUANTITIES, AN INITIAL BANK ANGLE IS MAINTAINED FROM 400,000 FEET TO A SPECIFIED G-LEVEL. IT IS THEN FOLLOWED BY A BACKUP BANK ANGLE TO A COMPUTED TIME TO REVERSE BANK, AND THE REVERSE BANK ANGLE IS FLOWN TO DROGUE CHUTE DEPLOYMENT. IN THIS STEERING MODE, THE INITIAL BANK ANGLE AND G-LEVEL ARE INPUT, AND THE BACKUP BANK ANGLE AND TIME TO REVERSE BANK ARE COMPUTED BY THE ARS PROCESSOR.

MODE 4 - COMBINED BANK/REVERSE-BANK AND GUIDANCE AND NAVIGATION CONTROL

THIS ENTRY MODE IS THE SAME AS THAT DESCRIBED IS THE SECOND STEERING MODE WITH THE EXCEPTION THAT THE PROCESSOR COMPUTES THE BACKUP BANK ANGLE. THE INPUTS CONSIST OF THE INITIAL BANK ANGLE AND THE TWO G-LEVELS.

MODE 5 - ROLLING

IN THIS ENTRY, AN INITIAL BANK ANGLE IS MAINTAINED FROM 400,000 FEET TO A SPECIFIED G-LEVEL FOLLOWED BY A CONSTANT ROLL RATE TO DROGUE CHUTE DEPLOYMENTC THIS MODE REQUIRES THE INPUT OF THE INITIAL BANK ANGLE, G-LEVEL, AND ROLL RATE.

MODE 6 - OPEN LOOP

THIS ENTRY CAN EITHER BE A BANK/REVERSE-BANK AS DESCRIBED IN THE THIRD STEERING MODE OR A CONSTANT BANK-ANGLE ENTRY FROM 400,000 FEET TO DROGUE CHUTE DEPLOYMENT. THE BANK/REVERSE-BANK OPTION OF THIS STEERING MODE REQUIRES THE INPUT OF THE INITIAL AND BACKUP BANK ANGLES, THE G-LEVEL, AND THE TIME TO REVERSE BANK. A CONSTANT BANK ANGLE ENTRY CAN BE SPECIFIED BY INPUTTING THE VALUE OF THE BANK ANGLE TO BE USED AS THE INITIAL BANK ANGLE AND INPUTTING THE G-LEVEL AND TIME TO REVERSE BANK AS LARGE VALUES.

A. TAPE SETUP FOR THE UNIVAC 1108 DATA PROCESSING SYSTEM

TAPE UNIT	TAPE DESCRIPTION
I	EPHEMERIS TAPE
K	SCRATCH UNIT ON FASTRAND
R	ARMACR PROGRAM (PCF) TAPE
U	MISSION DATA TAPE
V	SCRATCH TAPE
T	ARS PROGRAM (PCF) TAPE

B. CONTROL CARD LISTING FOR THE UNIVAC 1108 DATA PROCESSING SYSTEM.

```
COLUMN 1  4    8
       *   MSG                          COMMENTS
           ASG I = $EPHEM               EMPHEMERIS TAPE UNIT
           ASG K                        SCRATCH UNIT ON FASTRAND
           ASG R = XXXX                 ARMACR PROGRAM (PCF) TAPE
                                        NUMBER
           ASG T = XXXX                 ARS PROGRAM (PCF) TAPE
                                        UNIT
           ASG U = XXXX                 MISSION DATA TAPE NUMBER
           ASG V                        SCRATCH UNIT (200-WORD
                                        RECORD)
           XQT CUR                      EXECUTE THE FOLLOWING
                                        INSTRUCTIONS
               TRW R                    REWIND UNIT R
               IN R                     INPUT THE ENTIRE USER PCF
                                        FROM UNIT R
               TRI R                    REWIND UNIT R WITH
                                        INTERLOCK
            N XQT ARMACR                EXECUTE ARMACR PROGRAM
           PHASE (M, N, O, P)           M IS THE PHASE NUMBER
                                        N IS THE PHASE TYPE
                                        O IS THE DATE UPDATE
                                          NUMBER
                                        P IS THE FILE NUMBER OF
                                          THE DATA TAPE
           .
           .                            ARMACR UPDATES FOR PHASE 1
           .
COLUMN 1
           PHASE (M,N)
              .
              .                         ARMACR UPDATES FOR PHASE M
              .
           ENDRUN                       LAST CARD IN THE ARMACR
                                        PHASE UPDATES
           .                            INPUT OCTAL VECTOR FROM
           .                            1004
           .                            INPUT REFSMATT FROM 1004
              XQT                       EXECUTE THE FOLLOWING
                                        INSTRUCTIONS
                  ERS                   ERASE LAST PROGRAM FROM
                                        MEMORY
                  TRW T                 REWIND UNIT T
                  IN T                  INPUT THE ENTIRE USER PCF
                                        FROM UNIT T
              XQT COLSUS/XXX            EXECUTE ARS PROGRAM (SCS
                                        FOR BACKUP MODES AND DAP
                                        FOR G AND N ENTRIES
```

```
          .
          .                                  ARS DATA CARDS
          .
          ENDRUN                             LAST CARD OF THE ARS DATA
                                             CARDS
            EOF                              END OF FILE CARD
```

*INDICATES 7/8 OVERPUNCH IN COLUMN 1

C. INPUTS TO ARS PROCESSORS

ADDITIONAL ARMACR INPUT QUANTITIES FOR THE ARS PROCESSOR ARE LISTED BELOW

PHASE (1,0,3,P) = ANY FILE FOR ARS ENTRY

ARS(38)	(FP)	ENTRY WEIGHT (SET TO 12425.0 ON TAPE)
ARS(48)	1.	PREBURN SUMMARY SHEET
ARS(90)	(FP)	FOOTPRINT OPTION = 0. DO NOT COMPUTE FOOTPRINT = 1. COMPUTE FOOTPRINT
ARS(95)	(FP)	EMS INITIALIZATION G-LEVEL OR ALTITUDE (SET TO 0.05G IN ARS PROGRAM)
ARS(49)	(FP)	LAD (SET TO 0.27 ON TAPE)
ARS(50)	(FP)	LOD (SET TO 0.207 ON TAPE)
ARS(99)	(FP)	DIRECTION TO BEGIN BANK = 0 SOUTH THEN NORTH = 1 NORTH THEN SOUTH

PHASE (N,M) = ANY PHASE

IINTFC	I	200-WORD RECORD FLAG THIS 200-WORD ARRAY CONTAINS THE INFORMATION NECESSARY TO WRITE THE INTERFACE RECORD USED TO INITIATE OTHER PROGRAMS ARMACR COMPUTES WORDS 1-37 AND 130-136. ALL OTHER WORDS WILL BE ZERO UNLESS THEY HAVE BEEN INPUT. = 0 THE 200-WORD RECORD WILL NOT BE WRITTEN. = N THE 200-WORD RECORD WILL BE WRITTEN FOR VEHICLE (N), WHERE N = 1 OR 2, AT THE TERMINAL POINT OF THE PHASE IN WHICH IINTFC IS INPUT.

