

LM TRANSFER PHASE INITIATION (TPI)
TARGETING PROGRAM (P74)

LOGIC REV 05 11/27/68

PURPOSE:

(1) TO CALCULATE THE REQUIRED DELTA V AND OTHER INITIAL CONDITIONS REQUIRED BY THE LGC FOR LM EXECUTION OF THE TRANSFER PHASE INITIATION MANEUVER, GIVEN:

(A) TIME OF IGNITION TIG (TPI) OR THE ELEVATION ANGLE (E) OF THE LM/CSM LOS AT TIG(TPI)

(B) CENTRAL ANGLE OF TRANSFER (CENTANG) FROM TIG(TPI) TO INTERCEPT TIME (TIG(TPF)).

(2) TO CALCULATE TIG (TPI) GIVEN E OR E GIVEN TIG (TPI).

(3) TO DISPLAY TO THE ASTRONAUT AND THE GROUND CERTAIN DEPENDENT VARIABLES ASSOCIATED WITH THE MANEUVER FOR APPROVAL BY THE ASTRONAUT/GROUND.

ASSUMPTIONS:

(1) THE PROGRAM MUST BE DONE OVER A TRACKING STATION FOR REAL TIME GROUND PARTICIPATION IN CMC DATA INPUT AND OUTPUT. CMC COMPUTED VARIABLES MAY BE STORED FOR LATER VERIFICATION BY THE GROUND. THESE STORAGE CAPABILITIES ARE LIMITED ONLY TO THE PARAMETERS FOR ONE THRUSTING MANEUVER AT A TIME.

(2) IF P20 IS IN OPERATION WHILE THIS PROGRAM IS OPERATING THE ASTRONAUT MAY HOLD AT ANY FLASHING DISPLAY AND TURN ON THE RENDEZVOUS SIGHTING MARK ROUTINE (EITHER R21 OR R23) AND TAKE OPTICS MARKS AND/OR HE MAY ALLOW VHF RANGING MARKS TO ACCUMULATE. SEE P20 FOR DETAILED DESCRIPTION.

(3) ONCE THE PARAMETERS REQUIRED FOR COMPUTATION OF THE MANEUVER HAVE BEEN COMPLETELY SPECIFIED, THE VALUE OF THE ACTIVE VEHICLE CENTRAL ANGLE OF TRANSFER IS COMPUTED AND STORED. THIS NUMBER WILL BE AVAILABLE FOR DISPLAY TO THE ASTRONAUT THROUGH THE USE OF V06N52.

THE ASTRONAUT WOULD CALL THIS DISPLAY TO VERIFY THAT THE CENTRAL ANGLE OF TRANSFER OF THE ACTIVE VEHICLE IS NOT WITHIN 170 TO 190 DEGREES. IF THE ANGLE IS WITHIN THIS ZONE THE ASTRONAUT SHOULD REASSESS THE INPUT TARGETTING PARAMETERS BASED UPON DELTA V AND EXPECTED MANEUVER TIME.

(4) THE OPERATION OF THE PROGRAM UTILIZES THE FOLLOWING FLAGS:

ACTIVE VEHICLE FLAG - DESIGNATES THE VEHICLE WHICH IS DOING RENDEZVOUS THRUSTING MANEUVERS TO THE PROGRAM WHICH CALCULATES THE MANEUVER PARAMETERS. SET AT THE START OF EACH RENDEZVOUS PRE-THRUSTING PROGRAM.

FINAL FLAG - SELECTS FINAL PROGRAM DISPLAYS AFTER CREW HAS SELECTED THE FINAL MANEUVER COMPUTATION CYCLE.

(5) THERE IS NO REQUIREMENT FOR ISS OPERATION DURING THIS PROGRAM UNLESS AUTOMATIC STATE VECTOR UPDATING IS DESIRED BY THE RENDEZVOUS NAVIGATION PROGRAM (P20).

(6) THIS PROGRAM IS SELECTED BY THE ASTRONAUT BY DSKY ENTRY.

| PROG CNT | CMC | GROUND | CREW | CHECKLIST | TIME | TOTAL TIME |
|-------------------------|--|--------|--|-----------|------|---------------|
| | | | .CREW PROG. .SELECTION | | | |
| | ----- | . | ----- | | | |
| | START LM TRANSFER PHASE INITIATION TARGETING PROGRAM (P74). | ..... | KEY IN LM TRANSFER PHASE INITIATION TARGETING PROGRAM (P74) V37E 74E | | | #10 |
| ++ +05 | ----- | . | ----- | | | |
| + | . | . | . | | | |
| + | . | . | . | | | |
| + | . | . | . | | | |
| + | . | . | . | | | |
| + | ----- | . | ----- | | | |
| +05 | DISPLAY PROGRAM 74 | ..... | MONITOR DSKY: OBSERVE DISPLAY OF PROGRAM 74 | | | #20 |
| ++ EDIT | ----- | . | ----- | | | |
| | . | . | . | | | |
| | ----- | . | ----- | | | |
| | SET ACTIVE VEHICLE FLAG TO LM | . | . | | | |
| | ----- | . | ----- | | | |
| | . | . | . | | | |
| | "AN" | . | . | | | #30 |
| | . | . | . | | | |
| | . | . | . | | | |
| | . | . | . | | | |
| | . | . | . | | | |
| ++ +05 ++ EDIT | . | . | . | | | |
|  | .... | . | . |  |  | #40 |
| | . | . | . | | | |
| | ----- | . | ----- | | | |
| | RESFT COMP E FLAG | . | . | | | |
| | ----- | . | ----- | | | |
| | . | . | . | | | |
| | ----- | . | ----- | | | |
| | SFT TRACK FLAG (SEE P20) | . | . | | | #50 |
| | ----- | . | ----- | | | |
| | . | . | . | | | |
| | . | . | . | | | |
| | . | . | . | | | |
| | . | . | . | | | |
| | . | . | . | | | |

P74/COLOSSUS
P74/LUMINARY

SET UPDATE FLAG
(SEE P20)

"A"

HOLD . FLASH VERB-NOUN TO
..... REQUEST RESPONSE AND
SNAP . DISPLAY TIG(TPI):
V06N37
R1-TIG (TPI)-HRS
R2-TIG (TPI)-MIN
R3-TIG (TPI)-SEC

MONITOR DSKY:
OBSERVE VERB-NOUN
FLASH TO REQUEST
RESPONSE AND DISPLAY
OF TIG (TPI).

TIG(TPI)-TIME OF TPI
IGNITION (GET).
IN HRS, MIN, SEC
TO NEAREST .01 SEC.

AM I SATISFIED WITH
THIS VALUE?
(NOTE: THIS PROGRAM
ALWAYS REQUIRES AN
INITIAL VALUE OF
TIG(TPI) WHICH IS
WITHIN 30 MINUTES
OF THE ACTUAL VALUE
EVEN IF TIG (TPI) IS
TO BE CALCULATED
FROM A SPECIFIED E.)

.Y N.

RECORD THIS
VALUE FOR FUTURE
TRANSMISSION TO
THE LM.

#60

#70

#80

#90

#100

WAIT FOR KEYBOARD
ENTRY

KEY IN PROCEED

#110

TERMINATE FLASH UPON
RECEIPT OF PROCEED
OR NEW DATA

KEY IN V25E AND
LOAD THE DESIRED
TIG

#120

P . NEW
R . DATA
C

C . STORE DATA
E .
F .
D .

#130

HOLD . FLASH VERB-NOUN TO
..... REQUEST RESPONSE
SNAP . AND DISPLAY E AND
CENTANG:

MONITOR DSKY:
OBSERVE VERB-NOUN
FLASH TO REQUEST
RESPONSE AND DISPLAY
OF E AND CENTANG:

#140

V06 N55
R1-BLANK
R2-E
R3-CENTANG

E-ELEVATION ANGLE.
BETWEEN THE LM/
CSM LOS AND THE
LM LOCAL HORIZON-
TAL AT TIG (TPI)
REFERENCED TO THE
DIRECTION OF
FLIGHT (SEE SEC-
TION 5.4.4.2 OF
R577 FOR DETAILED
DESCRIPTION). FROM
J TO 360 IN DEG-
REES TO NEAREST
.01 DEGREE.

DO I WISH THE CMC TO
CALCULATE F?

.Y .N

#150

CENTANG-THE ORBIT-

IS R2=00000?

#160

++
+05
+
+
+
+
+
+
+
+
+
+
+ 482

AL CENTRAL ANGLE
OF THE PASSIVE
VEHICLE DURING
TRANSFER FROM
TIG(TPI) TO TIME
OF INTERCEPT. IN
DEGREES TO NEAREST
.01 DEGREE.

Y. .N

#170

.
.
.

WAIT FOR KEYBOARD
ENTRY

KEY IN V22E
AND LOAD
+00000E IN
R2.

#180

++

05

++

EDIT

AM I SATISFIED WITH
THE PRESENT VALUF
OF E?

.Y .N

#190

KEY IN V22E
AND LOAD THE
DESIRED E IN
R2.

#200

#210

+05
++
PCR
206

RECORD THIS VALUE
FOR FUTURE TRANS-
MISSION TO THE LM.

#220

AM I SATISFIED WITH
THE PRESENT VALUE OF
CENTANG?

.Y .N

KEY IN V23E AND
LOAD THE DESIRED
CENTANG IN R3.

#230

RECORD THIS VALUE
FOR FUTURE TRANS-
MISSION TO THE LM.

#240

TERMINATE FLASH UPON
RECEIPT OF PROCEED
OR NEW DATA

KEY IN PROCEED

#250

.P . NEW
.R . DATA
.Q
.C
.E STORE DATA
.E
.D

#260

IS F SPECIFIED TO
BE +00000?

.N . Y.

SET COMP E FLAG

"B"

"B"

++
+05
++
EDIT

RESET UPDATE
FLAG.

DID I SPECIFY E
TO BE +00000?

IS COMP E FLAG
SET?

.Y . N.

.N . Y.

COMPUTE E FOR
SPECIFIED
TIG(TPI)

MONITOR DSKY:
OBSERVE
VERB-NOUN
FLASH TO RE-
QUEST RESPON-
SE AND DIS-
PLAY OF CAL-
CULATED E.

POSS
HOLD .
.....
SNAP .

FLASH VERB-
NOUN TO RE-
QUEST RESPONSE
AND DISPLAY
CALCULATED E:
V06 M55
R1-BLANK
R2-F
R3-CENTANG

#270

#280

#290

#300

#310

(NOTE: FOR DE-
FINITION SEE
ABOVE).

RECORD THIS
VALUE FOR
FUTURE TRANS-
MISSION TO
THE LM.

#320

WAIT FOR KEY-
BOARD ENTRY

KEY IN PRO-
CEED.

#330

TERMINATE
FLASH UPON
RECEIPT OF
PROCEED

#340

.P
.R
.O
.C
.E
.E
.D

RESET FINAL
FLAG

#350

++
+05
++
EDIT

COMPUTE TIG
(TPI) FOR THE
SPECIFIED F.
ESTABLISH
ALARM IF NO
SOLUTION CAN
BE REACHED

#360

.N .A
.O .L
. .A
.A .R
.L .M
.A .

#370

POSS
HOLD .
.....

.P
.M FLASH VERB-

MONITOR DSKY:

| | | | | |
|----------------|--|-------|---|------|
| SNAP . | NCUN TO REQUEST RE- SPONSE AND DISPLAY ALARM CODE: V05N09 R1- R2- R3- EXPECTED ALARM CODE AT THIS TIME IS 00611 | ..... | DOES ALARM CODE DISPLAY INDICATE THAT NO SOLUTION CAN BE REACHED? ----- .Y . N. ----- | #380 |
| | WAIT FOR KEYBOARD ENTRY | ..... | RETURN TO START OF PROGRAM AND ADJUST INPUT PARA- METERS. KEY IN PROCEED. | #390 |
| | TERMINATE FLASH UPON RECEIPT OF PROCEED | ..... | ----- . . . . . . . . ----- GO TO "A" ABOVE | #400 |
| POSS HOLD . | FLASH VERR- NOUN TO RE- QUEST RESPONSE AND DISPLAY CALCULATED TIG(TPI): V06N37 R1-TIG(TPI) -HRS R2-TIG(TPI) -MINS R3-TIG(TPI) -SECS. | ..... | MONITOR DSKY: OBSERVE FLASH TO RE- QUEST RE- SPONSE AND DISPLAY OF CALCULATED TIG(TPI). ----- ----- RECCRD THIS VALUF FOR FUTURE TRANS- | #410 |
| SNAP . | (NCTE: FOR DE- FINITION SEE ABOVE). | | | #420 |

MISSION TO
THE LM.

#430

WAIT FOR KEY-
BOARD ENTRY

KEY IN
PROCEED

TERMINATE
FLASH UPON
RECEIPT OF
PROCEED.

#440

P
R
C
C
E
E
D

#450

BASED ON STORED
TARGET PARAMETERS
COMPUTE THE PARA-
METERS ASSOCIATED
WITH TPI AND
TPE AS DESCRIBED
IN SECTION
5.4.4.2 OF R577.

#460

++
+05
+
+
+05
++
PCN
582

#470

POSS
HOLD .
.....
SNAP .

FLASH VERB-NOUN
TO REQUEST RE-
SPONSE AND DIS-
PLAY CALCULATED
PER ALT, DELTA
V(TPI), AND DELTA
V(TPF):
V06N58
R1-PER ALT
R2-DELTA V(TPI)
R3-DELTA V(TPF)

PER ALT-ALTITUDE
OF PERIGEE ABOVE
THE LAUNCH PAD
RADIUS (EARTH
ORBIT) OR ALTI-
TUDE OF PERILUNE
ABOVE THE LUNAR
RADIUS AT THE
MOST RECENTLY DE-
FINED LANDING
SITE (LUNAR
ORBIT). IN NAUTI-
CAL MILES TO
NEAREST .1 NM.

DELTA V(TPI)-RE-
QUIRED IMPULSIVE
DELTA V TO ACCOM-
PLISH TPI MANEU-
VER AT TIG(TPI).
IN FPS TO NEAREST
.1 FPS.

DELTA V(TPF)-RE-
QUIRED IMPULSIVE
DELTA V TO ACCOM-
PLISH TPF MANEU-
VER AT TIME OF
INTERCEPT. IN FPS
TO NEAREST .1 FPS.

WAIT FOR KEYBOARD
ENTRY

MONITOR DSKY:
OBSERVE VERB-
NOUN FLASH TO
REQUEST RESPONSE
AND DISPLAY OF
CALCULATED PER
ALT, DELTA
V(TPI), AND
DELTA V(TPF).

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RECORD THESE
VALUES FOR
FUTURE TRANS-
MISSION TO THE
LM.

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KEY IN PROCEED

#480

#490

#500

#510

#520

TERMINATE FLASH
UPON RECEIPT OF
PROCEED

#530

IS THE FINAL FLAG
SET?

IS THIS THE
FINAL PASS
THROUGH THIS
PROGRAM?

#540

.N .Y.

.Y .N.

PCN
582
++
+
+05
+
++

SFT UP-
DATE
FLAG
{SEE
P20}

#550

++
+05
+
+05
++
EDIT

RESET
NEW
TARGET
FLAG

#560

POSS
HOLD .
.....
SNAP .