MODE 1 - AUTOMATIC GUIDANCE AND NAVIGATION CONTROL

PHASE (1,0,3,P) = ANY FILE FOR ARS ENTRY

ARS(39)	1.	AUTOMATIC GUIDANCE AND NAVIGATION CONTROL STEERING MODE
ARS(40)	0.05	XIGS

ARS(52)	(FP)	TARGET LONGITUDE
ARS(53)	(FP)	TARGET LATITUDE

MODE 2 - OPEN LOOP FOLLOWED BY GUIDANCE AND NAVIGATION CONTROL

PHASE (1,0,3,P) = ANY FILE FOR ARS ENTRY

ARS(39)	2.	OPEN LOOP WITH G AND N TAKEOVER
ARS(40)	(FP)	X1 G'S (SET TO 1.0 ON TAPE)
ARS(41)	(FP)	INITIAL BANK TO X1 G'S (SET TO 180.0 ON TAPE)
ARS(42)	(FP)	X2 G'S
ARS(43)	(FP)	BACKUP BANK TO X2 G'S
ARS(52)	(FP)	TARGET LONGITUDE
ARS(53)	(FP)	TARGET LATITUDE

MODE 3 BANK/REVERSE-BANK

PHASE (1,0,3,P) = ANY FILE FOR ARS ENTRY

ARS(39)	3.	BANK/REVERSE-BANK
ARS(40)	(FP)	X1 G'S (SET TO 1.0 ON TAPE)
ARS(41)	(FP)	INITIAL BANK TO X1 G'S (SET TO 180.0 ON TAPE)
ARS(52)	(FP)	TARGET LONGITUDE
ARS(53)	(FP)	TARGET LATITUDE

MODE 4 COMBINED BANK/REVERSE-BANK AND GUIDANCE AND NAVIGATION CONTROL

PHASE(1,0,3,P) = ANY FILE FOR ARS ENTRY

ARS(39)	4.	COMBINED BANK/REVERSE-BANK AND GUIDANCE AND NAVIGATION CONTROL

ARS(40)	(FP)	X1 G'S (SET TO 1. ON TAPE)
ARS(41)	(FP)	INITIAL BANK TO X1 G'S (SET TO 180. ON TAPE)
ARS(42)	(FP)	X2 G'S
ARS(52)	(FP)	TARGET LONGITUDE
ARS(53)	(FP)	TARGET LATITUDE

MODE 5 ROLLING

PHASE(1,0,3,P) = ANY FILE FOR ARS ENTRY

ARS(39)	5.	ROLLING
ARS(40)	(FP)	X1 G'S (SET TO 1. ON TAPE)
ARS(41)	(FP)	INITIAL BANK TO X1 G'S (SET TO 180. ON TAPE)
ARS(52)	(FP)	TARGET LONGITUDE
ARS(53)	(FP)	TARGET LATITUDE

MODE 6 OPEN LOOP

PHASE(1,0,3,P) = ANY FILE FOR ARS ENTRY

ARS(39)	6.	OPEN LOOP
ARS(40)	(FP)	X1 G'S (SET TO 1. ON TAPE)
ARS(41)	(FP)	INITIAL BANK TO X1 G'S (SET TO 180. ON TAPE)
ARS(43)	(FP)	BACKUP BANK TO GETHRS
ARS(44)	(FP)	GETRR (TIME TO REVERSE BANK SEC)
ARS(52)	(FP)	TARGET LONGITUDE
ARS(53)	(FP)	TARGET LATITUDE

10.2.3 GOST PROCESSOR. - THIS PROCESSOR WILL PRIMARILY BE USED TO VERIFY THE CM IMU STABLE MEMBER ALIGNMENT MADE BY USING THE CNBOARD OPTICAL SIGHTING EQUIPMENT CONSISTING OF A SCANNING TELESCOPE, A SEXTANT, AND A BORE SIGHT. BY USING A CATALOG OF STAR AND EARTH FIXED LANDMARK LOCATIONS, THIS PROCESSOR WILL CALCULATE IMU GIMBAL ANGLES, REFSMMATS, AND THE SHAFT AND TRUNNICN ANGLES OF THE OPTICAL EQUIPMENT. THE PROCESSOR HAS SEVERAL OPTIONS WHICH MAY BE USED TO DETERMINE THE POSITION OF STARS ON THE INSTRUMENT RETICLES, TO DETERMINE THE NECESSARY SPACECRAFT ATTITUDE FOR VIEWING A GROUND TARGET, TO DETERMINE REFSMMAT, AND TO DETERMINE IMU GIMBAL ANGLES.

A. TAPE SETUP FOR THE UNIVAC 1108 DATA PROCESSING SYSTEM

TAPE UNIT	TAPE DESCRIPTION
A	GEMMV PROGRAM (PCF) TAPE
I	EPHEMERIS TAPE UNIT
R	ARMACR PROGRAM (PCF) TAPE
U	MISSION DATA TAPE
V	SCRATCH TAPE (200-WORD RECORD)

B. CONTROL CARD LISTING FOR THE UNIVAC 1108 DATA PROCESSING SYSTEM

```
COLUMN 1  4    8
          MSG                          COMMENTS
          ASG A = XXXX                 GEMMV PROGRAM (PCF) TAPE
                                       NUMBER
          ASG I = $EPHEM               SUN, MOON, AND STAR
                                       EPHEMERIDES
          ASG R = XXXX                 ARMACR PROGRAM (PCF) TAPE
                                       NUMBER
          ASG U = XXXX                 MISSION DATA TAPE NUMBER
          ASG V                        SCRATCH TAPE (200-WORD
                                       RECORD)
          XQT CUR                      EXECUTE THE FOLLOWING
                                       INSTRUCTIONS
              TRW R                    REWIND UNIT R
              IN R                     INPUT THE ENTIRE USER PCF
                                       FROM UNIT R
              .                        SOURCE LANGUAGE CORREC-
              .                        TIONS (PATCHES)
        EN XQT ARMACR                  EXECUTE ARMACR PROGRAM
              .
              .                        ARMACR UPDATES
              .
        ENDRUN                         LAST ARMACR DATA CARD
         N XQT CUR                     EXECUTE THE FOLLOWING
                                       INSTRUCTIONS
              ERS                      ERASE LAST PROGRAM FROM
                                       MEMORY
              PER A                    POSITION TAPE A TO A END
                                       OF FILE
              PER A                    POSITION TAPE A TO A END
                                       OF FILE
              IN A                     INPUT THE ENTIRE USER PCF
                                       FROM UNIT A
              TRW I                    REWIND UNIT I
         N XQT DGOST                   EXECUTE GOST PROGRAM
              .
              .                        GOST DATA CARDS
              .
          EOF                          END OF FILE CARD
```

*INDICATES 7/8 OVERPUNCH IN COLUMN 1

A. THE INPUT QUANTITIES FOR THE ARMACR PART OF THE PROCESSOR ARE THE SAME FOR ALL GOST OPTIONS (WITH TWO EXCEPTIONS WHICH ARE INDICATED). THE STANDARD INPUT QUANTITIES ARE LISTED BELOW.

PHASE (1,0,3,1) = INITIAL COAST PHASE

IVECT	I	OCTAL VECTOR INPUT FLAG = 0 NO VECTOR DATA SET WILL BE INPUT = 1 ONE OCTAL VECTOR IN BESSELIAN COORDINATES = 2 TWO OCTAL VECTORS IN BESSELIAN COORDINATES
IREFM	I	INPUT REFSMMAT FLAG = 0 REFSMMAT WILL NOT BE INPUT = 1 ONE REFSMMAT WILL BE INPUT = 2 TWO REFSMMATS WILL BE INPUT
ATYPE	10	INPUT IMU GIMBAL ANGLE
ROLL1	(FP)	GIMBAL ANGLES (P,Y,R) (SET TO 0.,0.,0. ON TAPE)
GETHRS	(FP)	PHASE TERMINATION
IINTFC	I	200-WORD RECORD FLAG

B. THE OPTIONS OF THE GOST PART OF THE PROCESSOR TO BE INPUT, AS WELL AS THE CARD FORMATS ARE LISTED BELOW. OPTION 1 OR 11 REQUIRES TWO INPUT CARDS WHILE OPTION 5 OR 15 REQUIRES FOUR INPUT CARDS. THE REMAINING OPTIONS EACH REQUIRE ONLY ONE CARD. ALL DATA PUNCHED IN COLUMNS 10 THROUGH 70 MUST HAVE DECIMAL POINTS. THE GOST INPUT CARDS ARE PLACED IN THE SPECIAL GOST ON-LINE DECK JUST AFTER THE '*XCG DGOST' CARD.

OPTION 1 OR 11

INPUT	THE IDENTIFICATION OF TWO STARS AND THE SEXTANT SHAFT AND TRUNNION ANGLE
COMPUTE'	REFSMMAT

OPTION 2 OR 12

INPUT* — NO INPUTS ARE NEEDED FOR OPTION 2 OR 12

COMPUTE — THE LOCATION OF TWO STARS WHICH ARE IN THE SCANNING TELESCOPE FIELD OF VIEW AT A SPECIFIED SPACECRAFT ATTITUDE AND IMU ALIGNMENT. THE TWO STARS MUST SATISFY THE CONDITION THAT ONE STAR LIES ON THE R-LINE AND THE OTHER STAR LIES AS CLOSE AS POSSIBLE TO THE M-LINE OF THE TELESCOPE RECTICLE PATTERN.

OPTION 3 OR 13

INPUT — THE IDENTIFICATION OF STARS

COMPUTE — THE SEXTANT SHAFT AND TRUNNION ANGLES FOR EACH OF THE INPUT STARS.

OPTION 4 OR 14

INPUT — THE SPACECRAFT LVLH ROLL AND YAW ANGLES PLUS THE SPACECRAFT PITCH ANGLE TO THE HORIZON.

COMPUTE* — GIMBAL ANGLES AND LVLH PITCH ANGLE

OPTION 5 OR 15

INPUT — THIS OPTION IS THE SAME AS OPTION 1 OR 11 EXCEPT IMU GIMBAL ANGLES ARE INPUT IN THE GOST RATHER THAN THE GEMMV PROGRAM.

COMPUTE* — REFSMMAT

OPTION NUMBER	1-2 COLUMNS	10-25	30-45	50-65
1 OR 11	11	STAR NO.1	SHAFT NO.1	TRUNNION NO.1
	11	STAR NO.2	SHAFT NO.2	TRUNNION NO.2
2 OR 12	12	*	*	*
3 OR 13	13	STAR NO.1	STAR NC.2	
4 OR 14	14	LVLH ROLL	**	LVLH YAW
	15	STAR NO.1	SHAFT NO.1	TRUNNION NO.1
5 OR 15	15	STAR NO.2	SHAFT NO.2	TRUNNION NO.2
	15	ROLL GA NO.1	PITCH GA NO.1	YAW GA NO.1
	15	ROLL GA NO.2	PITCH GA NO.2	YAW GA NO.2

*NORMALLY THESE COLUMNS SHOULD BE BLANK. IF NON-BLANK, COLUMNS 10-15 SHOULD CONTAIN THE ROLL GIMBAL ANGLE, COLUMNS 30-45 SHOULD CONTAIN THE PITCH GIMBLE ANGLE, AND COLUMNS 50-65 SHOULD CONTAIN THE YAW GIMBAL ANGLE. IF ANY OF THESE ANGLES ARE ZERO, THEY MUST BE PUNCHED .00001.

**NORMALLY A BLANK OR 0. EITHER IS RECOGNIZED BY THE PROGRAM AS A 31.7 DEGREE PITCH BETWEEN THE X-BODY AXIS AND LINE-OF-SIGHT TO THE HORIZON. OTHERWISE, THE PITCH ANGLE (IF OTHER THAN 31.7 DEG) SHOULD BE INPUT.

10.2.4 EARTH-LIGHT ILLUMINANCE PROCESSOR. - THIS PROCESSOR WILL BE USED TO COMPUTE THE TOTAL AMOUNT OF REFLECTED EARTH-LIGHT ON THE SPACECRAFT SCANNING TELESCOPE.

A. TAPE SETUP FOR THE UNIVAC 1108 DATA PROCESSING SYSTEM

TAPE UNIT	TAPE DESCRIPTION
A	GEMMV PROGRAM (PCF) TAPE
I	EPHEMERIS TAPE UNIT
R	ARMACR PROGRAM (PCF) TAPE
U	MISSION DATA TAPE
V	SCRATCH TAPE (200-WORD RECORD)

B. CONTROL CARD LISTING FOR THE UNIVAC 1108 DATA PROCESSING SYSTEM

```
COLUMN 1  4    8
          MSG                          COMMENTS
          ASG A = XXXX                 GEMMV PROGRAM (PCF) TAPE
                                       NUMBER
          ASG I = $EPHEM               SUN, MOON, AND STAR
                                       EPHEMERIDES
          ASG R = XXXX                 ARMACR PROGRAM (PCF) TAPE
                                       NUMBER
          ASG U = XXXX                 MISSION DATA TAPE NUMBER
          ASG V                        SCRATCH TAPE (200-WORD
                                       RECORD)
          XQT CUR                      EXECUTE THE FOLLOWING
                                       INSTRUCTIONS
              TRW R                    REWIND UNIT R
              IN R                     INPUT THE ENTIRE USER PCF
                                       FROM UNIT R
              .
              .                        SOURCE LANGUAGE CORREC-
       EN XQT ARMACR                   TIONS (PATCHES)
              .                        EXECUTE ARMACR PROGRAM
              .
              .                        ARMACR UPDATES
       ENDRUN
        N XQT CUR                      LAST ARMACR DATA CARD
                                       EXECUTE THE FOLLOWING
              ERS                      INSTRUCTIONS
                                       ERASE LAST PROGRAM FROM
              PER A                    MEMORY
                                       POSITION TAPE A TO A END
              PER A                    OF FILE
                                       POSITION TAPE A TO A END
              PER A                    OF FILE
                                       POSITION TAPE A TO A END
              PER A                    OF FILE
                                       POSITION TAPE A TO A END
                                       OF FILE
```

```
        PER A                   POSITION TAPE A TO A END
                                OF FILE
        PER A                   POSITION TAPE A TO A END
                                OF FILE
        PER A                   POSITION TAPE A TO A END
                                OF FILE
        IN A                    INPUT THE ENTIRE USER PCF
                                FROM UNIT A
        TRW I                   REWIND UNIT I
  N XQT LUMAN                   ILLUMINANCE DATA CARDS
        •
        •                       GOST DATA CARDS
        •
   EOF                          END OF FILE CARD
```

*INDICATES 7/8 OVERPUNCH IN COLUMN 1

EARTH-LIGHT ILLUMINANCE PROCESSOR

(FILE 8, UNIVAC 1108)

A. THE STANDARD ARMACR INPUT QUANTITIES ARE LISTED BELOW

IVECT	I	OCTAL VECTOR INPUT FLAG = 0 NO VECTOR DATA SET WILL BE INPUT = 1 ONE OCTAL VECTOR IN BESSELIAN COORDINATES = 2 TWO OCTAL VECTORS IN BESSELIAN COORDINATES
IREFM	I	INPUT REFSMMAT FLAG = 0 REFSMMAT WILL NOT BE INPUT = 1 ONE REFSMMAT WILL BE INPUT = 2 TWO REFSMMATS WILL BE INPUT
GETHRS	(FP)	PHASE TERMINATION
IINTFC	I	200-WORD RECORD FLAG

B. INPUTS TO THE EARTH-LIGHT ILLUMINANCE PROCESSOR ARE LISTED BELOW

CARD 1	DATA CARD
COLUMNS	
11-30	SHAFT ANGLE
CARD 2	NEXT FILE ON PCF TO BE EXECUTED
COLUMNS	
1-6	FILE N (NORMALLY SET TO C)

11. SOLAR PARTICLE ALERT NETWORK PROGRAM (SPAN)

11.1 GENERAL

THIS SECTION PRESENTS A BRIEF DESCRIPTION OF THE SPAN PROGRAM, INCLUDING TAPE AND CONTROL CARD SETUPS AND INPUT INSTRUCTIONS.

11.2 PROGRAM DESCRIPTION

THE SOLAR PARTICLE ALERT NETWORK (SPAN) PROGRAM PROCESSES SOLAR FLARE DATA FROM THE SOLAR PARTICLE ALERT NETWORK TO DETERMINE THE SOLAR PARTICLE ENVIRONMENT IN THE EARTH-MOON REGION OF SPACE.

11.3 TAPE SETUP FOR THE UNIVAC 1108 PROCESSING SYSTEM

TAPE UNIT	TAPE DESCRIPTION
X	SPAN PROGRAM TAPE
A,B	FIRST AND SECOND DATA TAPES PRODUCED BY THE 418 FROM PAPER TAPE. BOTH UNITS A AND B, UNIT A ALONE, OR NEITHER UNIT MAY BE UTILIZED, DEPENDING ON WHETHER PAPER TAPES ARE PROVIDED.