FLASH VERB-
NOUN TO RE-
QUEST RESPONSE
AND DISPLAY
CALCULATED
COMPONENTS OF
DELTA V(LV)
FOR TPI:
V06N81
R1-DELTA
VX(LV)
R2-DELTA
VY(LV)
R3-DELTA
VZ(LV)
DELTA VX(LV)-
COMPONENT OF
IMPULSIVE
DELTA V AT

MONITOR DSKY:
OBSERVE
VERB-NOUN
FLASH TO RE-
QUEST RES-
PONSE AND
DISPLAY OF
DELTA V(LV)
FOR TPI

#570

AM I SATIS-
FIED WITH
THESE VALUES?
(NOTE: CREW
HAS THE OP-
TION AT THIS

#580

TIG(TPI) ALONG
(RXV)XP. IN
FPS TO NEAREST
.1 FPS.

DELTA VY(LV)-
COMPONENT OF
IMPULSIVE
DELTA V AT
TIG(TPI) ALONG
VXR. IN FPS TO
NEAREST .1 FPS

DELTA VZ(LV)-
COMPONENT OF
IMPULSIVE
DELTA V AT
TIG(TPI) ALONG
-R. IN FPS TO
NEAREST .1 FPS

WHERE R IS THE
LM GEOCENTRIC
(EARTH ORBIT)
OR SELENOGEN-
TRIC (LUNAR
ORBIT) RADIUS
VECTOR AND V
IS THE LM IN-
ERTIAL VELO-
CITY VECTOR AT
TIG(TPI).

WAIT FOR KEY-
BOARD ENTRY

TIME TO RE-
DEFINE THE
DELTA V(LV)
COMPONENTS
FOR THE SUB-
SEQUENT THRU-
STING MANEU-
VER. THIS
CAPABILITY
WILL NORMALLY
BE EXERCISED
TO CORRECT
OUT OF PLANE-
NESS BY FIRST
SELECTING THE
RENDEZVOUS
OUT OF PLANE
DISPLAY ROU-
TINE (R36)
(V90E), AND
THEN MODIFY-
ING DELTA
VY(LV).
HOWEVER IT
MUST BE RE-
MEMBERED THAT
THE R36 CALC-
ULATION IS
BASED UPON AN
ACTIVE CSM.

.Y N.

KEY IN V25E.
AND LOAD
THE DESIRED
DELTA V
VALUES.

#590

#600

#610

#620

#630

RECORD THESE
VALUES FOR
FUTURE TRANS-
MISSION TO THE
LM.

#640

TERMINATE
FLASH UPON RE-
CEIPT OF PRO-
CEED OR NEW
DATA

KEY IN
PROCEED.

#650

.P .NEW
.R .DATA
.N .

.C
.E STORE DATA

.E
.D

SET NEW
TARGET
FLAG.

#660

IS THE NEW
TARGET FLAG
SET?

.N .Y
. .
. .

CALCULATE
NEW TARGET
VECTOR
BASED ON
NEWLY
LOADED
DELTA
V(LV) FOR
TPI.

#680

#690

++
+05
++
EDIT

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. . .
. . .
. . .
. . .
. . .
. . .
. . .

. . .
. . .

. . .
. . .
. . .
. . .

POSS
HOLD .
.....
SNAP .

. FLASH VERB-NOUN
. TO REQUEST RE-
. SPONSE AND DIS-
. PLAY DELTA V(LCS)
. FOR TPI:
. V06N59
. R1-DELTA V1(LCS)
. R2-DELTA V2(LCS)
. R3-DELTA V3(LCS)

. MONITOR DSKY:
. OBSERVE VERB-
. NOUN FLASH TO
. REQUEST RESPONSE
. AND DISPLAY OF
. DELTA V(LCS).

#700

++
+05
+
+05
++
EDIT

. DELTA V(LCS) -
. LINE OF SIGHT
. COMPONENT IN FEET
. PER SECOND TO
. NEAREST .1 FPS
. (NOTE: FOR DEFINI-
. TION SEE SEC-
. TION 5.4.4.2 OF
. R577.)

. RECORD THESE VALUES
. FOR FUTURE TRANS-
. MISSION TO THE LM.

#710

. . .
. . .
. . .

. WAIT FOR KEYBOARD
. ENTRY
. TERMINATE FLASH
. UPON RECEIPT OF
. PROCEED.

. KEY IN PROCEED

#720

. . .
. . .
. . .

IS THE FINAL FLAG
SET?

. N . Y.
. . .
. . .
. . .
. . .
. . .
. . .

#730

#740

SET MGA DISPLAY
IN R3(BELOW)
= -00001.

SET MGA DIS-
PLAY IN R3
(BELOW) =
-00002.

#750

HOLD FLASH VERB-NOUN TO
..... REQUEST RESPONSE AND
MON DISPLAY MARK CTRS
TFI AND MGA;
V16N45
R1 - MARK CTRS
R2 - TFI
R3 - MGA

MONITOR DSKY:
OBSERVE VERB-NOUN
FLASH TO REQUEST
RESPONSE AND DISPLAY
OF MARK CTRS, TFI
AND MGA.

#760

MARK CTRS - THE NUM-
BER OF MARKS PROCES-
SED BY THE RENDEZ-
VOUS DATA PROCESSING
ROUTINE (R22) (REFER
TO ASSUMPTION (8) OF
P20). THE REGISTER
WILL DISPLAY XXBXX
WHERE THE TWO MOST
SIGNIFICANT DIGITS
IS THE VHF RANGING
MARK COUNTER AND THE
TWO LEAST SIGNIFI-
CANT DIGITS IS THE
OPTICS MARK COUNTER.

NOTE: THE OPTICS
MARK COUNTER DOES
NOT DISTINGUISH BE-
TWEEN BACK-UP AND
PRIMARY MARKS.

#770

#780

#790

#840

GO TO
"B"
ABOVE

WAS THIS THE LAST
PASS THROUGH THE
PROGRAM?

.Y .N

IS THE FINAL FLAG
SET?

GO TO
"B"
ABOVE

#850

.Y .N

SET THE FINAL
FLAG

GO TO
"B"
ABOVE

#860

TRANSMIT ALL MANEU-
VER PARAMETERS TO
THE LM.

#870

DO ROUTINE (R00).

#880

DO ROUTINE (R00)

EXIT P74

EXIT P74

#890

++
+05
++
PCR
206

397

CHANGE CONTROL NOTES

LOGIC REV 04 PCR MIT 66
LOGIC REV 05 PCR 206 EDITORIAL
PCN 582

01120000
01120001
01120002

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LM TRANSFER PHASE MIDCOURSE TARGETING PROGRAM (P75)

LOGIC REV 06 11/27/68

- PURPOSE: (1) TO CALCULATE THE REQUIRED DELTA V AND OTHER INITIAL CONDITIONS REQUIRED BY THE LGC FOR LM EXECUTION OF THE NEXT MIDCOURSE CORRECTION OF THE TRANSFER PHASE OF AN ACTIVE LM REND.
- ASSUMPTIONS: (1) IF P20 IS IN OPERATION WHILE THIS PROGRAM IS OPERATING THE ASTRONAUT MAY HOLD AT ANY FLASHING DISPLAY AND TURN ON THE RENDEZVOUS SIGHTING MARK ROUTINE (EITHER R21 OR R23) AND TAKE OPTICS MARKS AND/OR HE MAY ALLOW VHF RANGING MARKS TO ACCUMULATE, SEE P20 FOR DETAILED DESCRIPTION.
- (2) ONCE THE PARAMETERS REQUIRED FOR COMPUTATION OF THE MANEUVER HAVE BEEN COMPLETELY SPECIFIED, THE VALUE OF THE ACTIVE VEHICLE CENTRAL ANGLE OF TRANSFER IS COMPUTED AND STORED. THIS NUMBER WILL BE AVAILABLE FOR DISPLAY TO THE ASTRONAUT THROUGH THE USE OF V06N52.
 THE ASTRONAUT WOULD CALL THIS DISPLAY TO VERIFY THAT THE CENTRAL ANGLE OF TRANSFER OF THE ACTIVE VEHICLE IS NOT WITHIN 170 TO 190 DEGREES. IF THE ANGLE IS WITHIN THIS ZONE THE ASTRONAUT SHOULD REASSESS THE INPUT TARGETTING PARAMETERS BASED UPON DELTA V AND EXPECTED MANEUVER TIME.
- (3) THE OPERATION OF THIS PROGRAM UTILIZES THE FOLLOWING FLAGS:
 ACTIVE VEHICLE FLAG - DESIGNATES THE VEHICLE WHICH IS DOING RENDEZVOUS THRUSTING MANEUVERS TO THE PROGRAM WHICH CALCULATES THE MANEUVER PARAMETERS. SET AT THE START OF EACH RENDEZVOUS PRE-THRUSTING PROGRAM.
 FINAL FLAG-SELECTS FINAL PROGRAM DISPLAYS AFTER ASTRONAUT HAS SELECTED THE FINAL MANEUVER COMPUTATIONS.
- (4) THE TIME OF INTERCEPT (T(INT)) WAS DEFINED BY PREVIOUS COMPLETION OF THE LM TRANSFER PHASE INITIATION (TPI) PROGRAM (P74) AND IS PRESENTLY AVAILABLE IN CMC STORAGE.
- (5) THERE IS NO REQUIREMENT FOR ISS OPERATION DURING THIS PROGRAM UNLESS AUTOMATIC STATE VECTOR UPDATING IS DESIRED BY THE RENDEZVOUS NAVIGATION PROGRAM (P20).
- (6) THE PROGRAM IS SELECTED BY THE ASTRONAUT BY DSKY ENTRY.

| PROG CONT | CMC | GROUND | CREW | CHECKLIST | TIME | TOTAL TIME |
|--------------|-----|--------|------|-----------|------|---------------|
|--------------|-----|--------|------|-----------|------|---------------|

| | | | | | | |
|---------------------|-------|--|--------------------|--|--|-----|
| | | | .CREW | | | |
| | | | .PROG | | | |
| | | | .SELECTION | | | |
| | | | . | | | |
| | | | ... | | | |
| | | | . | | | |
| ----- | | | ----- | | | |
| START LM TRANSFER | . | | KEY IN LM TRANSFER | | | |
| PHASE MIDCOURSE | ..... |  | PHASE MIDCOURSE | | | |
| TARGETING (TPM) | . | | TARGETING (TPM) | | | |
| PROGRAM (P75). | | | PROGRAM (P75) | | | #10 |
| DISPLAY PROGRAM 75. | | | V37E 75E | | | |
| | | | ----- | | | |

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.....• MONITOR DSKY:
OBSERVE DISPLAY OF
PROGRAM 75

#20

•
•
•

SET ACTIVE VEHICLE
FLAG TO LM

•
•
•

RESET FINAL FLAG

•
•
•

SET TRACK FLAG (SEE
P20)

#30

#40

•
•
•

SET UPDATE FLAG
(SEE P20)

#50

•
•
•
•
•
•
•
•
•

"A"

•
•
•
•
•
•

• RESET NEW TARGET
• FLAG.

#60

•
•
•

• RESET UPDATE FLAG
•

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•
•
•
•
•
•
•
•
•

400

#70

· DEFINE TIG(MID)=
· T + "B" MINUTES
· WHERE:

· "B" WILL BE
· STORED IN ERAS-
· ABLE STORAGE AND
· MAY BE CHANGED BY
· PRELAUNCH ERAS-
· ABLE LCAD OR CMC
· UPDATE BY P27.
· NOTE: THIS PARA-
· METER (B) IS NOT
· THE SAME AS THAT
· REFERRED TO IN
· P34 AS A.

#80

++
+06
++
EDIT
PCR
206

·
·
·

#90

· EXTRAPCLATE LM
· STATE VECTOR TO
· TIG(MID)

·
·
·

#100

· EXTRAPOLATE CSM
· STATE VECTOR TO
· T(INT) (NOTE:
· REFER TO ASSUMP-
· TION (4) ABOVE).

·
·
·

#110

· DO LAMBERT ROUT-
· INE TO CALCULATE
· THE REQUIRED VEL-
· OCITY FOR THE
· MIDCOURSE COR-
· RECTION.

·
·
·

"A"

#120

IS THE FINAL FLAG
SET?

.N .Y.

SET UPDATE
FLAG

IS THIS THE FINAL
PASS THROUGH THIS
PROGRAM?

.Y .N.

#130

POSS
HOLD .
.....
SNAP .

FLASH VERB-
NOUN TO REQ-
UEST RESPONSE
AND DISPLAY
CALCULATED
COMPONENTS OF
DELTA V(LV)
FOR TPM;
V06N81
R1-DELTA
VX(LV)
R2-DELTA
VY(LV)
R3-DELTA
VZ(LV)

DELTA VX(LV)-
COMPONENT OF
IMPULSIVE
DELTA V AT
TIG(TPM)
ALONG (RXV)
XR. IN FPS TO
NEAREST .1
FPS.

DELTA VY(LV)-
COMPONENT OF
IMPULSIVE
DELTA V AT
TIG(TPM)
ALONG VXR. IN
FPS TO NEAR-
EST .1 FPS

DELTA VZ(LV)-

MONITOR
DSKY:
OBSERVE
VFRB-NCUN
FLASH TO
REQUEST RE-
SPONSE AND
DISPLAY OF
DELTA V(LV)
FOR TPM

AM I SATIS-
FIED WITH
THESE
VALUES?
(NOTE: CREW
HAS THE OP-
TION AT
THIS TIME
TO REDEFINE
THE DELTA V
(LV) COM-
PONENTS FOR
THE SUBSE-
QUENT
THRUSTING
MANEUVER.
THIS CAPA-
BILITY WILL
NORMALLY BE
EXERCISED
TO CORRECT

#140

#150

#160

#170

++
+06
++
EDIT
PCR
206

. COMPONENT OF
. IMPULSIVE
. DELTA V AT
. TIG(TPM)
. ALONG -R. IN
. FPS TO NEAR-
. EST .1 FPS

. WHERE R IS
. THE LM GEO-
. CENTRIC
. (EARTH ORBIT)
. OR SELENO-
. CENTRIC
. (LUNAR ORBIT)
. RADIUS VECTOR
. AND V IS THE
. LM INERTIAL
. VELOCITY
. VECTOR AT
. TIG(TPM).

. .
. .
. .

. WAIT FOR KEY-
. BOARD ENTRY

. OUT OF
. PLANENESS
. BY FIRST SE-
. LECTING THE
. RENDEZVOUS
. OUT OF
. PLANE DIS-
. PLAY ROU-
. TIME (R36)
. (V90E), AND
. THEN MGDIFY
. VY(LV).
. HOWEVER IT
. MUST BE RE-
. MEMBERED
. THAT THE
. R36 CALCU-
. LATION IS
. BASED UPON
. AN ACTIVE
. CSM.

. Y N.
. .
. .

. KEY IN
. V25E
. AND
. LOAD
. THE DE-
. SIRED
. DELTA V
. VALUES.

. .
. .
. .

. RECORD
. THESE
. VALUES FOR
. FUTURE
. TRANSMISSION
. TO THE LM.

. .
. .
. .

#180

#190

#200

#210

#220

#230

TERMINATE
FLASH UPON
RECEIPT OF
PROCEED OR
NEW DATA

KEY IN
PROCEED.

.P .NEW
.R .DATA
.D .
.C .
.E -----
.E STORE
.D DATA

#240

. SET NEW
. TARGET
. FLAG.

#250

. IS THE NEW
. TARGET FLAG
. SET?