11.4 CONTROL CARD SETUP FOR THE UNIVAC 1108 PROCESSING SYSTEM

```
CCLUMN 1  4    8
          MSG
          ASG A = XXXX          COMMENTS
                                FIRST TAPE GENERATED BY
                                418 IS PROVIDED
          ASG B = XXXX          SECOND TAPE GENERATED BY
                                418 IS PROVIDED
          ASG X=XXXX            SPAN PROGRAM (PCF) TAPE
          XQT CUR
              TRW A             REWIND UNIT A
              TRW B             REWIND UNIT B
              TRW X             REWIND UNIT X
              IN X              INPUT THE ENTIRE PCF FROM
                                UNIT X
        N XQT RFANAL            EXECUTE SPAN PROGRAM
              .
              .                 DATA
              .
          EOF
```

11.5 INPUTS

AN INPUT SHEET FOR SPAN, CONTAINING AS MANY AS 30 INPUTS, IS PROVIDED BY THE TRAJECTORY STAFF SUPPORT ROOM. ONE OR TWO PUNCHED PAPER TAPES MAY ALSO BE PROVIDED, IN WHICH CASE, THESE TAPES ARE PROCESSED BY THE 418 IN BUILDING 12, WITH THE RESULTS BEING PUT ON ONE OR TWO MAGNETIC TAPES. IF TWO TAPES ARE PRODUCED, UNITS A AND B WILL BE ASSIGNED TO THESE TAPE NUMBERS. IF ONE TAPE IS PRODUCED, UNIT A WILL BE ASSIGNED TO THAT NUMBER. THE CARD INPUT DATA FOR SPAN BEGINS IN COL.1 AND CONSISTS OF THE NUMBERS AND LETTERS ON THE SPAN INPUT SHEET, AS PROVIDED BY THE SSR, INCLUDING THE TWO INPUT SEQUENCE NUMBERS. ONLY THOSE CARDS CONTAINING DATA ON THE PROVIDED SHEET NEED TO BE INPUT.

12. OPERATING INSTRUCTIONS FOR THE APOLLO GENERALIZED OPTICS PROGRAM (AGOP)

12.1 GENERAL

THE APOLLO GENERALIZED OPTICS PROGRAM INCLUDES THOSE COMPUTATIONS PRESENTLY BEING PERFORMED BY GOST, SOME OPTICS OF THE WORK SCHEDULE PROCESSOR, A LM OST (LOST), STAR SIGHTING TABLE (SST), AND OTHER RELATED OPTICS/ANTENNA POINTING CALCULATIONS. THESE CALCULATIONS CAN BE MADE FOR EITHER VEHICLE (CSM OR LM), BOTH VEHICLES, OR VEHICLES IN A DOCKED CONFIGURATION. THERE ARE 9 OPTIONS PRESENTLY AVAILABLE WITH 3 OF THESE TO BE USED FOR SUPPORT OF APOLLO 9.

12.2 PROGRAM DESCRIPTION

OPTION 1 OF THE APOLLO GENERALIZED OPTICS PROGRAM WILL BE USED FOR CISLUNAR NAVIGATION. THIS PROGRAM OPTION DEFINES AN INERTIAL ATTITUDE WHICH WILL ALIGN THE OPTICAL SYSTEM TO THE HORIZON OR SOME SPECIFIED LANDMARK ON THE EARTH OR MOON. OUTPUT CONSIST OF IMU GIMBAL ANGLES AND THE OPTICS SHAFT AND TRUNNION ANGLES TO POINT THE SEXTANT AT THE SPECIFIED STAR. IF THE REQUIRED ATTITUDE CANNOT BE OBTAINED WITHOUT GOING THROUGH GIMBAL LOCK, A 'PSEUDO METHOD' IS AVAILABLE WHEREBY A YAW GIMBAL ANGLE IS INPUT AND THE PROGRAM COMPUTES THE PITCH AND ROLL GIMBAL ANGLES NECESSARY TO EFFECT THE DESIRED ALIGNMENT.

OPTION 2 WILL ACCEPT A STATE VECTOR AND COMPUTE THE RIGHT ASCENSION AND DECLINATION OF THE SPACECRAFT WITH RESPECT TO THE EARTH, AND THE RIGHT ASCENSION AND DECLINATION OF THE EARTH, MOON AND SUN WITH RESPECT TO THE SPACECRAFT. ADDITIONALLY IT COMPUTES THE SAME QUANTITES REFERENCED TO AN INPUT LANDMARK WHEN MODE 2 IS SELECTED.

MODE 2 OF OPTION 2 WILL COMPUTE RIGHT ASCENSION, DECLINATION, AND THE UNIT VECTOR FROM THE SPACECRAFT TO THE SPECIFIED LANDMARK OR TO THE CENTER OF THE EARTH, MOON, AND SUN AS DESIRED.

OPTION 3 WILL OUTPUT THE RIGHT ASCENSION AND DECLINATION OF ALL STARS IN THE CATALOG (EARTH REFERENCED, 1969)

OPTION 4 WILL ACCEPT A STATE VECTOR AND IMU GIMBAL ANGLES AND COMPUTE THE PITCH AND YAW ANGLES OF THE ONBOARD S-BAND HI-GAIN ANTENNA, S-BAND STEERABLE ANTENNA, AND RENDEZVOUS RADAR ANTENNA NECESSARY TO POINT AT A SPECIFIED GROUND BASED RADAR. THIS COMPUTATION ALSO OUTPUTS THE RELATED AZIMUTH AND ELEVATION ANGLES REQUIRED FOR THE GROUND STATION TO ACQUIRE THE SPACECRAFT. AN ADDITIONAL OPTION PROVIDES THE CAPABILITY OF FIXING THE ANTENNA POSITION AND COMPUTING THE NECESSARY SPACECRAFT GIMBAL ANGLES FOR POINTING THE ANTENNA AT THE SPECIFIED GROUND STATION.

OPTION 5 COMPUTES THE IMU GIMBAL ANGLE REQUIRED TO PLACE THE SPACECRAFT IN A PASSIVE THERMAL CONTROL (PTC) ATTITUDE, WITH THE +X-AXIS ORIENTED 90 DEGREES WITH RESPECT TO THE SUN AND TO THE EARTH FOR OMNIDIRECTIONAL COMMUNICATION. IN ORDER TO AVOID GIMBAL LOCK, THIS OPTION IS CONSTRAINED TO 20 DEGREES IN YAW GIMBAL ANGLE. IF THE ALIGNMENT REQUIRES GREATER THAN 20 DEGREES, A NEW PREFERRED REFSMMAT WILL BE COMPUTED WHICH WILL RESULT IN GIMBALS EQUAL TO 0,0,0.

OPTION 6 COMPUTES THE ANGLE IN THE SPACECRAFT XZ PLANE FROM THE SPACECRAFT X-AXIS TO THE LUNAR HORIZON AND THE LUNAR TERMINATOR. THE OUTPUT GIVES THE PITCH DOWN ANGLE TO THE HORIZON AND THE TERMINATOR, WITH AN INDICATION AS TO WHETHER THE HORIZON IS LIT.

OPTION 7 (OST) WILL PRIMARILY BE USED TO VERIFY THE CMC AND LM STABLE MEMBER ALIGNMENT MADE BY USING THE ONBOARD OPTICAL SIGHTING EQUIPMENT. THIS OPTION IS DIVIDED INTO 5 MODES WHICH ARE AS FOLLOWS:

MODE 1 COMPUTES THE YAW GIMBAL ANGLE REQUIRED TO PLACE THE Z-AXIS IN THE LOCAL VERTICAL PLANE AND A PITCH ANGLE WHICH WILL PLACE THE HORIZON ON THE LANDING POINT DESIGNATOR (LPD). THE NECESSARY INPUTS ARE REFSMMAT, GIMBAL ANGLES, AND TIME.

MODE 2 USES AN INPUT REFSMMAT, SPACECRAFT ATTITUDE, AND TIME INTERVAL TO COMPUTE AOS, LOS, AND OPTICS ANGLES FOR 10 STARS. THESE QUANTITIES WILL ALSO BE COMPUTED FOR INPUT STARS (FROM 1 TO 10).