#260

.N .Y
. .
. .

. CALCULATE
. NEW TAR-
. GET VEC-
. TOR BASED
. ON NEWLY
. LOADED
. DELTA V
. (LV) FOR
. TPM.

#270

#280

405

POSS
HOLD
.....
SNAP

. . . .
. . . .
. . . .
. . . .
. . . .
. . . .

FLASH VERB-NOUN
TO REQUEST RE-
SPONSE AND DIS-
PLAY DELTA V (LOS)
FOR TPM:
V06N59
R1-DELTA
V1 (LOS)
R2-DELTA
V2 (LOS)
V3-DELTA
V3 (LOS)

DELTA V (LOS) -
LINE OF SIGHT
COMPONENTS IN FPS
TO NEAREST .1 FPS
(NOTE: FOR DEFIN-
ITION SEE SECTION
5.4.4.3 OF R577.)

. . . .
. . . .
. . . .
. . . .
. . . .

WAIT FOR KEYBOARD
ENTRY
TERMINATE FLASH
UPON RECEIPT OF
PROCEED.

. P
. R
. C
. C
. F
. E
. D
. .
. .

IS THE FINAL FLAG
SET?

.N . Y.
. .
. .
. .
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. .

. . . .
. . . .
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. . . .
. . . .
. . . .

MONITOR DSKY:
OBSERVE VERB-
NOUN FLASH TO RE-
QUEST RESPONSE
AND DISPLAY OF
DELTA V (LOS).

. . . .
. . . .
. . . .
. . . .
. . . .

RECORD THESE
VALUES FOR
FUTURE TRANSMIS-
SION TO THE LM.
(NOTE: UNLIKE
DELTA V (LV) FOR
TPM ABOVE, THESE
VALUES CANNOT BE
WRITTEN OVER.

. . . .
. . . .
. . . .

KEY IN PROCEED

. . . .
. . . .
. . . .
. . . .
. . . .
. . . .

P75/COLOSSUS
P75/LUMINARY

#290

#300

#310

#320

#330

P75/COLOSSUS
P75/LUMINARY

SET MGA DISPLAY
IN R3(BELCW)=
-00001.

SET MGA DIS-
PLAY IN R3
(BELCW)=
-00002.

#340

HOLD .
.....
MON .
FLASH VERB-NOUN TO
REQUEST RESPONSE AND
DISPLAY OF MARK CTRS
TFI AND MGA:
V16N45
R1-MARK CTRS
R2-TFI
R3-MGA

MONITOR DSKY:
OBSERVE VERB-NOUN
FLASH TO REQUEST
RESPONSE AND DISPLAY
OF MARK CTRS, TFI
AND MGA.

#350

MARK CTRS - THE
NUMBER OF MARKS PRO-
CESSED BY THE RENC-
EZVOUS DATA PROCESS-
ING ROUTINE (R22)
(REFER TO ASSUMPTION
(8) OF P20).
THE REGISTER WILL
DISPLAY XXXXX WHERE
THE TWO MOST SIGNIF-
ICANT DIGITS IS THE
VHF RANGING MARK
COUNTER AND THE TWO
LEAST SIGNIFICANT
DIGITS IS THE OPTICS
MARK COUNTER
NOTE : THE OPTICS
MARK COUNTER DOES
NOT DISTINGUISH BE-
TWEEN BACK-UP AND
PRIMARY MARKS.

#360

#370

#380

TFI—TIME FROM TIG
(TPM) IN MIN AND SEC
TO NEAREST SEC. MAX
READING IS 59859.
SIGN IS - BEFORE +
AFTER TIG(TPM).

MGA—MIDDLE GIMBAL
ANGLE IS NOT PERTI-
NENT TO THIS PROGRAM
THEREFORE:

(A) WHEN DISPLAY-
ED AT ANY TIME
OTHER THAN THE
LAST PASS THROUGH
THE PROGRAM THE
THE VALUE IS -
00001

(B) ON THE LAST
PASS WHEN THE IMU
IS NOT ALIGNED
THE VALUE IS
-00002.
IN DEGREES TO THE
NEAREST .01
DEGREES

WAS THIS THE LAST
PASS THROUGH THE
PROGRAM?

.Y N.

.

. DO I WISH TO
. TERMINATE THE
. MARK PROCESS AND
. DO THE FINAL PASS
. THROUGH THE PRO-
. GRAM?

.Y N.

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#390

#400

#410

WAIT FOR KEYBOARD
ENTRY

..... KEY IN PROCEED.

#420

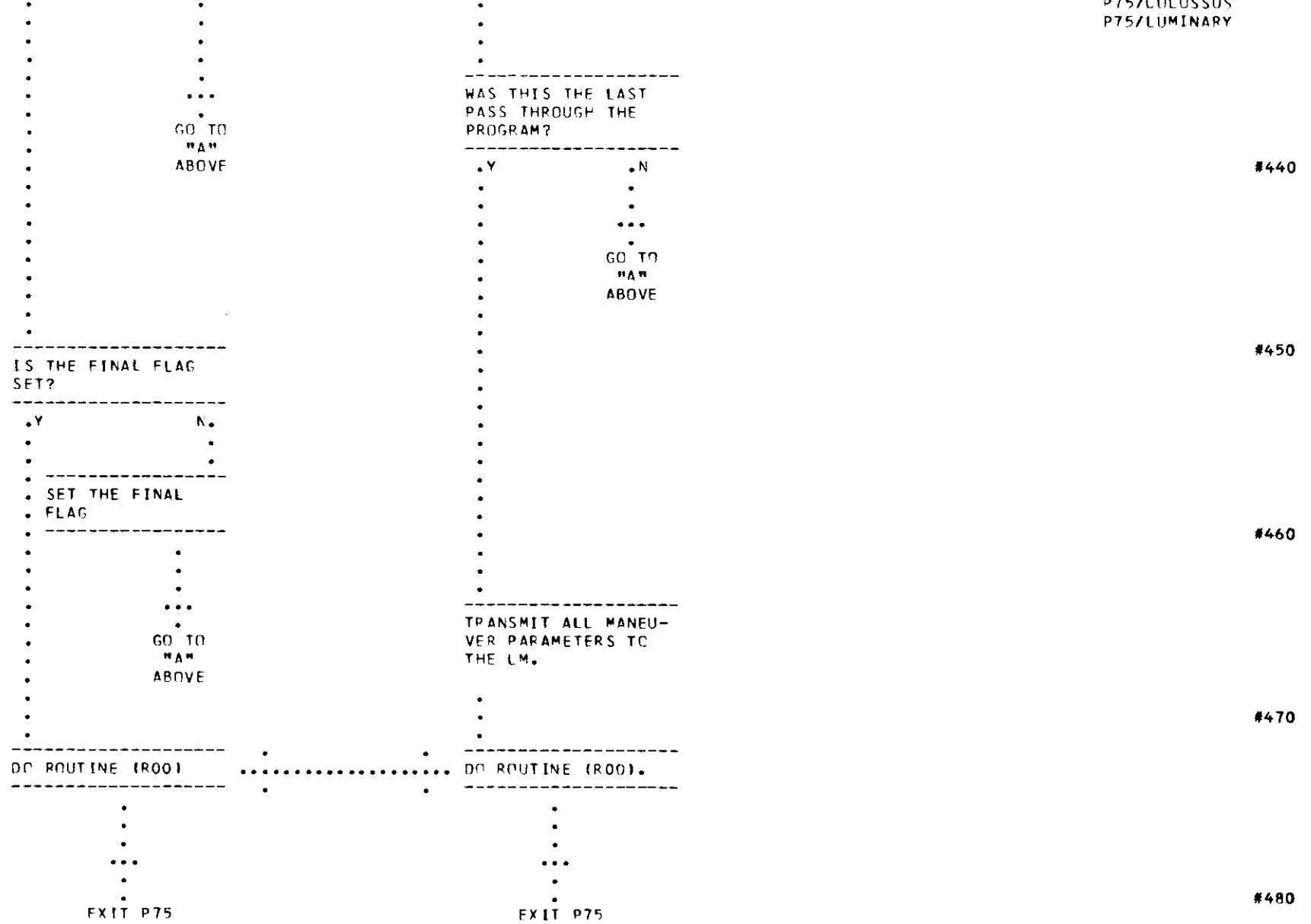
TERMINATE FLASH UPON
RECEIPT OF PROCEED
OR RECYCLE

..... KEY IN RECYCLE
V32E

.P .R
.R .E
.D .C
.C .Y
.E .C
.F .L
.D .F
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. GO TO
. "A"
. ABOVE
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#430



409

CHANGE CONTROL NOTES

REV 04 PCR MIT 66
REV 05 PCR 206
REV 06 PCR 206 EDITORIAL

00637000
00638000
00638001

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TARGET DELTA V PROGRAM (P76)

LOGIC REV 05 07/11/68

PURPOSE: (1) TO PROVIDE A MEANS OF NOTIFYING THE CMC THAT THE LM HAS CHANGED ITS ORBITAL PARAMETERS BY THE EXECUTION OF A THRUSTING MANEUVER.
 (2) TO PROVIDE TO THE CMC THE DELTA V APPLIED TO THE LM TO ENABLE AN UPDATING OF THE LM STATE VECTOR.

ASSUMPTIONS: (1) THE CSM CREW HAS THE DELTA V TO BE APPLIED BY THE LM IN LOCAL VERTICAL AXES AT A SPECIFIED TIG. THESE VALUES ARE DISPLAYED PRIOR TO TIG BY THE PRETHRUST TARGETING PROGRAM IN THE LM. NO PROVISION IS MADE IN THESE THRUSTING PROGRAMS TO DISPLAY THE RESULTS OF THE MANEUVER IN A FORM USABLE BY THIS ROUTINE. IF THE BURN IS NOT NOMINAL AND THIS DELTA V IS NOT AS SPECIFIED OR IF TIG IS NOT AS ORIGINALLY SPECIFIED CONSULT BACKUP PROCEDURES.

++ (2) CARE SHOULD BE EXERCISED TO INCORPORATE STATE VECTOR CHANGES VIA THIS PROGRAM IN LOGICAL ORDER WITH STATE VECTOR
 +05 CHANGES RESULTING FROM THE RENDEZVOUS NAVIGATION PROGRAM (P20). A SUGGESTED PROCEDURE WOULD BE TO STOP OPTICS
 + MARKING, VERIFY DATA INCORPORATION BY REVIEWING NOUN 45 MARK COUNTERS, INCORPORATE STATE VECTOR CHANGES VIA THIS
 + PROGRAM AND DO NOT TAKE OPTICS MARKS OR ENABLE VHF RANGE LINK UNTIL THE LM MANEUVER HAS TAKEN PLACE.

+ (3) IN THE EVENT OF AN UPLINK FAILURE THE ASTRONAUT CAN CREATE A REASONABLE LM STATE VECTOR FOR LM INSERTION
 + INTO ORBIT FROM THE LUNAR SURFACE BY KEYING IN THE EXPECTED LM THRUSTING MANEUVER FROM THE LUNAR SURFACE WHILE
 + THE SURFACE FLAG IS SET. THIS WILL CAUSE THE COMPUTER TO TAKE THE POSITION VECTOR OF THE LANDING SITE AND ADD THE
 + INPUTED DELTA V AND STORE THE RESULTS IN THE LM STATE VECTOR. THE LANDING SITE WILL NOT BE ALTERED.

+05 (4) THIS PROGRAM IS SELECTED BY THE ASTRONAUT BY DSKY ENTRY.
 ++

| PROG CONT | CMC | GROUND | CREW | CHECKLIST | TIME | TOTAL TIME |
|--------------|--------------------|--------|----------------|-----------|------|---------------|
| ++ | | | .CREW | | | |
| | | | .PROGRAM | | | |
| | | | .SELECTION | | | |
| | | | ... | | | |
| | | | . | | | |
| +05 | ----- | | ----- | | | |
| + | START TARGET | . | KEY IN V37E76E | | | |
| + | DELTA V | ..... | ----- |  |  |  |
| + | PROGRAM (P76) | . | | | | #10 |
| + | DISPLAY P76 | | | | | |
| + | ----- | | | | | |
| + | . | | | | | |
| + | : | | | | | |
| + | : | | | | | |
| + | ----- | | | | | |
| +05 | SET THE TRACK FLAG | | | | | |
| ++ | ----- | | | | | |
| | . | | | | | |
| | : | | | | | |
| | : | | | | | |
| | . | | | | | |
| | | | | | | #20 |

HOLD . . . FLASH VERB-NOUN
 TO REQUEST RESPONSE
 SNAP . . . AND DISPLAY THREE
 COMPONENTS OF DELTA
 V(OV).
 V06N84
 R1-DELTA VX(OV)
 R2-DELTA VY(OV)
 R3-DELTA VZ(OV)

DELTA VX(OV)-
 COMPONENT OF DELTA V
 OF OTHER VEHICLE
 APPLIED AT TIG
 ALONG (RXV)XR. IN
 FPS TO NEAREST .1
 FPS.

DELTA VY(OV)-
 COMPONENT OF DELTA V
 OF OTHER VEHICLE
 APPLIED AT TIG ALONG
 VXR. IN FPS TO NEAR-
 EST .1 FPS.

DELTA VZ(OV)-
 COMPONENT OF DELTA V
 OF OTHER VEHICLE
 APPLIED AT TIG ALONG
 -R. IN FPS TO NEAR-
 EST .1 FPS.

 .
 .
 .

 WAIT FOR KEYBOARD
 ENTRY

MONITOR DSKY
 OBSERVE VERB-NOUN
 FLASH TO REQUEST
 RESPONSE AND DISPLAY
 THREE COMPONENTS OF
 DELTA V APPLIED
 ALONG LOCAL VERTICAL
 AXES AT TIG.

 ARE THE VALUES
 DISPLAYED THE
 CORRECT ONES
 EXECUTED OR TO BE
 EXECUTED BY THE LM?

.Y .N
 . .
 . .
 . .
 . .
 . .
 . .
 . .
 . .
 . .
 . .
 . .

#30

#40

#50

#60

#70

KEY IN
PROCEED

KEY IN V25E
AND LOAD THE
CORRECT DELTA V.

TERMINATE FLASH UPON
RECEIPT OF PROCEED
OR NEW DATA

.PROCEED .NEW
.DATA

STORE DATA

HOLD . FLASH VERB-NOUN
..... TO REQUEST RESPONSE
SNAP . AND DISPLAY TIG
V06N33
R1-TIG-HRS
R2-TIG-MINS
R3-TIG-SECS

TIG-TIME OF IGNITION
(GET). IN HRS,MINS,
SEC TO NEAREST .01
SEC.

WAIT FOR KEYBOARD
ENTRY.

MONITOR DSKY
OBSERVE VERB-NOUN
FLASH TO REQUEST
RESPONSE AND DISPLAY
OF TIG.

IS THE VALUE
DISPLAYED THE
CORRECT TIME AT
WHICH THE LM EXECUT-
ED OR WILL EXECUTE
THE MANEUVER?

.Y .N

#80

#90

#100

#110

#120

TERMINATE FLASH UPON
RECEIPT OF PROCEED
OR NEW DATA

.P .NEW
.R .DATA

.O STORE DATA

.E

.E
.D
.
.
.
.
.

..... KEY IN PROCEED

KEY IN V25E
AND LOAD THE
CORRECT TIG

#130

UPDATE LM STATE
VECTOR TO REFLECT
THE DELTA V ADDED.