MODE 3 COMPUTES A REFSMMAT BY SPECIFYING THE TIME OF THE STAR SIGHTINGS, STARS I.D., OPTICS ANGLES, AND SPACECRAFT ATTITUDE. THE CAPABILITY EXISTS TO INPUT TWO SETS OF GIMBAL ANGLES WITH THE ABOVE INPUT DATA AND COMPUTE THE REFSMMAT.

MODE 4 USES AN INPUT REFSMMAT, SPACECRAFT ATTITUDE FOR BOTH VEHICLES, AND A TIME TO COMPUTE THE SECOND VEHICLE REFSMMAT. IF BOTH REFSMMATS ARE INPUT, THE SECOND VEHICLE ATTITUDE WILL BE COMPUTED.

MODE 5 COMPUTES THE CSM GIMBAL ANGLES REQUIRED TO POINT THE AOT AT THE DESIRED TARGET. THE INPUTS ARE REFSMMAT, DOCKING ANGLE, ONE STAR I.D. AND OPTICS ANGLES.

OPTION 8 (SST) WILL BE USED TO COMPUTE GROUND AND CELESTIAL SIGHTING DATA FOR SELECTED TARGETS. THE SPACECRAFT ATTITUDE CAN BE FIXED AND THE OPTICS MOVED, OR THE OPTICS ANGLES ARE FIXED AND THE SPACECRAFT IS MOVED IN ORDER TO SIGHT THE TARGET. THIS OPTION IS DIVIDED INTO 5 MODES WHICH ARE AS FOLLOWS.

MODE 1 COMPUTES IMU GIMBAL ANGLES FOR SIGHTING A SPECIFIED LANDMARK. INPUTS ARE REFSMMAT, LANDMARK, ELEVATION ANGLE, OPTICS DATA, AND A TIME.

MODE 2 COMPUTES IMU GIMBAL ANGLES FOR SIGHTING A SPECIFIED STAR. INPUTS ARE REFSMMAT, STAR I.D. OR RIGHT ASCENSION AND DECLINATION, TIME, AND OPTICS DATA.

MODE 3 COMPUTES THE OPTICS ANGLES FOR SIGHTING A SPECIFIED LANDMARK. INPUTS ARE REFSMMAT, LANDMARK, OPTICS SYSTEM, ELEVATION ANGLE, GIMBAL ANGLES, AND A TIME.

MODE 4 COMPUTES THE OPTICS ANGLES FOR SIGHTING A SPECIFIED STAR. INPUTS ARE REFSMMAT, STAR I.D. OR RIGHT ASCENSION AND DECLINATION, TIME, AND THE OPTICAL SYSTEM.

MODE 5 COMPUTES AN IMAGINARY STAR GIVEN THE REFSMMAT, GIMBAL ANGLES, AND OPTICAL SYSTEM.

THE REQUIRED INPUTS DESCRIBED ABOVE ARE EITHER INPUT INTO ARMACR OR AGOP. NORMALLY, THE ARMACR INPUTS ARE STATE VECTOR, REFSMMAT, GIMBAL ANGLES, TIME INTERVAL AND STEP SIZE. THE AGOP INPUTS ARE DESCRIBED BELOW.

12.3 TAPE SETUP FOR THE UNIVAC 1108 DATA PROCESSING SYSTEM.

TAPE UNIT	TAPE DESCRIPTION
A	AGOP PROGRAM (PCF) TAPE
I	EPHEMERIS TAPE UNIT
R	ARMACR PROGRAM (PCF) TAPE
U	MISSION DATA TAPE
Q	EPHEMERIS TAPE FROM ARMACR

12.4 CONTROL CARD LISTING AND ONLINE DECK SETUP FOR THE UNIVAC 1108 DATA PROCESSING SYSTEM.

```
COLUMN 1  4    8
       *  MSG                    COMMENTS
          ASG A = XXXX           AGOP PROGRAM (PCF) TAPE
          ASG I =$EPHEM          EPHEMERIS TAPE UNIT
          ASG R = XXXX           ARMACR PROGRAM (PCF) TAPE
                                 NUMBER
          ASG U = XXXX           MISSION DATA TAPE NUMBER
          ASG Q                  EPHEMERIS TAPE TO BE WRIT-
                                 TEN BY ARMACR
          XQT CUR                EXECUTE THE FOLLOWING
                                 INSTRUCTIONS
              TRW R              REWIND UNIT R
              IN R               INPUT THE ENTIRE USER PCF
                                 FROM UNIT R
              TRI R              REWIND UNIT R WITH
                                 INTERLOCK
         N XQT ARMACR            EXECUTE ARMACR PROGRAM
        .
        .                        ARMACR UPDATES
        .
          XQT CUR                EXECUTE THE FOLLOWING
                                 INSTRUCTIONS
              ERS                ERASE CORE
              TRW A,Q            REWIND UNITS A AND Q
              IN A               INPUT THE ENTIRE USER PCF
          XQT AGOP               EXECUTE THE AGOP PROGRAM
        G
        .
        .                        G-ARRAY INPUTS FOR CASE 1
        .
              TRA 2,4            EXECUTE CASE 1
        G
        .
        .                        G-ARRAY INPUTS FOR CASE 2
        .
              TRA 2,4            EXECUTE LAST CASE
            EOF                  END OF FILE CARD
```

*INDICATES 7/8 OVERPUNCH IN COLUMN 1

12.5 AGOP INPUT DEFINITIONS

AGOP INPUTS CAN BE DIVIDED INTC TWO TYPES, GENERAL AND REQUIRED. THE GENERAL INPUTS ARE THOSE THAT ARE COMMON TO ALL THE OPTIONS, WHILE THE REQUIRED INPUTS ARE COMMON TO SPECIFIC OPTIONS CR MJDES. THE GENERAL INPUTS ARE LISTED BELOW FOLLOWED BY THE REQUIRED INPUTS FOR EACH OPTION.

GENERAL INPUTS

*G4	VEHICLE EPHEMERIS TAPE UNIT (IF OTHER THAN Q)
G14	IF SET TO 1, REFSMMAT MUST BE INPUT IN G31-9
G24-o	IMU GIMBAL ANGLES (O.G.A, I.M.A, M.G.A)
G29	SET TO 0 ON TAPE (EXPECTS GA'S TO BE INPUT IN G24-6 SET TO 1 TO PICK UP GA'S FROM ARM EPHEMERIS TAPE
*G30	ACTIVE VEHICLE =0 CSM =1 LM =2 CSM AND LM
G31-9	REFSMMAT (TSMZI)
G127	CSM SPECIAL OPTION FLAG =0 NO EFFECT =1 REPEAT RUN(WHERE LM OPTICS WERE USED) FOR CSM OPTICS
G1127	LM SPECIAL OPTION FLAG =0 NO EFFECT =1 REPEAT RUN(WHERE CSM OPTICS WERE USED) FOR LM OPTICS
G128	SPECIFIES WHICH SECTION OF THE EPH. TAPE CONTAINS CSM DATA =0 CSM FIRST 40 =1 CSM SECOND 40
G1128	SPECIFIES WHICH SECTION OF THE EPH. TAPE CONTAINS LM DATA =0 LM FIRST 40 =1 LM SECOND 40
G255	ELEVATION ANGLE
G343	SET TO 1 TO INPUT FDAI ANGLES

*G340-42	LM FDAI ANGLES (R,P,Y)
G348-50	SECOND SET OF IMU GIMBAL ANGLES FOR MODE 3 ONLY
G361-69	SECOND REFSMMAT FOR LM OPTICS ONLY
*G2000	NUMBER OF STARS
*G2001-10	STAR I.D.(1-10). IF SET TO 392 INPUT RIGHT ASCENSION AND DECLINATION OF THE STAR
*G426	RIGHT ASCENSION OF A STAR
*G427	DECLINATION OF A STAR
*G2011	NUMBER OF LANDMARKS
*G2012	LANDMARK NUMBER (1 TO 86) IF NEW EARTH LANDMARKS ARE TO BE INPUT, SET G2012 TO 1 AND INPUT THE COORDINATES AS FOLLOWS' LE1 DEC LONGITUDE,LATITUDE,HEIGHT IF MOON LANDMARKS ARE TO BE INPUT, SET G2012 TO 60 AND INPUT THE COORDINATES AS FOLLOWS. ML1 DEC LONGITUDE,LATITUDE,HEIGHT
*G1129	DOCKED CONFIGURATION (SET TO 1)
*G1130	DOCKING ANGLE

OPTICAL DATA - FLAG TO SPECIFY WHICH OPTICAL SYSTEM TO BE USED, FOLLOWED BY THE CORRESPONDING INPUTS.