.
.
.

ZERO THE RENDEZVOUS
OPTICS MARK COUNTER.

.
.
.

ZERO THE RENDEZVOUS
VHF RANGING MARK
COUNTER.

.
.
.

DO ROUTINE R00

..... DO ROUTINE R00

.
.
.
.
.
EXIT

.
.
.
.
.
EXIT

#140

#150

#160

#170

#180

++
+05
++

415

CHANGE CONTROL NOTES

LOGIC REV 5 PCR 440
 PCR 468

00269000
00270000

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PURPOSE:

- (1) TO ACCEPT A DESIRED TIME OF TRANSFER PHASE INITIATION (TIG(TPI)) AS A DSKY INPUT FROM THE ASTRONAUT, AND TO COMPUTE THEREFROM THE PARAMETERS ASSOCIATED WITH A MINIMUM ENERGY, SAFE PERIAPSIS TRANSFER MANEUVER AT TIG(TPI) AND THE RESULTANT RENDEZVUS INTERCEPT FOR AN ACTIVE LM.
- (2) TO PROVIDE THE ASTRONAUT WITH THE OPTION OF DEFINING TO THE CMC THE INITIAL TRANSFER TRAJECTORY SEARCH SECTOR FOR CENTRAL ANGLES EITHER GREATER THAN OR LESS THAN 180 DEGREES FROM THE POSITION OF THE ACTIVE VEHICLE (LM) AT TIG (TPI).
- (3) TO DISPLAY TO THE ASTRONAUT THE PARAMETERS ASSOCIATED WITH THE TRANSFER (TPI AND INTERCEPT).

ASSUMPTIONS:

- (1) IF P20 IS IN OPERATION WHILE THIS PROGRAM IS OPERATING THE ASTRONAUT MAY HOLD AT ANY FLASHING DISPLAY AND TURN ON THE RENDEZVOUS SIGHTING MARK ROUTINE (EITHER R21 OR R23) AND TAKE OPTICS MARKS AND/OR HE MAY ALLOW VHF RANGING MARKS TO ACCUMULATE. SEE P20 FOR DETAILED DESCRIPTION.
- (2) THE OPERATION OF THIS PROGRAM UTILIZES THE ACTIVE VEHICLE FLAG WHICH DESIGNATES THE VEHICLE WHICH IS DOING THE RENDEZVOUS THRUSTING MANEUVERS TO THE PROGRAM WHICH CALCULATES THE MANEUVER PARAMETERS. SET AT THE START OF EACH RENDEZVOUS PRE-THRUSTING PROGRAM.
- (3) TO EXECUTE THE TPI MANEUVER SELECT THE LM TRANSFER PHASE INITIATION TARGETING (TPI) PROGRAM (74) AND TRANSMIT MANEUVER DATA TO THE LM.
- (4) THIS PROGRAM IS SELECTED BY THE ASTRONAUT BY DSKY ENTRY.

| PROG CONT | CMC | GROUND | CREW | CHECKLIST | TIME | TOTAL TIME |
|---------------------------------------|-----|--------|--|-----------|------|---------------|
| | | | <ul style="list-style-type: none"> . CREW . PROGRAM ...SELECTION . | | | |
| ----- | | | ----- | | | |
| START LM TPI SEARCH PROGRAM (P77). | . | | KEY IN LM TPI SEARCH PROGRAM (P77) V37E77E | | | #10 |
| | . | | ----- | | | |
| | | | MONITOR DSKY: OBSERVE DISPLAY OF PROGRAM 77. | | | |
| DISPLAY PROGRAM 77 | . | | ----- | | | |
| | . | | | | | |
| | . | | | | | |
| | . | | | | | |
| | . | | | | | #20 |

SET TRACK FLAG
(SEE P20)

SET UPDATE FLAG
(SEE P20)

SET ACTIVE VEHICLE
FLAG TO LM

"A"

"A"

HOLD
SNAP

FLASH VERB-NOUN TO
REQUEST RESPONSE AND
DISPLAY TIG(TPI):

V06N37
R1-TIG(TPI)-HRS
R2-TIG(TPI)-MINS
R3-TIG(TPI)-SECS

TIG(TPI)-TIME OF TPI
IGNITION (GET). IN
HRS, MINS, SECS TO
NEAREST .01 SEC.

MONITOR DSKY:
OBSERVE VERB-NOUN
FLASH TO REQUEST RE-
SPONSE AND DISPLAY
OF TIG(TPI).

AM I SATISFIED WITH
THESE VALUES?

.Y .N

RECORD THIS
VALUE.

#30

#40

#50

#60

#70

WAIT FOR KEYBOARD
ENTRY

KEY IN PROCEED

TERMINATE FLASH UPON
RECEIPT OF PROCEED
OR NEW DATA

KEY IN V25E AND
LOAD THE DESIR-
ED TIG(TPI)

#80

.PROCEED .NEW
 .DATA

 STORE DATA

#90

RESET UPDATE FLAG

#100

COMPUTE VEHICLE
POSITIONS AT
TIG(TPI) AND SELECT
NOMINAL SEARCH OP-
TION AS FOLLOWS:
IF ACTIVE VEHICLE IS
ABOVE PASSIVE VEH-
ICLE (NEGATIVE DELTA
ALTITUDE) SELECT
OPTION 00001.
IF ACTIVE VEHICLE IS
BELOW PASSIVE VEHICLE
(POSITIVE DELTA ALT)
SELECT OPTICN 00002

#110

SET UPDATE FLAG

#120

| | | | |
|-------|----------------------|----------------------|------|
| HOLD | ----- | MONITOR DSKY: | |
| ..... | FLASH VERB-NOUN TO | OBSERVE VERB-NOUN | #130 |
| SNAP | REQUEST RESPONSE AND | FLASH TO REQUEST | |
| | DISPLAY TPI PARA- | RESPONSE AND DISPLAY | |
| | METERS: | OF TPI PARAMETERS. | |
| | V06N72 | ----- | |
| | R1-DELT ANG(TPI) | | |
| | R2-DELT ALT(TPI) | | |
| | R3-SEARCH OPTION | | |
| | DELT ANG(TPI)-CENT- | | |
| | RAL ANGLE AROUND THE | | |
| | EARTH OR MOON AT TIG | | #140 |
| | (TPI) BETWEEN THE | | |
| | ACTIVE AND PASSIVE | | |
| | VEHICLES. POLARITY | | |
| | INDICATES ACTIVE VE- | | |
| | HICLE IS BEHIND (-) | | |
| | OR AHEAD OF (+) | | |
| | PASSIVE VEHICLE. IN | | |
| | DEGREES TO NEAREST | | |
| | .01 DEGREE. | | #150 |
| | DELT ALT(TPI)-THE | | |
| | MAGNITUDE OF THE | | |
| | ALTITUDE DIFFERENC | | |
| | BETWEEN THE POSITION | | |
| | VECTORS OF THE ACT- | | |
| | IVE AND PASSIVE | | |
| | VEHICLES AT TIG(TPI) | | |
| | IN NAUTICAL MILES TO | | |
| | THE NEAREST .1 NM. | | |
| | POLARITY INDICATES | | #160 |
| | THE PASSIVE VEHICLE | | |
| | IS ABOVE (+) OR BE- | | |
| | LOW (-) THE ACTIVE | | |
| | SEARCH OPTION-AN OP- | | |
| | TION CODE TO CONTROL | | |
| | CMC SEARCH FOR TERM- | | |
| | INAL PHASE | | |
| | DEFINITION: | | |
| | 00001-CMC SEARCHES | | |
| | TO DEFINE A TERMINAL | | #170 |
| | PHASE WHERE THE REN- | | |
| | DEZVOUS INTERCEPT | | |
| | OCCURS AT A CENTRAL | | |
| | ANGLE LESS THAN 180 | | |
| | DEGREES FROM THE | | |
| | ACTIVE VEHICLE POS- | | |
| | ITION AT TIG(TPI). | | |
| | CR | | |
| | 00002-SAME AS | | |
| | 00001 EXCEPT CENTRAL | | #180 |
| | ANGLE IS GREATER | | |
| | THAN 180 DEGREES. | | |

:
:

WAIT FOR KEYBOARD
ENTRY.

DO I WISH TO
CHANGE TIG(TPI)?

.N .Y

KEY IN RECY-
CLE
V32E

GO TO
"A"
ABOVE

DO I WISH TO
CHANGE THE SEARCH
OPTION DISPLAYED?

.N .Y

RECORD THESE
VALUES

KEY IN PROCEED

#190

#200

#210

#220

#230

#290

.NO .ALARM
.ALARM .
. .
. .

SET UP- SET UP-
DATE FLAG DATE FLAG
(SEE P20) (SEE P20)

#300

POSS
HOLD .
.....
SNAP .

. .
. .

. FLASH VERR-NCUN .
. TO REQUEST RE- .
. SPONSE AND DIS- .
. PLAY PROGRAM .
. ALARM CODE .
. V05N09 .
. R1- .
. R2- .
. R3- .
. .
. EXPECTED ALARM .
. CODE AT THIS .
. TIME IS 00124 .

. .
. .

. WAIT FOR KEY- .
. BOARD ENTRY .
. .
. .

. MONITOR DSKY: .
. DOES PROGRAM .
. ALARM INDICATE THAT .
. CMC CAN FIND NO SOL- .
. UTION. .

.N .Y
. .
. .
. .
. .
. .
. .
. .

#310

. TERMINATE FLASH .
. UPON RECEIPT OF .
. RECYCLE. .

. TO ADJUST TIG .
. (TPI) AND/OR THE .
. SEARCH OPTION .
. KEY IN RECYCLE .
. V32F .

#330

.R
.E
.C
.Y
.C
.L
.F
. .
. .
. .

. .
. .
. .
. .
. .
GO TO
"A"
ABCVE

#340

GO TO
"A"
ABOVE

HOLD
SNAP
FLASH VERB-NOUN TO
REQUEST RESPONSE AND
DISPLAY CALCULATED
TERMINAL PHASE
PARAMETERS:
V06N58
R1-PER ALT
R2-DELTA V(TPI)
R3-DELTA V(TPF)

++
+04
++
FDIT
PCR
206
PER ALT-ALTITUDE OF
PERIGEE ABOVE LAUNCH
PAD RADIUS (EARTH
ORBIT) OR ALTITUDE
OF PERILUNE ABOVE
THE MOST RECENTLY
DEFINED LANDING SITE
RADIUS (LUNAR ORBIT)
AFTER TPI MANEUVER.
IN NAUTICAL MILES TO
NEAREST .1 NM.

DELTA V(TPI)-REQUIR-
ED IMPULSIVE DELTA V
TO ACCOMPLISH TPI
MANEUVER AT TIG
(TPI). IN FPS TO
NEAREST .1 FPS.

DELTA V(TPF)-REQUIR-
ED IMPULSIVE DELTA V
TO ACCOMPLISH TPF
MANEUVER AT TIME OF
INTERCEPT. POLARITY
INDICATES ACTIVE
VEHICLE ASCENDING
(+) OR DESCENDING
(-) TO INTERCEPT.
IN FPS TO NEAREST .1
FPS.

WAIT FOR KEYBOARD
ENTRY.

MONITOR DSKY:
OBSERVE VERB-NOUN
FLASH TO REQUEST
RESPONSE AND DISPLAY
OF CALCULATED TER-
MINAL PHASE
PARAMETERS.

DO I WISH TO ADJUST
TIG(TPI) AND/OR THE
SEARCH OPTION?

| .N | .Y |
|----|----|
| . | . |
| . | . |
| . | . |
| . | . |
| . | . |
| . | . |
| . | . |
| . | . |
| . | . |

RECORD THESE
VALUES.

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|---|---|
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| . | . |

KEY IN PROCEED

#350

#360

#370

#380

#390

TERMINATE FLASH UPON
RECEIPT OF PROCEED,
OR RECYCLE.

KEY IN RECYCLE
V32E

.P .R
.R .F
.O .C
.C .Y
.E .C
.E .L
.D .E
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. .
. .
. .
. .
. .
. .
GO TO
"A"
ABOVE
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.
.
GO TO
"A"
ABOVE

#400

#410

HOLD .
.....
SNAP .

FLASH VERB-NOUN TO
REQUEST RESPONSE AND
DISPLAY CALCULATED
PER CODE AND CENTANG:
V06N55
R1-PER CODE
R2-BLANK
R3-CENTANG

MONITOR DSKY:
OBSERVE VERB-NOUN
FLASH TO REQUEST
RESPONSE AND DISPLAY
OF PER CODE AND
CENTANG.

#420

PER CODE-DEFINES
WHEN PERIGEE/PERI-
LUNE WILL OCCUR REL-
ATIVE TO TIG(TPI)
AND TIME OF INTER-
CEPT.

00001-INDICATES
PERIGEE/PERILUNE
WILL OCCUR BETWEEN
TPI AND TPF.

00002-INDICATES
PERIGEE/PERILUNE
WILL OCCUR AFTER
INTERCEPT (BEYOND
THE RENDEZVOUS
POINT).

#430

#440

CENTANG-THE ORBITAL
CENTRAL ANGLE OF THE
PASSIVE VEHICLE
DURING TRANSFER FROM
TIG(TPI) TO TIME
OF INTERCEPT. IN
DEGREES TO THE NEAR-
EST .01 DEGREES.

DO I WISH TO ADJUST
TIG(TPI) AND/OR THE
SEARCH OPTION?

.N .Y
.
.

#450

RECORD THESE
VALUES

.
.
.

#460

WAIT FOR KEYBOARD
ENTRY.

KEY IN PROCEED

TERMINATE FLASH UPON
RECEIPT OF PROCEED,
OR RECYCLE.