G373	SET TO 0 TO USE THE CSM SXT/SCT (SEXTANT/TELESCOPE) OPTICAL SYSTEM
G411-12	SHAFT ANGLES FOR TWO STARS
G413-14	TRUNNION ANGLES FOR TWO STARS
G373	SET TO 1 TO USE THE LM COAS (CREWMAN OPTICAL ALIGNMENT SIGHT) OPTICAL SYSTEM
G352	COAS MOUNTED ON LM AXIS =0 X-AXIS =1 Z-AXIS
G353-54	EL (COAS ELEVATION ANGLE) FOR TWO STARS

G355-56	SXP (POSITION ON COAS RETICLE LINE) FOR TWO STARS
G373	SET TO 2 TO USE THE LM AOT (ALIGNMENT OPTICAL TELESCOPE) OPTICAL SYSTEM
G371-72	AOT LINE I.D. FOR TWO STARS =1 +Y-AXIS =2 +X-AXIS =3 -Y-AXIS =4 -X-AXIS
G352	AOT DETENT POSITIONS (0 TO 5)
G353-54	A1 (ANGLE TO PLACE STAR ON LINE I.D.) FOR TWO STARS
G355-56	A2 (ANGLE TO PLACE STAR ON SPIRAL) FOR TWO STARS

THE FOLLOWING INPUTS CAN BE USED IF AGOP IS TO BE EXECUTED ALONE. (NO EPHEMERIS TAPE)

G1	CURRENT GREENWICH LONGITUDE
*G3	SET TO 1 FOR EARTH REFERENCED INPUTS SET TO 2 FOR LUNAR REFERENCED INPUTS
G5	SET TO 1 IF ALL INPUT WILL BE FROM CARDS. SET TO 0 IF EPHEMERIS TAPE WILL BE USED FOR ANY INPUTS. (FOR INSTANCE THE VECTOR AND TIME MAY BE TAKEN FROM THE TAPE. IN ALL CASES, CARD INPUT OVER-RIDES EPHEMERIS TAPE INPUT.
*G7	YEAR
*G16	DAY OF YEAR OF LIFT-OFF
*G10-12	HR, MIN, SEC OF LIFT-OFF
G13	VECTOR TIME (G.E.T. HOURS)
G18-20	POSITION VECTOR (BESSELIAN ECI ER)
G21-23	POSITION VECTOR (BESSELIAN MCI ER)
G106-8	POSITION VECTOR (BESSELIAN ECI FT)
G109-11	POSITION VECTOR (BESSELIAN MCI FT)
G112	SET TO 0 IF POSITION VECTOR IS IN FT, 1 IF IN ER

G101-3	VECTOR TIME(G.E.T. HRS, MIN, SEC)
G113	SET TC 1 IF G.E.T. IS INPUT IN HRS, MIN, SEC

OPTION 1 - CISLUNAR NAVIGATION

G201	MODE TC BE USED 1 STAR/EARTH HORIZON 2 STAR/MOON HORIZON 3 STAR/EARTH LANDMARK 4 STAR/MOON LANDMARK
G206-8	G.E.T. START HR, MIN, SECS
G210-12	G.E.T. STOP HR, MIN, SECS
G214	DELTA T MIN
*G2000	NUMBER OF STARS
*G2001	STAR I.D.
G215	SET TC 1 FOR 'PSEUDO METHOD' (YAW GIMBAL INPUT)
G26	DESIRED YAW FOR G215=1

OPTION 2 - REFERENCE BODY COMPUTATION

G225	SET TO 1
G226-8	G.E.T. START HR, MIN, SECS
G229-31	G.E.T. STOP HR, MIN, SEC
*G2011	NUMBER OF LANDMARKS
*G2012	LANDMARK NUMBER
G236	DELTA T MIN
G237	OPTION FOR MODE 2 OF OPTION 2 0 EITHER 0 OR NO INPUT CALLS MODE 1 1 CENTER OF EARTH *THESE OPTIONS OUT- 2 CENTER OF MOON *PUT RIGHT ASCENSION, *DECLINATION, AND *UNIT VECTOR TO THE 3 CENTER OF SUN *SPECIFIED BODY FROM 4 LANDMARK (E OR M) *THE SPACECRAFT

OPTION 3 - STAR CATALOG

G240	SET TO 1

OPTION 4 - ANTENNA POINTING

G24-6	IMU GIMBAL ANGLES (O.G.A., I.G.A., M.G.A.) (INPUT IF OTHER THAN THOSE ON THE EPH. TAPE)
*G30	ACTIVE VEHICLE =0 CSM =1 LM =2 CSM AND LM
G250	ANTENNA POINTING OPTION =1 S-BAND HI-GAIN (MOVABLE) =2 S-BAND STEERABLE (MOVABLE) =3 RENDEZVOUS RADAR (MOVABLE) =4 S-BAND HI-GAIN (FIXED) (TO COMPUTE LM GIMBALS WHEN DOCKED INPUT CSM AS VEHICLE TWO, LM AS VEHICLE ONE, AND A NEGTIVE DOCKING ANGLE) =5 S-BAND STEERABLE (FIXED) (TO COMPUTE CSM GIMBALS WHEN DOCKED INPUT THE CSM REFSMMAT INTO G-ARRAY G31-9 AND G1031-9) =6 RENDEZVOUS RADAR (FIXED) (TO COMPUTE CSM GIMBALS WHEN DOCKED INPUT THE CSM REFSMMAT INTO G-ARRAY G31-9 AND G1031-9)
G252-4	G.E.T. START HR, MIN, SECS
G263-5	G.E.T. STOP HR, MIN, SECS
G267	DELTA T MIN
G255	DESIRED ELEVATION ANGLE
*G2011	NUMBER OF LANDMARKS
*G2012	LANDMARK NUMBER
G268-9	ANTENNA PITCH AND YAW ANGLES (REQUIRED FOR G250=4,5, OR 6)
G270	AXIS DIRECTION (LM MUST BE VEH. 2) =0 HEADS UP =1 HEADS DOWN

OPTION 5 - PASSIVE THERMAL CONTROL (PTC) ATTITUDE

G275	SET TO 1
G279-81	G.E.T. START HR, MIN, SECS
G283-5	G.E.T. STOP HR, MIN, SECS
G286	DELTA T MIN

OPTION 6 - TERMINATOR-HORIZON ANGLES

G300	SET TO 1 FOR OPTION 6
G301-303	G.E.T. OF START HR, MIN, SECS
G304-306	G.E.T. OF STOP HR, MIN, SECS
G307	DELTA TIME BETWEEN COMPUTATIONS (MINS)
G310	SET TO 1 TO HAVE OPTION 6 EXECUTED FOR FIRST AND LAST POINTS ONLY OF THE EPHEMERIS TAPE

OPTION 7 - OST

MODE 1 LM HORIZON CHECK

G1330	SET TO 1 TO CALL MODE 1 (VEHICLE TWO)
*G30	LM VEHICLE ACTIVE (SET TO 1)
G1331-33	G.E.T. START HR, MIN, SEC
G1334-36	G.E.T. STOP HR, MIN, SEC
G1337	DELTA T MIN
G1128	SET TO 2 TO READ VEHICLE TWO DATA FROM THE SECOND HALF OF EPH. TAPE