KEY IN RECYCLE
V32E

.P .R
.R .E
.D .C
.C .Y
.E .C
.E .L
.D .E

GO TO
"A"
ABOVE

GO TO
"A"
ABOVE

#470

#480

DO ROUTINE R00

DO ROUTINE R00

EXIT

EXIT

#490

427

CHANGE CONTROL NOTES

P77/COLESSUS

LOGIC REV 63 PCR MIT 66
LOGIC REV 64 PCR 286 EDITORIAL

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LM STABLE ORBIT RENDEZVOUS TARGETING (SCPI)
PROGRAM (P78)

LOGIC REV 07 12/26/68

- PURPOSE:
- (1) TO CALCULATE THE REQUIRED DELTA V AND OTHER INITIAL CONDITIONS REQUIRED BY THE LGC FOR LM EXECUTION OF THE FIRST PHASE OF THE STABLE ORBIT RENDEZVOUS MANEUVER, GIVEN:
 - (A) TIME OF IGNITION (TIG).
 - (B) CENTRAL ANGLE OF TRANSFER (CENTANG) FROM TIG TO INTERCEPT TIME.
 - (C) THE OFFSET OF THE STABLE ORBIT POINT SPECIFIED AS A DISTANCE ALONG THE PASSIVE VEHICLE ORBIT.
 - (2) TO CALCULATE THE REQUIRED DELTA V AND OTHER INITIAL CONDITIONS REQUIRED BY THE LGC FOR LM EXECUTION OF THE SECOND PHASE OF THE STABLE ORBIT RENDEZVOUS MANEUVER, GIVEN:
 - (A) A RESPECIFICATION OF 1(A) ABOVE.
 - (B) AN OPTIONAL RESPECIFICATION OF 1(B) ABOVE.
 - (3) TO CALCULATE THESE PARAMETERS BASED UPON MANEUVER DATA APPROVED AND KEYED INTO THE CMC BY THE ASTRONAUT.
 - (4) TO DISPLAY TO THE ASTRONAUT AND THE GROUND CERTAIN DEPENDENT VARIABLES ASSOCIATED WITH THE MANEUVER FOR APPROVAL BY THE ASTRONAUT/GROUND.
- ASSUMPTIONS:
- (1) THE STABLE ORBIT POINT IS DEFINED AS THE FINAL POSITION (AT COMPLETION OF SECOND PHASE) OF THE ACTIVE VEHICLE RELATIVE TO THE PASSIVE VEHICLE.
 - (2) CMC COMPUTED VARIABLES MAY BE STORED FOR LATER VERIFICATION BY THE GROUND. THESE STORAGE CAPABILITIES ARE LIMITED ONLY TO THE PARAMETERS FOR ONE THRUSTING MANEUVER AT A TIME EXCEPT FOR STABLE ORBIT RENDEZVOUS MANEUVER SEQUENCES.
 - (3) IF P20 IS IN OPERATION WHILE THIS PROGRAM IS OPERATING THE ASTRONAUT MAY HOLD AT ANY FLASHING DISPLAY AND TURN ON THE RENDEZVOUS SIGHTING MARK ROUTINE (EITHER P21 OR P23) AND TAKE OPTICS MARKS AND/OR HE MAY ALLOW VHF RANGING MARKS TO ACCUMULATE. SEE P20 FOR DETAILED DESCRIPTION.
 - (4) ONCE THE PARAMETERS REQUIRED FOR COMPUTATION OF THE MANEUVER HAVE BEEN COMPLETELY SPECIFIED, THE VALUE OF THE ACTIVE VEHICLE CENTRAL ANGLE OF TRANSFER IS COMPUTED AND STORED. THIS NUMBER WILL BE AVAILABLE FOR DISPLAY TO THE ASTRONAUT THROUGH THE USE OF V06N52.
THE ASTRONAUT WOULD CALL THIS DISPLAY TO VERIFY THAT THE CENTRAL ANGLE OF TRANSFER OF THE ACTIVE VEHICLE IS NOT WITHIN 170 TO 190 DEGREES. IF THE ANGLE IS WITHIN THIS ZONE THE ASTRONAUT SHOULD REASSESS THE INPUT TARGETTING PARAMETERS BASED UPON DELTA V AND EXPECTED MANEUVER TIME.
 - (5) THE OPERATION OF THIS PROGRAM UTILIZES THE FOLLOWING FLAGS.
ACTIVE VEHICLE FLAG- DESIGNATES THE VEHICLE WHICH IS DOING RENDEZVOUS THRUSTING MANEUVERS TO THE PROGRAM WHICH CALCULATES THE MANEUVER PARAMETERS. SET AT THE START OF EACH RENDEZVOUS PRE-THRUSTING PROGRAM.
FINAL FLAG- SELECTS FINAL PROGRAM DISPLAYS AFTER THE CREW HAS SELECTED THE FINAL MANEUVER COMPUTATION CYCLE.
 - (6) THE SECOND PHASE OF THIS PROGRAM REQUIRES THE TIG INPUT BE BIASED AS A FUNCTION OF THE AND ANY MIDCOURSE CORRECTIONS PERFORMED IN THE LM STABLE ORBIT MIDCOURSE (TARGETING) PROGRAM (P79)

1A

(7) THERE IS NO REQUIREMENT FOR ISS OPERATION DURING THIS PROGRAM UNLESS AUTOMATIC STATE VECTOR UPDATING IS DESIRED BY THE RENDEZVOUS NAVIGATION PROGRAM (P20).

(8) THIS PROGRAM IS SELECTED BY THE ASTRONAUT BY DSKY ENTRY.

| PRG CNT | CMC | GROUND | CREW | CHECKLIST | TIME | TOTAL TIME |
|------------|-----|--------|---|--|------|---------------|
| | | | CREW PROG SELECTION | | | |
| | | | ----- START LM STABLE OR- BIT RENDEZVOUS TAR- GETING (SOP) PROGRAM (P78) DISPLAY P78 | . | | |
| | | | KEY IN LM STABLE OR- BIT RENDEZVOUS TAR- GETING (SOP) PROGRAM (P78) V37E 78E ----- | | | #10 |
| | | | | MONITOR DSKY: OBSERVE DISPLAY OF PROGRAM 78 ----- | | |
| | | | SET ACTIVE VEHICLE FLAG TO LM. ----- | | | |
| | | | SET TRACK FLAG. (SEE P20) ----- | | | |
| | | | | | | #40 |

SET UPDATE FLAG.
(SEE D20)

HOLD .
.....
SNMP .

FLASH VER-NDJN
TO REQUEST RESPONSE
AND DISPLAY TIC.
V06 N37
R1-TIC HRS.
R2-TIC MIN.
R3-TIC SEC.

TIC - TIME OF IGNIT-
ION (GFI). IN HOURS
MIN AND SEC TO NEAR-
EST .01 SEC.

MONITOR DSKY:
OBSERVE VER-NDJN
FLASH TO REQUEST
RESPONSE AND DISPLAY
OF TIC.

AM I SATISFIED WITH
THIS VALUE?

RECORD THIS
VALUE FOR FUTURE
TRANSMISSION TO
THE IM.

WAIT FOR KEYBOARD
ENTRY.

KEY IN PROCEED

#50

#60

#70

#80

#90

1A

1A

TERMINATE FLASH UPON
RECEIPT OF PROCEED
OR NEW DATA.

KEY IN V250
AND LOAD THE
DESIRED TIG
(SDP)

.P .NEW
.R .DATA
.D .
.C .
.F .
.F .
.D .

STORE
DATA

#100

#110

#120

#130

#140

HOLD .
.....
SNAP .

FLASH VERB-NOUN TO
REQUEST RESPONSE AND
DISPLAY CENTANG
V06 N55
R1-BLANK
R2-BLANK
R3-CENTANG

MONITOR DSKY:
OBSERVE VERB-NOUN
FLASH TO REQUEST
RESPONSE AND DISPLAY
OF CENTANG:

CENTANG- THE ORBITAL
CENTRAL ANGLE OF THE
PASSIVE VEHICLE DURING
TRANSFER FROM
TIG TO TIME OF IN-
TERCEPT. IN DEGREES
TO NEAREST .01
DEGREES

AM I SATISFIED WITH
THIS VALUE?

.Y .N

RECORD THIS
VALUE FOR FUTURE
TRANSMISSION TO
THE LM.

.

#150

WAIT FOR KEYBOARD
ENTRY.

KEY IN
RECORDED.

#160

TERMINATE FLASH UPON
RECEIPT OF PROCEED
OR NEW DATA

KEY IN M23C
AND LOAD THE
DESIRED
CENTANG.

#170

P NEW
P DATA
C
F
F
D

STORE
DATA

#180

HOLD . FLASH VERB-NOIN TO
SNAP . REQUEST RESPONSE AND
DISPLAY OF ASSUMED
STABLE ORBIT RENEZ-
VOUS PHASE OPTION:
V04 N06
01-00005
02-0000X
03-011AX

MONITOR DISK:
OBSERVE VERB-NOIN
FLASH TO REQUEST
RESPONSE AND DISPLAY
OF ASSUMED STABLE
ORBIT RENEZVOUS
PHASE OPTION.

#190

1A

R1 IS OPTION CODE
FOR ASSUMED STABLE
ORBIT RENDEZVOUS
PHASE OPTION.

IS THIS PHASE OPTION
CORRECT?

R2 IS THE CMC ASSU-
MED OPTION:

.Y .N

00001-FIRST PHASE-
LOAD DELTA R
CMC COMPUTES SDP
PARAMETERS FOR
FIRST PHASE.

00002-SECOND PHASE-
NO ADDITIONAL
DATA REQUIRED:
CMC CALCULATES
SDP PARAMETERS
FOR SECOND PHASE.

KEY IN
PROCEED

WAIT FOR KEYBOARD
ENTRY

TERMINATE FLASH UPON
RECEIPT OF PROCEED
OR NEW DATA

KEY IN V22F
AND LOAD DE-
SIRED OPTION
CODE IN R2.

.P .NEW
.P .DATA
.D
.C
.F .STORE DATA
.F
.D

DID I SPECIFY FIRST
PHASE?

IS PHASE OPTION = 1?

.Y .N

RESET UPDATE
FLAG

#200

#210

#220

#230

#240

#250

++
+07
+
+
+07
++

113

PCN
577

COMPUTE
T(FINAL) GO TO

"A"
BELOW

GO TO
"A"
BELOW

#260

++
+07'
++
PCN
577

SFT UPDATE
FLAG

#270

HOLD
.....
SNAP

FLASH VERR-NOUN
TO REQUEST RES-
PONSE AND DISPLAY
DELTA R:

MONITOR DSKY:
OBSERVE VERR-
NOUN FLASH TO
REQUEST RES-
PONSE AND DIS-
PLAY OF DELTA
R.

#280

V06 N57
R1-DELTA P
R2-BLANK
R3-BLANK

DELTA R- THE OFFSET
OF THE STABLE
ORBIT POINT, SPE-
CIFIED AS THE DIS-
TANCE ALONG THE
PASSIVE VEHICLE
ORBIT. REFER TO
SECTION 5.4.4.5
OF 2577, FOR
DETAILED DESCIP-
TION. IN NM TO
THE NEAREST .1 NM
(+ INDICATES STABLE
ORBIT POINT BEHIND
PASSIVE VEHICLE;
- INDICATES AHEAD
OF THE PASSIVE
VEHICLE.)

AM I SATISFIED
WITH THIS
VALUE?

#290

#300

1A

1A

RECORD
THIS
VALUE FOR
FUTURE
TRANSMIS-
SION TO
THE LM.

#310

WAIT FOR KEYBOARD
ENTRY

KEY IN
PROCEED

TERMINATE FLASH
UPON RECEIPT OF
PROCEED OR NEW
DATA

KEY IN
V21F
AND LOAD
DESIRED
DELTA P

#320

P
R
D
STORE .C
DATA .F

F
D

D
P

#330

HOLD .
.....
SNAP .

FLASH VERB-NOUN TO
REQUEST RESPONSE AND
DISPLAY T(FINAL):

MONITOR DSKY:
OBSERVE VERB-
NOUN FLASH TO
REQUEST RES-
PONSE AND DIS-
PLAY OF T
(FINAL)

#340

V06N34
R1-T(FINAL)HRS
R2-T(FINAL)MIN
R3-T(FINAL)SEC.

T(FINAL) - TIME OF
ARRIVAL AT STABLE
ORBIT (G.E.T.) IN
HOURS, MIN SEC TO
THE NEAREST .01 SEC-
ONDS.

#350

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WAIT FOR KEYBOARD
ENTRY

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RECORD THIS
VALUE FOR
FUTURE
TRANSMIS-
SION TO THE
LM.

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KEY IN PROCEED

TERMINATE FLASH UPON
RECEIPT OF PROCEED

PROCEED

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RESET UPDATE FLAG.

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. .

. BASED ON STORED
. TARGET PARAMETERS
. COMPUTE THE
. TRANSFER TRAJECTORY,
. INITIAL CONDITIONS
. AND THE NECESSARY
. DEPENDENT VARIABLES
. FOR EVALUATION OF
. THE MANEUVER AS
. DESCRIBED IN SECTION
. 5.4.4.6 OF REF 77

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. .
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#360

#370

#380

#390

#400

1A #410

1A

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IS THE FINAL FLAG SET?

Y N
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.
SFT
UPDATE
FLAG.

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"BB"

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#420

#430

HOLD
SNAP

FLASH VERR-NOUN TO REQUEST RESPONSE AND DISPLAY CALCULATED PER ALT, DELTA V(SOR) AND DELTA V(SOR-FINAL)

V06 N5R
R1=PER ALT(SOR)
R2=DELTA V(SOR)
R3=DELTA V(SOR-FINAL)

PER ALT(SOR)= ALTITUDE OF PERIGEE ABOVE THE LAUNCH PAD PARTUS (EARTH ORBIT) OR ALTITUDE OF PERILUNE ABOVE THE LUNAR RADIUS AT THE MOST RECENTLY DEFINED LANDING SITE (LUNAR ORBIT). IN NAUTICAL MILES TO NEAREST .1 NM.

MONITOR DSKY: OBSERVE VERR-NOUN FLASH TO REQUEST RESPONSE AND DISPLAY OF CALCULATED PER ALT, DELTA V(SOR), AND DELTA V(SOR-FINAL).

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RECORD THESE VALUES FOR FUTURE TRANSMISSION TO THE LM.

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#440

#450

#460

#470

DELTA V (SOR)-
REQUIRED IMPUL-
SIVE DELTA V TO
ACCOMPLISH SOR
MANEUVER AT TIC
IN FDS TO NEAREST
.1 FDS.

DELTA V(SOR-FIN-
AL) REQUIRED IM-
PULSIVE DELTA V
TO ACCOMPLISH SOR
MANEUVER AT TIME
OF INTERCEPT.
IN FDS TO NEAREST
.1 FDS.

#480

.
.
.

WAIT FOR KEYBOARD
ENTRY.

#490

TERMINATE FLASH
UPON RECEIPT OF
PROCEED

KEY IN PROCEED

PROCEED

#500

HOLD .
.....
SNAP .

FLASH VERR NOUN TO
REQUEST RESPONSE AND
DISPLAY DELTA V(I,V):
V06NR1
R1-DELTA VX (I,V)
R2-DELTA VY (I,V)
R3-DELTA VZ (I,V)

MONITOR DSKY:
OBSERVE VERR NOUN
FLASH TO REQUEST
RESPONSE AND DISPLAY
OF DELTA V(I,V)
COMPONENTS.

#510

DELTA VX - IMPULSIVE
COMPONENT OF DELTA V
AT TIC ALONG (RYV) XZ
IN FDS TO NEAREST
.1 FDS

1A

1A

DELTA VY IMPULSIVE
COMPONENT OF DELTA V
AT TIG ALONG VXP IN
FPS TO NEAREST
.1 FPS

#520

DELTA VZ IMPULSIVE
COMPONENT OF DELTA V
AT TIG ALONG -P IN
FPS TO NEAREST
.1 FPS

WHERE R IS THE LM
GEOCENTRIC (EARTH
ORBIT) OR SELENOCENT-
RIC (LUNAR ORBIT)
RADIUS VECTOR AND V
IS THE LM INERTIAL
VELOCITY VECTOR AT
TIG.

#530

RECORD THESE
VALUES FOR
FUTURE
TRANSMISSION
TO THE LM.

#540

WAIT FOR KEYBOARD
ENTRY

#550

#560

TERMINATE FLASH FROM
RECEIPT OF RECEIVED KEY IN PROCEED

. B
. B
. C
. C
. E
. F
. D
. .

RESET FINAL FLAG RESET EX-
TERMINAL
DELTA V
FLAG

. .
. .
. . "A"
. .
. .
. .
. .
. .

. RESET
. FINAL
. FLAG
. .
. .
. .

IS FINAL FLAG SET?

. N . Y
. .
. .

SET MCA
DISPLAY
IN R2
(BELOW)
=-90001

#570

#580

#590

#600

#610

1A

1A

```

-----
SET MGA
DISPLAY IN
R3 (BELOW)=
-00002
-----

```

"A"

#620

```

HOLD . FLASH VERB-NOUN TO
..... REQUEST RESPONSE AND
MON . DISPLAY MARK CTRS,
      TEI, AND MGA.
      VIA N45
      R1 MARK CTRS
      R2 TEI
      R3 MGA

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-----
MONITOR DSKY:
OBSERVE VERB-
NOUN FLASH TO
REQUEST RES-
PONSE AND DISPLAY
OF MARK CTRS,
TEI, AND MGA.
-----

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#630

MARK CTRS - THE NUM-
BER OF MARKS PROCES-
SED BY THE PFMDFZ-
VDSU DATA PROCESSING
ROUTINE (R22) (REFER
TO ASSUMPTION (A1 OF
D20). THE REGISTER
WILL DISPLAY XXXX
WHERE THE TWO MOST
SIGNIFICANT DIGITS
IS THE VHF RANGING
MARK COUNTER AND
THE TWO LEAST SIGNI-
FICANT DIGITS IS THE
OPTICS MARK COUNTER.

#640

NOTE: THE OPTICS
MARK COUNTER DOES
NOT DISTINGUISH RE-
TWEEN BACK-UP AND
PRIMARY MARKS.

#650

TEI-TIME FROM IGNI-
TION IN MIN AND
SEC TO NEAREST
SEC. MAX READING
IS 50R50. (-BEFORE,
AND + AFTER T(G.)

#660

10A-MIDDLE CIRCUM-
ANGLE DISPLAY IS NOT
PERTINENT TO THIS
PROGRAM.

THEREFORE:

- (A) WHEN DISPLAYED
AT ANY TIME OTHER
THAN THE LAST
PASS THROUGH THE
PROGRAM THE
VALUE IS -00001.
- (B) ON THE LAST PASS
THE VALUE IS
-00002. IN
DEGREES TO THE
NEAREST .01
DEGREES.

WAS THIS THE
LAST PASS
THROUGH THE
PROGRAM?

.Y .N

DO I WISH
TO TERMIN-
ATE THE
MARK PRO-
CESS AND DO
THE FINAL
PASS THRO-
UGH THE
PROGRAM?

WAIT FOR KEYBOARD
ENTRY

KEY IN
DEGREE

#670

#680

#690

#700

#710

1A

1A

TERMINATE FLASH UPON
RECEIPT OF RECYCLE
OR PROCEED

.R .P
.E .R
.C .C
.Y .C
.C .E
.L .E
.F .D

GO TO
"A"
ABOVE

IS FINAL FLAG SET?

.N .Y

SET FINAL
FLAG

GO TO
"A"
ABOVE

DO ROUTINE P00

KEY IN
RECYCLE
V32E

GO TO
"B"
ABOVE

WAS THIS THE LAST
PASS THROUGH THE
PROGRAM?

.Y .N

GO TO
"B"
ABOVE

TRANSMIT ALL MANEU-
VER PARAMETERS TO
THE LM.

DO ROUTINE P00

#770

#730

#740

#750

#760

13

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. .
. .
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. .
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. .
.
EXIT

.
. .
. .
. .
. .
.
EXIT

078/00102515
078/00102516

#770

CHANGE CONTROL NOTES

REV 03 PCR MIT 45
REV 04 PCR MIT 66
REV 05 PCR 206
REV 06 PCR 206 EDITORIAL
PCR 578
REV 07 PCR 577

1A

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LM STABLE ORBIT MIDCOURSE TARGETING (SOM) PROGRAM (P79)

LOGIC REV 06 07/09/68

PURPOSE:

- (1) TO CALCULATE THE REQUIRED DELTA V AND OTHER INITIAL CONDITIONS REQUIRED BY THE LGC FOR LM EXECUTION OF THE NEXT POSSIBLE MIDCOURSE CORRECTION OF THE STABLE ORBIT TRANSFER PHASE OF AN ACTIVE LM RENDEZVOUS.
- (2) TO COMPUTE AND DISPLAY SUITABLE INFORMATION TO ENABLE THE CREW TO ENTER THE FINAL RENDEZVOUS PHASE AT THE CORRECT TIME TO COMPLETE THE REQUIRED THRUSTING MANEUVER.

ASSUMPTIONS:

- (1) THE ISS NEED NOT BE ON TO COMPLETE THIS PROGRAM.
- (2) IF P20 IS IN OPERATION WHILE THIS PROGRAM IS OPERATING THE ASTRONAUT MAY HOLD AT ANY FLASHING DISPLAY AND TURN ON THE RENDEZVOUS SIGHTING MARK ROUTINE (EITHER R21 OR R23) AND TAKE OPTICS MARKS AND/OR HE MAY ALLOW VHF RANGING MARKS TO ACCUMULATE. SEE P20 FOR DETAILED DESCRIPTION.
- (3) ONCE THE PARAMETERS REQUIRED FOR COMPUTATION OF THE MANEUVER HAVE BEEN COMPLETELY SPECIFIED, THE VALUE OF THE ACTIVE VEHICLE CENTRAL ANGLE OF TRANSFER IS COMPUTED AND STORED. THIS NUMBER WILL BE AVAILABLE FOR DISPLAY TO THE ASTRONAUT THROUGH THE USE OF V06N52.
THE ASTRONAUT WOULD CALL THIS DISPLAY TO VERIFY THAT THE CENTRAL ANGLE OF TRANSFER OF THE ACTIVE VEHICLE IS NOT WITHIN 170 TO 190 DEGREES. IF THE ANGLE IS WITHIN THIS ZONE THE ASTRONAUT SHOULD REASSESS THE INPUT TARGETTING PARAMETERS BASED UPON DELTA V AND EXPECTED MANEUVER TIME.
- (4) THE OPERATION OF THIS PROGRAM UTILIZES THE FOLLOWING FLAGS.

ACTIVE VEHICLE FLAG - DESIGNATES THE VEHICLE WHICH IS DOING RENDEZVOUS THRUSTING MANEUVERS TO THE PROGRAM WHICH CALCULATES THE MANEUVER PARAMETERS. SET AT THE START OF EACH RENDEZVOUS PRE-THRUSTING PROGRAM.

FINAL FLAG-SELECTS FINAL PROGRAM DISPLAYS AFTER CREW HAS SELECTED THE FINAL MANEUVER COMPUTATION AND DISPLAY CYCLE.
- (5) THE TIME OF INTERCEPT (T(INT)) WAS DEFINED BY PREVIOUS COMPLETION OF THE LM STABLE ORBIT RENDEZVOUS TARGETING (SOR) PROGRAM (P78) AND IS PRESENTLY AVAILABLE IN CMC STORAGE.
- (6) THIS PROGRAM IS SELECTED BY THE ASTRONAUT BY DSKY ENTRY.

.CREW
 .PROG
 .SELECTION
 .
 .
 .

| | | | |
|---|-----------------|--|-----|
| START LM STABLE ORBIT MIDCOURSE TARGETING (SOM) PROGRAM (79). DISPLAY PROGRAM 79. | | KEY IN LM STABLE ORBIT MIDCOURSE TARGETING (SOM) PROGRAM (P79) V37E79E | #10 |
|---|-----------------|--|-----|

| | | | |
|-----------------|-----------------|---|-----|
| | | MONITOR DSKY: OBSERVE DISPLAY OF PROGRAM 79 | #20 |
|-----------------|-----------------|---|-----|

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| | | | |
|----------------------------------|--|--|--|
| SET ACTIVE VEHICLE FLAG TO LM | | | |
|----------------------------------|--|--|--|

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|------------------|--|--|--|
| RESET FINAL FLAG | | | |
|------------------|--|--|--|

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|-----------------------------|--|--|--|
| SET TRACK FLAG (SEE P20) | | | |
|-----------------------------|--|--|--|

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| | | | |
|------------------------------|--|--|--|
| SET UPDATE FLAG (SEE P20) | | | |
|------------------------------|--|--|--|

| | | |
|--|---|-----|
| | "A" | #50 |
|--|---|-----|

P79/COLOSSUS
 P79/LUMINARY

DO LAMBERT
ROUTINE TO CALCULATE THE
REQUIRED VELOCITY
FOR MIDCOURSE
CORRECTION.

#110

CALCULATE THRUST
INITIAL CONDITION
PARAMETERS REFER
TO R577 SECTION
5.4.4.5, FOR
DEFINITION OF
CALCULATIONS

#120

IS THE FINAL FLAG
SET?

#130

 .N .Y
 . .
 . .

SET THE
UPDATE
FLAG.

"A"
.
.
.
.
.
.
.
.
.
.

#140

HOLD .
.....
SNAP .

FLASH VERB-NOUN
TO REQUEST RESP-
ONSE AND DISPLAY
THREE STORED
COMPONENTS OF
DELTA (LV):
 V06N81
 R1-DELTA VX(LV)
 R2-DELTA VY(LV)
 R3-DELTA VZ(LV)
DELTA VX (LV):
COMPONENT OF
IMPULSIVE DELTA V
AT TIG ALONG
(RXV)XR. IN FPS
TO NEAREST .1

MONITOR DSKY:
OBSERVE VERB-NOUN
FLASH TO REQUEST
RESPONSE AND DISPLAY
OF STORED COMPONENTS
OF DELTA V(LV).

#150

.
.
.
.
.
.
.
.
.
.

. FPS.
. DELTA VY (LV):
. COMPONENT OF
. IMPULSIVE DELTA V
. AT TIG ALONG VXR,
. IN FPS TO NEAREST
. .1 FPS.
. DELTA VZ (LV):
. COMPONENT OF
. IMPULSIVE DELTA V
. AT TIG ALONG -R.
. IN FPS TO NEAREST
. .1 FPS
. WHERE R IS LM
. GEOCENTRIC (EARTH
. ORBIT) OR SELEN-
. OCENTRIC (LUNAR
. ORBIT) RADIUS
. VECTOR AND V IS
. LM INERTIAL VEL-
. OCITY VECTOR AT
. TIG.

#160

#170

RECORD THESE
VALUES FOR
FUTURE TRANS-
MISSION TO THE
LM.

#180

WAIT FOR KEYBOARD
ENTRY

KEY IN PROCEED

#190

. TERMINATE FLASH
. UPON RECEIPT OF
. PROCEED OR NEW
. DATA

#200

. P
. R
. O
. C
. E
. E
. O
. .
. .

IS FINAL FLAG SET?

. N . Y
. .
. .
. .
. .
. .
. .
. .

#210

SET MGA DIS-
PLAY IN R3
(BELOW)
= -00001.

#220

SET MGA
DISPLAY IN
R3 (BELOW)
= -00002.

#230

HOLD .
.....
MON .

FLASH VERB-NOUN TO
REQUEST RESPONSE AND
DISPLAY MARK CTRS
TFI AND MGA:
V16 N45
R1-MARK CTRS
R2-TFI
R3-MGA

MONITOR DSKY:
OBSERVE VERB-NOUN
FLASH TO REQUEST
RESPONSE AND DISPLAY
OF MARK CTRS, TFI,
AND MGA

#240

MARK CTRS - THE NUM-
BER OF MARKS PROCES-
SED BY THE RENDEZ-
VOUS DATA PROCESSING
ROUTINE (P22) (REFER
TO ASSUMPTION (8) OF
P20). THE REGISTER
WILL DISPLAY XXBXX
WHERE THE TWO MOST
SIGNIFICANT DIGITS
IS THE VHF RANGING
MARK COUNTER AND
THE TWO LEAST SIGNI-
FICANT DIGITS IS THE
OPTICS MARK COUNTER.

#250

NOTE: THE OPTICS
MARK COUNTER DOES
NOT DISTINGUISH BE-
TWEEN BACK-UP AND
PRIMARY MARKS.

#260

TFI - TIME FROM TIG.
IN MIN AND SEC TO
NEAREST SEC.
MAXIMUM READING IS
59859. (-BEFORE
+ AFTER TIG.)

MGA-MIDDLE CIMBAL
ANGLE IS NOT PERTIN-
ENT IN THIS PROGRAM.
THEREFORE:

(A) WHEN DISPLAYED
AT ANY TIME OTHER
THAN THE LAST PASS
THROUGH THE PRO-
GRAM THE VALUE IS
-00001

(B) ON THE LAST
PASS THE VALUE IS
-00002 IN DEGREES
TO THE NEAREST .01
DEGREES

++
+
+06
++

WAIT FOR KEYBOARD
ENTRY

.....
.

.
. .
. .
. .
. .
. .
. .
. .
. .
. .

WAS THIS THE LAST
PASS THROUGH THE
PROGRAM?

.Y .N
.
.
.
.

. DO I WISH TO TER-
. MINATE THE MARK
. PROCESS AND DO
. THE FINAL PASS
. THROUGH THE
. PROGRAM?

.Y .N
.
.
.
.
.
.
.
.
.
.
.
.
.
.
.
.

KEY IN RECYCLE
V32E

.
.
.
.
.
GO TO
"A"
ABOVE

#270

#280

#290

#300

#310

TERMINATE FLASH UPON
RECEIPT OF PROCEED
OR RECYCLE

KEY IN PROCEED

.R .P
.E .R
.C .Q
.Y .C
.C .F
.L .E
.E .D

GO TO
"A"
ABOVE

WAS THIS THE LAST
PASS THROUGH THE
PROGRAM?

.Y .N
. .
. .
. .
GO TO
"A"
ABOVE

#320

#330

IS THE FINAL
FLAG SET?

.Y .N
. .
. .

. SET THE
. FINAL FLAG.

GO TO
"A"
ABOVE

TRANSMIT ALL MANEUV-
ER PARAMETERS TO THE
LM.

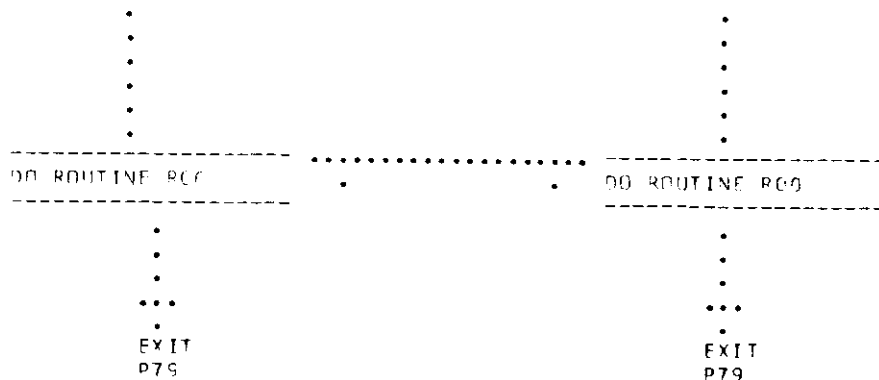
#340

#350

#360

454

455



P79/COLLOSSUS
P79/LUMINARY

#370

CHANGE CONTROL NOTES

REV 04 PCR MIT 45
 REV 05 PCR MIT 66
 REV 06 PCR 206

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FINAL AUTOMATIC REQUEST TERMINATE
ROUTINE (P00)

LOGIC REV 09 11/29/68

- PURPOSE: (1) TO PROVIDE A STANDARD EXIT FOR PROGRAMS, AND AN OPTION TO SELECT ANY PROGRAM DESIRED.
 (2) TO PROVIDE A GENERAL DESCRIPTION OF THE COMPUTER ACTIVITY FOLLOWING ANY V37CXXE.
- ASSUMPTIONS: (1) THE CALLING PROGRAM HAS SUCCESSFULLY COMPLETED ALL ITS FUNCTIONS OR THE OPERATOR HAS PREMATURELY TERMINATED THE PROGRAM.
 (2) THE COMPUTER CHECKS ON THE RENDEZVOUS PROCESS FOLLOWING ANY V37CXXE IN THE FOLLOWING WAYS:
- (A) IF P20 IS THE NEW PROGRAM KEYED IN AND IS NOT PRESENTLY RUNNING AND WAS NOT RUNNING IN THE BACKGROUND IT WILL BE STARTED AS A NEW PROGRAM.
 - (B) IF P20 IS THE NEW PROGRAM KEYED IN AND P20 IS PRESENTLY RUNNING (I.E. 20 DISPLAYED IN THE PROG LIGHTS) IT WILL BE STARTED AS A NEW PROGRAM (I.E. RE-INITIALIZED).
 - (C) IF P20 IS THE NEW PROGRAM KEYED IN AND IS NOT PRESENTLY THE ONLY PROGRAM RUNNING (I.E. A PROGRAM OTHER THAN P20 IS DISPLAYED IN THE PROG LIGHTS) AND P20 IS RUNNING IN THE BACKGROUND THE PROG LIGHTS WILL BE CHANGED TO 20 AND P20 WILL START AT REED P20 WITH THE FLAGS SET TO ALLOW TRACKING AND UPDATING.
 - (D) IF P00 IS SELECTED, THE RENDEZVOUS FLAG IS RESET (SHUTS OFF P20) AND P00 IS STARTED.
 - (E) IF A PROGRAM OTHER THAN P20 AND P00 IS KEYED IN, THE NEW PROGRAM WILL BE STARTED AND THE PROG LIGHTS WILL DISPLAY THE NEW PROGRAM. THE COMPUTER WILL THEN ATTEMPT TO RESTART P20 AND WILL BE SUCCESSFUL IF P20 WAS RUNNING IN THE BACKGROUND AND THE NEW PROGRAM WILL ALLOW TRACKING.

| | | | | | | |
|-------------|-----|--------|------|-----------|------|---------------|
| PROG CNT | CMC | GROUND | CREW | CHECKLIST | TIME | TOTAL TIME |
|-------------|-----|--------|------|-----------|------|---------------|

| | | |
|-------|-------------------------------|--|
| | . CMC ROUTINE SELECTION | |
| | . | |
| | . | |
| ----- | | |
| | IS MAX OR FLAG SET? | |
| | ----- | |
| | . N . Y | |
| | . | |
| | . | |
| | . | |
| | . | |
| | . | |
| | . | |
| | . | |
| | . | |
| | . | |
| | . | |

| | |
|--|--------------------------------|
| | . CREW ROUTINE SELECTION |
| | . |
| | . |
| | . |
| | . |
| | . |
| | . |
| | . |
| | . |
| | . |
| | . |
| | . |
| | . |
| | . |
| | . |

SET MAX
DEAD-
BAND IN
RCS DAP.

SET MIN DEAD-
BAND IN RCS DAP.

HOLD .
..... SNAP .

FLASH VERR 27 TO
REQUEST PLEASE PER-
FORM CHANGE OF
PROGRAM
V37 IN BLANK
P1 BLANK
P2 BLANK
P3 BLANK

WAIT FOR KEYBOARD
ENTRY TERMINATE
FLASH ON RECEIPT OF
OF XXF

RECEIVE V37EYX
TO REQUEST NEW
PROGRAM.

++
+00
++
RCP
607

RAN ENTRY
FROM V37
WITH PROGRAM
ROO SPECIFIED

MONITOR DSKY:
OBSERVE VERR 27
FLASH TO REQUEST
PLEASE PERFORM
CHANGE OF PROGRAM.

KEY IN DESIRED
PROGRAM:
XXF

KEY IN DESIRED
PROGRAM:
V37EYX

#20

#30

#40

#50

#60

ZERO RENDEZ-
VOUS OPTICS
MARK COUNTER.

#230

ZERO RENDEZ-
VOUS VHF
RANGING MARK
COUNTER

#240

RESET THE Z-AXIS
FLAG

#250

COMMAND ZERO RATE
IN THE RCS DAP (TO
STOP RATE DRIVE
FROM R201)

#260

RESET THE TRACK FLAG

#270

RESET THE UPDATE
FLAG.

#280

.....

RESET STICK FLAG

.....

.....

SHUT OFF UPLINK ACTY
LIGHT

.....

.....

PESET VHF RANGE
FLAG

.....

.....

IS MAX DB FLAG SET?

.N .Y
.....

.....

SET MAX
DEAD-
BAND IN
RCS DAP.

.....

.....

SET MIN DEAD-
BAND IN RCS DAP

.....

.....

IS NEW PROGRAM P00?

.N .Y
.....

ROO/COLOSSUS
ROO/SUNDANCE
ROO/LUMINARY

#290

#300

#310

#320

#330

ROO/COLOSSUS
ROO/SUNDANCE

RESET
THE REN-
DEZVOUS
FLAG.

IS NEW PROGRAM P20?

.Y .N

IS THE CURRENT
PROGRAM P20?

.N .Y

RESET
THE REN-
DEZVOUS
FLAG.

IS THE RENDEZVOUS
FLAG SET?

.Y .N

SET THE TRACK
FLAG

#340

#350

#360

#370

#380

1164

465

.
.
.
.
.
.

SET THE UPDATE
FLAG

.
.
.

DISPLAY NEW PROGRAM

.
.
.
.
.

. DISPLAY NEW
. PROGRAM AND
. GO TO PROGRAM
. SELECTED.

.
.
.

PLEASE DISPLAY
SYSTEM.

.
.
.

IS THE RENDEZVOUS
FLAG SET?

.N .Y
. .
. .
. .
. .
.

.
GO TO REOD
. P20 IN P20.

.
.
...
. .
EXIT EXIT

.
.
.
.
.
.
.
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.
.
.
.

MONITOR DISKY:
OBSERVE DISPLAY OF
NEW PROGRAM.

.
.....
.

.
.....
.

.
.
.
.

GO TO
PROGRAM
SELECTED

ROO/COLOSSUS
ROO/SUNDANCE
ROO/LUMINARY

#390

#400

#410

#420

#430

CHANGE CONTROL NOTES

REV 06 PCR 80.3
REV 07 PCR NASA 151
PCR MIT 66
REV 08 PCR 465
PCR 447
PCR 492
PCR 225
REV 09 PCR 507

00510000
00511000
00512000
00513000
00514000
00515000
00516000
00516001

IMU STATUS CHECK ROUTINE (R02)

LOGIC REV 03 04/12/68

PURPOSE: (1) TO CHECK WHETHER IMU IS ON AND IF ON WHETHER IT IS ALIGNED TO AN ORIENTATION KNOWN BY THE CMC.
 (2) TO ESTABLISH A PROGRAM ALARM AND STORE AN ALARM CODE IF THE IMU IS OFF OR NOT ALIGNED TO AN ORIENTATION KNOWN BY THE CMC.

ASSUMPTIONS: (1) THE ROUTINE IS ONLY AUTOMATICALLY SELECTED.

| PROG CONT | CMC | GROUND | CREW | CHECKLIST | TIME | TOTAL TIME |
|--------------|-----|--------|------|-----------|------|---------------|
|--------------|-----|--------|------|-----------|------|---------------|

.CMC
 .ROUTINE
 .SELECTION
 .
 .
 .

 START IMU STATUS
 CHECK ROUTINE (R02)

#10

.
 .
 .

 IS THE ISS ORIENTA-
 TION KNOWN FLAG SET?
 (CHECK REFSMMAT
 FLAG)

#20

.Y .N
 . .
 . .

 . IS THE ISS ON?

.Y .N
 . .
 . .
 . .
 . .
 . .
 . .
 . .
 . .
 . .
 . .
 . .
 . .
 . .
 . .

#30