MODE 2 ALIGNMENT AND MANEUVER CHECK

G330	SET TO 2 TO CALL MODE 2
*G30	ACTIVE VEHICLE =0 CSM =1 LM =2 CSM AND LM

G373	SET TO DESIRED OPTICAL SYSTEM =0 ONLY INPUT REQUIRED =1 INPUT G352 =2 INPUT G371-72 AND G352
G359	OPTION FLAG =0 STAR SEARCH =1 STARS WILL BE INPUT
G360	STAR NUMBER TO BEGIN SEARCH (WILL BEGIN WITH 1 IF NOT SET)
*G2000	NUMBER OF STARS (REQUIRED IF G359=1)
*G2001-10	STAR I.D.'S (REQUIRED IF G359=1)
G331-33	G.E.T. START HR, MIN, SEC (REQUIRED INPUT)
G334-36	G.E.T. STOP HR, MIN, SEC (REQUIRED INPUT)
G337	DELTA T MIN

MODE 3 COMPUTE REFSMMAT

G330	SET TO 3 TO CALL MODE 3
*G30	ACTIVE VEHICLE =0 CSM =1 LM =2 CSM AND LM
G373	SET TO DESIRED OPTICAL SYSTEM (INPUT RELATED OPTICS ANGLES)
G344	SET TO 1 TO INPUT TWO SETS OF ATTITUDES
*G2000	NUMBER OF STARS
*G2001-2	TWO STAR I.D.'S
G331-33	G.E.T. START HR, MIN, SEC
G334-36	G.E.T. STOP HR, MIN, SEC
G337	DELTA T MIN

MODE 4 DOCKING ALIGNMENT

G330	SET TO 4 TO CALL MODE 4
*G30	CSM AND LM ACTIVE (SET TO 2)

*G1129	DOCKED CONFIGURATION (SET TO 1)
*G1130	DOCKING ANGLE
G385	OPTION FLAG =0 COMPUTE GIMBAL AND FDAI ANGLES =1 COMPUTE REFSMMAT (INPUT REQUIRED G-ARRAYS)
G331-33	G.E.T. START HR, MIN, SEC
G334-36	G.E.T. STOP HR, MIN, SEC
G337	DELTA T MIN

MODE 5 POINT AOT WITH CSM

G330	SET TO 5 TO CALL MODE 5
*G30	CSM AND LM ACTIVE (SET TO 2) =0 CSM =1 LM =2 CSM AND LM
*G1129	DOCKED CONFIGURATION (SET TO 1)
*G1130	DOCKING ANGLE
G373	SET TO 2 TO CALL AOT OPTICS (INPUT RELATED OPTICS ANGLES)
*G2000	SET TO 1 TO INPUT 1 STAR
*G2001	STAR I.D.
G331-33	G.E.T. START HR, MIN, SEC
G334-36	G.E.T. STOP HR, MIN, SEC
G337	DELTA T MIN

OPTION 8 - SST

MODE 1 LANDMARK FIXED OPTICS

G400	SET TO 1 TO CALL MODE 1
*G30	ACTIVE VEHICLE =0 CSM =1 LM =2 CSM AND LM

*G2011	NUMBER OF LANDMARKS
*G2012	LANDMARK NUMBER
G255	ELEVATION ANGLE
G373	SET TO DESIRED OPTICAL SYSTEM (INPUT RELATED OPTICS ANGLES)
G401-03	G.E.T. START HR, MIN, SEC
G404-06	G.E.T. STOP HR, MIN, SEC
G407	DELTA T MIN

MODE 2 STAR FIXED OPTICS

G400	SET TO 2 TO CALL MODE 2
*G30	ACTIVE VEHICLE =0 CSM =1 LM =2 CSM AND LM
G373	SET TO DESIRED OPTICAL SYSTEM (INPUT RELATED OPTICS ANGLES)
*G2000	NUMBER OF STARS
*G2001	STAR I.D.
G401-03	G.E.T. START HR, MIN, SEC
G404-06	G.E.T. STOP HR, MIN, SEC
G407	DELTA T MIN

MODE 3 LANDMARK MOVABLE OPTICS

G400	SET TO 3 TO CALL MODE 3
*G30	ACTIVE VEHICLE =0 CSM =1 LM =2 CSM AND LM
*G2011	NUMBER OF LANDMARKS
*G2012	LANDMARK NUMBER
G255	ELEVATION ANGLE

G373	SET TO DESIRED OPTICAL SYSTEM =0 ONLY INPUT REQUIRED =1 INPUT G352 =2 INPUT G371-72 AND G352
G401-03	G.E.T. START HR, MIN, SEC
G404-06	G.E.T. STOP HR, MIN, SEC
G407	DELTA T MIN

MODE 4 STAR MOVABLE OPTICS

G400	SET TO 4 TO CALL MODE 4
*G30	ACTIVE VEHICLE =0 CSM =1 LM =2 CSM AND LM
*G2000	NUMBER OF STARS
*G2001	STAR I.D.
G373	SET TO DESIRED OPTICAL SYSTEM =0 ONLY INPUT REQUIRED =1 INPUT G352 =2 INPUT G371-72 AND G352
G401-03	G.E.T. START HR, MIN, SEC
G404-06	G.E.T. STOP HR, MIN, SEC
G407	DELTA T MIN

MODE 5 STAR SPECIAL

G400	SET TO 5 TO CALL MODE 5
*G30	ACTIVE VEHICLE =0 CSM =1 LM =2 CSM AND LM
G373	SET TO DESIRED OPTICAL SYSTEM (INPUT RELATED OPTICS ANGLES)
G401-03	G.E.T. START HR, MIN, SEC
G404-06	G.E.T. STOP HR, MIN, SEC
G407	DELTA T MIN

*THESE G-ARRAYS ARE USED FOR EITHER VEHICLE ONE OR VEHICLE TWO. THE REMAINNING G-ARRAYS LISTED ABOVE ARE FOR VEHICLE ONE, BUT CAN BE CHANGED TO VEHICLE TWO BY ADDING 1000 TO THE G-ARRAY.

**TO SPCIFY A SINGLE TIME POINT, THE START AND STOP TIME SHOULD BE EQUAL.

13. OPERATING INSTRUCTION FOR THE MASS PROPERTIES, REACTION CONTROL SYSTEM, SERVICE PROPULSION SYSTEM (MRS) PROGRAM

13.1 GENERAL

THIS SECTION PRESENTS A BRIEF DESCRIPTION OF THE MRS PROGRAM, THE TAPE SETUP AND CONTROL CARDS REQUIRED TO OPERATE THE PROGRAM ON THE IBM 7094 AND UNIVAC 1108 DATA SYSTEMS.

13.2 PROGRAM DESCRIPTION

THE MRS PROGRAM WILL BE USED TO GENERATE A COMPLETE REACTION CONTROL SYSTEM PROPELLANT BUDGET USING PREVIOUSLY SUPPLIED DATA FOR INDIVIDUAL MANEUVER PROPELLANT CONSUMPTION AND INTERNALLY COMPUTED MASS PROPERTIES CHARACTERISTICS.

13.3 TAPE SETUP FOR THE IBM 7094 DATA PROCESSING SYSTEM

TAPE UNIT	TAPE DESCRIPTION
A5	NEW BLOCKED EVENT DEFINITIONS
B5	TIMELINE EVENTS
B6	BLOCKED EVENT DEFINITIONS

13.4 TAPE SETUP FOR THE UNIVAC 1108 PROCESSING SYSTEM

TAPE UNIT	TAPE DESCRIPTION
F	NEW BLOCKED EVENT DEFINITIONS
G	TIMELINE EVENTS
I	BLOCKED EVENT DEFINITIONS
X	MRS PROGRAM TAPE

13.5 CONTROL CARD LISTING FOR THE UNIVAC 1108 DATA PROCESSING SYSTEM

```
COLUMN 1  4    8
          MSG                          COMMENTS
          ASG F= XXXX                  NEW BLOCKED EVENT
                                       DEFINITIONS TAPE
          ASG G= XXXX                  TIMELINE EVENTS TAPE
          ASG I= XXXX                  BLOCKED EVENT DEFINITIONS
                                       TAPE
          ASG X= XXXX                  MRS PROGRAM (PCF) TAPE
          XQT CUR                      EXECUTE THE FOLLOWING
                                       INSTRUCTIONS
              TRW F,G,I,X              REWIND UNITS F,G,I, AND X
              IN X                     INPUT THE ENTIRE USER PCF
                                       FROM UNIT X
```

```
N XQT MRSDRV          EXECUTE THE MRS PROGRAM
      •
      •               MRS DATA CARDS
      •
  EOF                 END OF DATA
```

13.6 INPUTS TO THE MRS PROGRAM

THE INPUTS TO THE MRS PROGRAM ARE PRESENTED IN THE CSM MRS PROGRAM DESCRIPTION (REFERENCE 6).