```

-----
. TURN ON PROGRAM .
. ALARM LIGHT BUT .....
. DO NOT CHANGE .
. PRESENT DIS- .
. PLAY. (PROGRAM .
. ALARM DISPLAY .
. IF CALLED IS: .
.   V05N09 .
.   R1- .
.   R2- .
.   R3- .

```

```

-----
. MONITOR DSKY: .
.   DOFS PROGRAM .
. ALARM LIGHT INDICATE .
. THAT EITHER IMU IS .
. NOT ON OR NOT .
. ALIGNED? .

```

```

-----
. EXPECTED ALARM .
. CODE IS 00210 .

```

#40

```

-----
. TURN ON PROGRAM .
. ALARM LIGHT BUT .
. DO NOT CHANGE .
. PRESENT DISPLAY. .
. PROGRAM ALARM .....
. DISPLAY IF .
. CALLED IS: .
.   V05 N09 .
.   R1- .
.   R2- .
.   R3- .

```

```

-----
. EXPECTED ALARM .
. CODE AT THIS .
. TIME IS 00220 .

```

#50

#60

++
+03
++

```

-----
. .Y . .N .
. . . .
. . . .

```

#70

```

-----
. CALL PROGRAM ALARM .
. DISPLAY (V05N09) .
. TO IDENTIFY ABNOR- .
. MALITY. WHEN FIN- .
. IShed PUSH KEY .
. RELEASE. .

```

#80

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DIGITAL AUTOPILOT DATA LOAD
ROUTINE (R03)

LOGIC REV 06 07/09/68

- PURPOSE: (1) TO LOAD AND VERIFY CMC DIGITAL AUTOPILOT (DAP) DATA.
 (2) TO PROVIDE THE CREW A MEANS FOR SELECTING APPROPRIATE GCAST AUTOPILOTS. AFTER COMPLETION OF THIS ROUTINE, WHICH IDENTIFIES THE VEHICLE CONFIGURATION, THE USE OF VERB 46 ENTER ("ESTABLISH GNC CONTROL") WILL CAUSE THE APPROPRIATE DAP TO BECOME ACTIVE.
- ASSUMPTIONS: (1) THE MOMENTS OF INERTIA AND OTHER PERTINENT PARAMETERS ARE STORED IN THE CMC AS A FUNCTION OF THE KEYED IN WEIGHTS.
 (2) THE TVC DAP REDUCES THE VALUE FOR WEIGHT LINEARLY AS A FUNCTION OF SPS MANEUVER TIME DURING SPS THRUSTING PROGRAM (P40) MANEUVERS ONLY. ALL THRUSTING MANEUVERS THAT ARE PERFORMED WITHOUT USING P40 COULD CAUSE THE CMC'S KNOWLEDGE OF WEIGHT TO BE COMPROMISED.
- ++
 +05 (3) THIS ROUTINE IS SELECTED BY THE ASTRONAUT BY DSKY ENTRY.
 ++
 (4) THIS ROUTINE IS NOT AVAILABLE IF UNDER THRUST VECTOR CONTROL.

| PROG CONT | CMC | GROUND | CREW | CHECKLIST | TIME | TOTAL TIME |
|----------------|--------------------------------------|--------|--|-----------|------|---------------|
| | | | .CREW .ROUTINE .SELECTION | | | |
| | START DAP DATA LOAD ROUTINE (R03) | ..... | KEY IN V48E | | | #10 |
| | . | | | | | |
| | . | | | | | |
| ++ +06 + | IS ANOTHER EXTENDED VERB ACTIVE? | | | | | |
| + | .N .Y | | | | | |
| + | . | | | | | |
| + | . | | | | | |
| + | TURN ON OPERATER ERROR LIGHT. | | | | | #20 |
| + | . | | | | | |
| + | . | | | | | |
| + | . | | | | | |
| + | . | | | | | |
| + | . | | | | | |

```

+
+
+
+
+
+
+
+
+06
++

```

EXIT

#30

```

HOLD .
.....
SNAP .

```

```

-----
FLASH VERB-NOUN TO
REQUEST RESPONSE AND
DISPLAY DAP CONFIG-
URATION DATA:
  V04 N46
  R1-ABCDE
  R2-ABCDE
  R3-BLANK

```

```

R1 DATA CODE:
A-VEHICLE CONFIG.
CODE:
  0-NO DAP
  1-CSM
  2-CSM + LM
    (ASCENT PLUS
    DESCENT)
  3-SIVR
  6-CSM + LM
    (ASCENT ONLY)
B-QUAD AC FOR
+X TRANS CODE:
  0-DON'T USE
  QUAD
  1-USE QUAD
C-QUAD BC FOR
+X TRANS CODE:
  0-DON'T USE
  QUAD
  1-USE QUAD
D-DEADBAND CODE:
  0-0.5 DEG
  1-5.0 DEG
E (LSB)-MANEUVER
RATE CODE:
  0-0.05 DEG/SEC
  1-0.2 DEG/SEC
  2-0.5 DEG/SEC
  3-4.0 DEG/SEC
NOTE: IF BOTH B+C
      DISPLAY ZERO
      THIS MEANS 1-1

```

```

-----
MONITOR DSKY:
OBSERVE VERB-NOUN
FLASH TO REQUEST
RESPONSE AND DISPLAY
OF DAP CONFIGURATION
DATA

```

#40

```

-----
AM I SATISFIED WITH
THE STORED DAP CON-
FIGURATION DATA?

```

#50

```

  .Y      .N

```

#60

#70

R2 DATA CODE:
 A-QUAD AC OR RD
 ROLL CODE
 0-USE RD
 1-USE AC
 B-QUAD A CODE
 0-DON'T USE
 QUAD
 1-USE QUAD
 C-QUAD B CODE
 0-DON'T USE
 QUAD
 1-USE QUAD
 D-QUAD C CODE
 0-DON'T USE
 QUAD
 1-USE QUAD
 E-QUAD C CODE
 0-DON'T USE
 QUAD
 1-USE QUAD

#80

#90

#100

 .
 .
 .

 WAIT FOR KEYBOARD
 ENTRY

 KEY IN PRO-
 CEED

 .
 .
 .

 TERMINATE FLASH UPON
 RECEIPT OF PROCEED
 OR NEW DATA

 KEY IN V21E, V22E,
 OR V24E AND LCAD DE-
 SIRED DATA CODES IN
 R1, R2

#110

 .PROCEED .NEW DATA
 .
 .
 .
 .
 .
 .
 .

 TRANSFER STORE DATA
 DATA TO -----
 DAP .

#120

 DID THE ASTRONAUT
 SELECT MAXIMUM DEAC-
 BAND (D IN R1 = 1)?

#130

 .N .Y
 .
 .
 .
 .
 .
 .
 .

RESET
MAX DB
FLAG

#140

SET MAX DB
FLAG

#150

HOLD .
.....
SNAP .

FLASH VERB-NOUN TO
REQUEST RESPONSE AND
DISPLAY CSM AND LM
WEIGHTS:
V06 N47
R1-CSM WEIGHT
R2-LM WEIGHT
R3-BLANK

CSM WEIGHT-WEIGHT OF
THE CSM IN POUNDS TO
THE NEAREST POUND.

LM WEIGHT-WEIGHT OF
THE LM IN POUNDS TO
THE NEAREST POUND.

MONITOR DSKY:
OBSERVE VERB-NOUN
FLASH TO REQUEST
RESPONSE AND DISPLAY
OF CSM AND LM WEIGHT

#160

IS THE LM ATTACHED?

.Y .N
. .
. .

#170

ARE THE VALUES
FOR CSM AND
LM CORRECT?

.N .Y
. .
. .

IS THE CSM
WEIGHT
CORRECT?

#180

.Y .N

475