14. OPERATING INSTRUCTIONS FOR THE LUNAR MODULE (LM) REACTION CONTROL SYSTEM (RCS) CONSUMABLES PROGRAM

14.1 GENERAL

THIS SECTION PRESENTS A BRIEF DESCRIPTICN OF THE LM RCS PROGRAM, THE TAPE SETUP AND CONTROL CARDS REQUIRED TO OPERATE THE PROGRAM ON THE IBM 7094 AND UNIVAC 1108 DATA SYSTEMS.

14.2 PROGRAM DESCRIPTION

THE LM RCS PROGRAM GENERATES LM RCS PROPELLANT CONSUMPTION BUDGETS IN RESPONSE TO AN INPUT MISSION TIMELINE EVENT DESCRIPTION. IT IS BASICALLY A BUDGET PROGRAM AND NOT A ACTUAL SIMULATION OF VEHICLE PERFORMANCE. THE RCS PROPELLANT CONSUMPTION CATA AND MASS PROPERTIES DATA USED TO COMPUTE THE PROFILE ARE STORED IN THE PROGRAM PRE-FLIGHT, BUT CAN BE UPDATED IN REAL-TIME.

14.3 TAPE SETUP FOR THE IBM 7094 DATA PROCESSING SYSTEM

TAPE UNIT	TAPE DESCRIPTION
A2	LM RCS PROGRAM (PCF) TAPE
A5	NEW BLOCKED EVENT DEFINITION
A6	NAMELIST LMDATA TAPE
A7	OUTPUT TAPE
B5	TIMELINE EVENTS
B6	BLOCKED EVENT DEFINITIONS

14.4 TAPE SETUP FOR THE UNIVAC 1108 PROCESSING SYSTEM

TAPE UNIT	TAPE DESCRIPTION
F	NEW BLOCKED EVENT DEFINITICN
G	TIMELINE EVENTS
H	NAMELIST LMDATA TAPE
I	BLOCKED EVENT DEFINITIONS
J	OUTPUT TAPE
X	LM RCS PROGRAM (PCF) TAPE

14.5 CONTROL CARD LISTING FOR THE UNIVAC 1108 DATA PROCESSING SYSTEM

COLUMN 1 4 8	
MSG	CCMMENTS
ASG F= XXXX	NEW BLOCKED EVENT DEFINITIONS TAPE
ASG G= XXXX	TIMELINE EVENTS TAPE
ASG I= XXXX	BLOCKED EVENT DEFINITIONS TAPE

```
ASG X= XXXX                    LM RCS PROGRAM (PCF) TAPE
ASG H,J                        SCRATCH TAPES
XQT CUR                        EXECUTE THE FOLLOWING
                               INSTRUCTIONS
    TRW F,G,I,H,J,X            REWIND UNITS F,G,I,H,J,
                               AND X
    IN X                       INPUT THE ENTIRE USER PCF
                               FROM UNIT X
N XQT LEMDRV                   EXECUTE THE LM RCS
                               PROGRAM
      .
      .                        LM RCS DATA CARDS
      .
EOF                            END OF DATA
```

14.6 INPUTS TO THE LM RCS PROGRAM

THE INPUTS TO THIS PROGRAM ARE CONTAINED IN THE LM RCS CONSUMABLES PROGRAM USER'S MANUAL (REFERENCE 7).

15. OPERATING INSTRUCTION FOR THE DESCENT PROPULSION SYSTEM SUPERCRITICAL HELIUM SYSTEM (SHE) PROGRAM

15.1 GENERAL

THIS SECTION PRESENTS A BRIEF DESCRIPTICN OF THE SHE PROGRAM, THE TAPE SETUP AND CONTROL CARDS REQUIRED TO OPERATE THE PROGRAM ON THE UNIVAC 1108 DATA PROCESSING SYSTEMS.

15.2 PROGRAM DESCRIPTION

THIS PROGRAM MODELS THE DPS SUPERCRITICAL HELIUM PROPELLANT TANK PRESSURIZATION SYSTEM, AND OUTPUTS THE MAXIUM PRESSURE THAT WILL RESULT DURING THE MISSION.

15.3 TAPE SETUP FOR THE UNIVAC 1108 PROCESSING SYSTEM

TAPE UNIT	TAPE DESCRIPTION
A	SHE PROGRAM TAPE

15.4 CONTROL CARD LISTING FOR THE UNIVAC 1108 DATA PROCESSING SYSTEM

```
COLUMN 1  4    8
          MSG                      COMMENTS
          ASG  A= XXXX             SHE PROGRAM (PCF) TAPE
          XQT  CUR                 EXECUTE THE FOLLOWING
                                   INSTRUCTIONS
               TRW A               REWIND UNIT A
               IN A                INPUT THE ENTIRE USER PCF
                                   FROM UNIT A
        N XQT  MAIN                EXECUTE THE SHE PROGRAM
               .
               .                   SHE DATA CARDS
               .
          EOF                      END OF DATA
```

15.5 INPUTS TO THE SHE PROGRAM

THE INPUTS TO THIS PROGRAM ARE PRESENTED IN THE DESCENT PROPULSION SYSTEM SUPERCRITICAL HELIUM SYSTEM PROGRAM USER'S GUIDE (REFERENCE 8), BUT ARE IN THE PROCESS OF BEING CHANGED. THEREFORE, THE INPUTS REQUIRED WILL BE PUBLISHED AT A LATER TIME.

16. OPERATING INSTRUCTION FOR THE SPACECRAFT ELECTRICAL ENERGY NETWORK ANALYSIS (SEENA) PROGRAM

16.1 GENERAL

THE SEENA PROGRAM IS A ELECTRICAL POWER SYSTEM PROGRAM THAT CAN BE CONFIGURED TO COMPUTE THE ELECTRICAL POWER PROFILE FOR ANY SPACECRAFT. THE PROGRAM IS DESIGNED TO CALL VARIOUS BLOCKS OF POWER CONSUMING COMPONENTS AND COMPUTE THE ENERGY CONSUMED.

A USER'S MANUAL IS BEING PREPARED AT THIS TIME.

REFERENCES

1. OPERATIONAL SUPPORT PLAN FOR REAL-TIME AUXILIARY COMPUTING FACILITY APOLLO 9 FLIGHT ANNEX MSC INTERNAL NOTE NO. 68-FM- , NUMBER AND DATE TO BE ASSIGNED.

2. TASK AGREEMENT FOR OPERATIONAL SUPPORT FOR THE REAL-TIME AUXILIARY COMPUTING FACILITY, TASK MSC/TRW A-130, AMENDMENT NO.8, SEPTEMBER 20,1968.

3. APOLLO BLOCK DATA USER'S MANUAL (REVISION 1), TRW NOTE 68-FM-683, SEPTEMBER 20,1968.

4. ADDITIONS AND CHANGES TO ABDP, TRW/ICC NO. 3423.7-27, DECEMBER 3,1968.

5. APOLLO REFERENCE MISSION PROGRAM USER'S MANUAL - VERSION ARM06, TRW REPORT 05952-H578-R0-00, AUGUST 26,1968.

6. CSM MRS PROGRAM DESCRIPTION, TRW NOTE NO. 68-FMT-621, FEBRUARY 28,1968.

7. LM RCS CONSUMABLES PROGRAM USER'S MANUAL, TRW NOTE NO. 68-FMT-716, NOVEMBER 30,1968.

8. DESCENT PROPULSION SYSTEM SUPERCRITICAL HELIUM SYSTEM PROGRAM USER'S GUIDE, TRW NOTE 68-FMT-664, JUNE 28,1968.