```
-----  
WAIT FOR KEYBOARD  
ENTRY
```

```
-----  
KEY IN  
PROCEED  
-----
```

```
-----  
KEY IN V21E,  
V22E, OR V24E  
AND LOAD  
CORRECT DATA  
-----
```

```
-----  
KEY IN V21E  
AND LOAD  
CORRECT DATA  
-----
```

```
-----  
TERMINATE FLASH UPON  
RECEIPT OF PROCEED  
OR NEW DATA
```

```
-----  
.P      .NEW  
.R      .DATA  
.O      .  
.C      .  
.E      -----  
.E      STORE DATA  
.D      -----  
.  
.  
.  
.  
.  
-----
```

```
-----  
IS THE VEHICLE CON-  
FIGURATION CODE  
EQUAL TO 0 OR 3?  
-----
```

```
.Y      .N  
.  
.  
.  
.....  
.  
.  
.  
.  
.  
.  
.  
.
```

#190

#200

#210

#220

#230

#240

+ .
 + .
 + .
 + .
 + .
 + .
 05 .
 ++ .

 . IS VEHICLE CONFIGUR-
 . ATION CODE EQUAL TO
 . 2 OR 6?

. .N .Y
 . .
 . .

 . TRANSFER TRANSFER
 . CSM WEI- LM + CSM
 . GHT TO WEIGHT TO
 . DAP DAP

#250

HOLD .

 SNAP .

. FLASH VERB-NOUN TO
 . REQUEST RESPONSE AND
 . DISPLAY GIMBAL ACTU-
 . ATCR TRIM VALUES:
 . V06 N48
 . R1-PITCH TRIM
 . R2-YAW TRIM
 . R3-BLANK

. MONITOR DSKY:
 . OBSERVE VERB-NOUN
 . FLASH TO REQUEST
 . RESPONSE AND DISPLAY
 . OF GIMBAL ACTUATOR
 . TRIM VALUES

 . .
 . .

#260

. PITCH TRIM AND YAW
 . TRIM-SPS ENGINE BELL
 . TRIM ANGLES AT
 . IGNITION DATA
 . TAKEN IN DEGREES
 . TO NEAREST .01
 . DEGREE.

. DO THESE VALUES
 . AGREE WITH MY CARRY
 . ON DATA?

#270

. Y. .N
 . .
 . .
 . .

#280

 . WAIT FOR KEYBOARD
 . ENTRY

. KEY IN PROCEED

417

R03/COLUSSUS

TERMINATE FLASH UPON
RECEIPT OF PROCEED
OR NEW DATA

KEY IN V21F, V22F,
OR V24F AND LOAD THE
CORRECT DATA

P. . NEW
P. . DATA
Q. .
C. .
E. . STORE DATA
E. .
D. .
.
.

TRANSFER
DATA TO DAP

.
.
...
.
EXIT R03

#290

#300

#310

CHANGE CONTROL NOTES

REV 04 PCR 123
PCR 151
REV 05 PCR 423
PCR 474
REV 06 PCR 206

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S-BAND ANTENNA ROUTINE (R05)

LOGIC REV 10 11/27/68

PURPOSE: (1) TO COMPUTE AND DISPLAY THE TWO STEERABLE S-BAND ANTENNA GIMBAL ANGLES WHICH WILL POINT THE ANTENNA TOWARD THE CENTER OF THE EARTH.

- ASSUMPTIONS: (1) THIS ROUTINE CAN BE INITIATED ONLY WHILE THE CMC IDLING PROGRAM (P00) IS IN OPERATION. (2) THE IMU IS ON AND ALIGNED (3) THIS ROUTINE IS SELECTED BY THE ASTRONAUT BY DSKY ENTRY.

Table with 7 columns: PROC CONT, CMC, GROUND, CREW, CHECKLIST, TIME, TOTAL TIME. It contains a flowchart for the S-BAND ANTENNA ROUTINE (R05) with decision points like 'IS THE CURRENT PROGRAM P00?' and 'IS ANOTHER EXTENDED VERB ACTIVE?'. Total time markers #10 and #20 are present.

481

R05/COLOSSUS
R05/LUMINARY

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#90

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.....
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.....
.....

#100

HOLD
MON
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#110

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#120

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#130

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R05/COLOSSUS
R05/LUMINARY

R-577 CHAPTER V
SECTION 5.6.6

++
+09
+
+
+
+
+
+
+
+
+
+
+
+
+
+
+
+
+
+09
++

NOTE:
THIS LOOP
WILL BE
PERFORM-
ED AT A
FREQUENCY
NOT LESS
THAN ONCE
EVERY 3
SECONDS.

WAIT FOR KEYBOARD
ENTRY

CONSIDERING THE PRE-
SENT POSITION AND
ATTITUDE, DO THESE
ANGLES YIELD AN UN-
OBSTRUCTED ANTENNA
LOS TO THE EARTH
CENTER?

Y. .N

DO I WISH
TO MANEU-
VER THE
THE VEHI-
CLE AND
MONITOR
THE DIS-
PLAY TO
ACHIEVE
AN UNOBS-
TRUCTED
VIEW OF
THE FAR-
TH?

#140

#150

#160

#170

#180

#190

.N .Y

SET AN-
TENNA TO
THESE
ANGLES

#200

USING
THE RHC
MANEU-
VER THE
VEHICLE
UNTIL
SATIS-
FACTORY
ANGLES
ARE AC-
HIEVED.

#210

#220

KEY IN PROCEED

#230

EXIT
R05

TERMINATE FLASH UPON
RECEIPT OF PROCEED

#240

.P
.R
.D
.C
.E
.F
.D
.
.

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. .
. .
. .
. .
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. .
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. .
EXIT
R05

#250

CHANGE CONTROL NOTES

LOGIC REV 09 PCR MIT 66
REV 10 EDITORIAL

48

RENDEZVOUS TRACKING SIGHTING MARK ROUTINE (R21)

LOGIC REV OR 11/27/68

PURPOSE: (1) TO PERFORM SIGHTING MARKS IN CONJUNCTION WITH THE RENDEZVOUS NAVIGATION PROGRAM (P20).

ASSUMPTIONS: (1) SIGHTINGS ARE MADE ON THE LM USING THE SXT.

PCR (2) WHEN THE CMC ACCEPTS A MARK IT RECORDS AND STORES 5 ANGLES (3 LCOUS AND 2 OCOUS) AND THE TIME OF MARK POSITION
 401 #1 AND MOVES PREVIOUS MARK DATA (IF ANY) TO POSITION #2. IF A MARK IS REJECTED (BY PRESSING MARK REJECT BUTTON) THE
 ++ MARK DATA IN POSITION #1 IS ERASED.
 +08 THE RENDEZVOUS TRACKING DATA PROCESSING ROUTINE (R22) ATTEMPTS TO PROCESS THE MARK DATA (IF ANY) IN POSITION #2
 ++ ONCE EVERY 4 SECONDS. IF DATA IS IN POSITION #2, IT IS MOVED TO POSITION #3 FOR PROCESSING BY (R22). IF NO DATA IS IN
 POSITION #2, R 22 INTERROGATES POSITION #2 AFTER 4 SECONDS.
 IF MARKS ARE MADE AT A GREATER FREQUENCY THAN R22 PROCESSES THEM THE OVERFLOW FROM POSITION #2 IS LOST.

(3) THE TRACKING ATTITUDE ROUTINE (R61) WILL AUTOMATICALLY HOLD RENDEZVOUS REFERENCE VECTOR AIMED AT THE LM, IF THE
 SC CONTROL SWITCH IS PLACED AT CMC, IF THE AUTOMODE IS SELECTED AND IF THE PREFERRED ATTITUDE FLAG IS SET.
 IF THE FREE MODE IS SELECTED THE ASTRONAUT MAY HOLD THE LM IN THE FIELD OF VIEW USING THE MINIMUM IMPULSE CONTROLLER.
 IF THE ATTITUDE HOLD MODE IS SELECTED THE ASTRONAUT MAY HOLD THE LM IN THE FIELD OF VIEW USING THE ROTATIONAL HAND
 CONTROLLER.

(4) THIS ROUTINE IS MANUALLY SELECTED BY THE ASTRONAUT BY KEYING IN V57E.

| PROG CONT | CMC | GROUND | CREW | CHECKLIST | TIME | TOTAL TIME |
|---|---|--------|---|-----------|------|---------------|
| | | | .CREW .ROUTINE .SELECTION | | | |
| | ----- | | | ----- | | |
| | START RENDEZVOUS TRACKING SIGHTING MARK ROUTINE (R21) | | KEY IN V57E | | | #10 |
| | | | . | | | |
| | | | . | | | |
| ++ +08 + + + + + + + + | ----- | | | ----- | | |
| | IS ANOTHER EXTENDED VEH ACTIVE? | | | | | |
| | N. | | .Y | | | #20 |
| | . | | . | | | |
| | . | | . | | | |
| | . | | . | | | |
| | . | | . | | | |
| | . | | . | | | |
| | . | | . | | | |
| | . | | . | | | |
| | . | | . | | | |
| | . | | . | | | |


```

. E . . . . .
. J . . . . .
. F . . . . .
. C . . . . .
. T . . . . .
. . . . .

```

```

-----
ERASE
MARK DATA
IN POSI-
TION #1
(IF ANY)
-----

```

```

-----
IS THERE
MARK DATA
IN POSI-
TION #1?
-----
. Y . . . . . N
. . . . .
. . . . .

```

```

-----
TRANSFER
MARK DATA
FROM POSI-
TION #1 TO
POSITION
#2
-----

```

```

-----
DO I WISH TO
MAKE MORE MARKS
-----

```

```

. Y . . . . . N
. . . . .
. . . . .

```

```

-----
KEY IN PROCEED
-----

```

```

-----
TURN OPTICS MODE
SWITCH TO CMC
-----

```

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. . . . .
. . . . .
. . . . .
EXIT R21

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#140

#150

#160

#170

#180

488

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491

RENDEZVOUS TRACKING DATA PROCESSING ROUTINE (R22)

LOGIC REV 16 11/27/68

PURPOSE: (1) TO PROCESS RENDEZVOUS SIGHTING MARK DATA TO UPDATE THE STATE VECTOR OF EITHER THE CSM OR LM AS DEFINED BY THE STATE VECTOR FLAG (SEE P20).

(2) TO PROCESS RENDEZVOUS VHF RANGING DATA TO UPDATE THE STATE VECTOR OF EITHER THE CSM OR LM AS DEFINED BY THE STATE VECTOR FLAG (SEE P20).

ASSUMPTIONS: (1) THIS ROUTINE IS AUTOMATICALLY SELECTED BY THE RENDEZVOUS NAVIGATION PROGRAM (P20).

(2) V06N49 DISPLAYED IN THIS ROUTINE IS A PRIORITY DISPLAY AND WILL REMAIN UP A MINIMUM OF 2 SECONDS. RESPONSE AFTER 2 SECONDS WILL CAUSE THE PROGRAM TO CONTINUE AS DESCRIBED.

| PROG CONT | CMC | GROUND | CREW | CHECKLIST | TIME | TOTAL TIME |
|--------------|-----|--------|------|-----------|------|---------------|
|--------------|-----|--------|------|-----------|------|---------------|

.CMC
.ROUTINE
.SELECTION

START RENDEZVOUS
TRACKING DATA PROC-
ESSING ROUTINE (R22)

#10

SET VHF TIMER
TO ZERO

#20

.
. "R"
. .
. .
. .

#30
.
.
.
.
.
.

GO TO
"C"

#150

"C"
.
.
.
.
.
.

#160

BASED ON THE DATA
AND ITS SOURCE
(OPTICS OR VHF AND,
IF OPTICS-PRIMARY OR
BACK UP)
CALCULATE THE RE-
QUIRED CORRECTION
TO UPDATE THE STATE
VECTOR DESIGNATED BY
THE STATE VECTOR
FLAG (SEE P20).
FOR DESCRIPTION
OF UPDATE PROCESS
REFER TO SECTION
5.2.5.2.2 OF R577

#170

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.
.

#180

IS THIS THE 2ND
OPTICS CORRECTION
FOR THIS MARK?

.Y .N
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#190

494

495

 . IS THE MAGNITUDE
 . OF THE STATE VECTOR
 . CHANGE GREATER THAN
 . THE TEST TOLERANCE
 . STORED IN ERASABLE
 . MEMORY?
 . FOR DEFINITION
 . OF TEST TOLERANCE
 . REFER TO ERASABLE
 . LOAD FOR THE SPECI-
 . FIC MISSION.

#200

0001

.N .Y
 .
 .
 .
 .
 .
 .
 .

#210

0001

POSS
 PRIO
 HOLD FLASH VERB-NOUN TO .
 REQUEST RESPONSE AND .
 SNAP DISPLAY EXCESSIVE
 UPDATE PARAMETERS.
 . V06 N49
 . R1-DELTA R
 . R2-DELTA V
 . R3-SOURCE CODE

 . MONITOR DSKY: DOES .
 VERB NOUN FLASH TO .
 REQUEST RESPONSE AND .
 DISPLAY EXCESSIVE
 UPDATE PARAMETERS?
 .Y .N
 .
 .

 .

#220

0001

. DELTA R-MAGNITUDE
 . OF THE DIFFERENCE
 . BETWEEN THE POSITION
 . VECTOR BEFORE AND
 . AFTER INCORPORATION
 . OF THIS MARK DATA.
 . IN N.M. TO THE NEAR-
 . EST .1 NM.

 IS THE SOURCE CODE
 IN R3 = 1?

#230

. DELTA V-MAGNITUDE
 . OF THE DIFFERENCE
 . BETWEEN THE VELOCITY
 . VECTOR BEFORE AND
 . AFTER INCORPORATION
 . OF THIS MARK DATA.
 . IN FPS TO THE NEAR-
 . EST .1 FPS.

 . VERIFY THAT .
 MARKING WAS DONE .
 ON THE LM AND .
 DISCUSS OUT OF .
 TOLERANCE CON- .
 DITION WITH THE .
 GROUND, IF .
 POSSIBLE.

#240

. SOURCE CODE-DEFINES
 . SOURCE OF DATA:
 . 1 = OPTICS MARKS
 . 2 = VHF RANGING

 .
 .

++
+16
++
EDIT

WAIT 2 SECONDS

VERIFY (TO BE
DEFINED) AND
DISCUSS OUT OF
TOLERANCE CON-
DITION WITH THE
GROUND, IF
POSSIBLE.

#250

SHALL I INCORPORATE
THIS UPDATE?

#260

.Y .N

WAIT FOR KEYBOARD
ENTRY

KEY IN RE-
CYCLE V32E

#270

TERMINATE FLASH UPON
RECEIPT OF PROCEED
OR RECYCLE

KEY IN PROCEED

.P .R
.R .F
.O .C
.C .Y
.E .C
.E .L
.D .E

#280

IS SOURCE CODE =
1?

#290

.N .Y


```

+ 499 . . . .
+ . . . .
+ . . . .
+ . . . .
+ . . . .
+ . . . .
+ . . . .
+ . . . .
+ . . . .
+ . . . .
+ . . . .
+ . . . .
+16 . . . .
++ . . . .
PCN . . . .
570 . . . .

```

EXIT

IS R60 OPERATING?

.Y .N

#410

IS THE UPDATE FLAG SET?

.Y .N

#420

IS THE TRACK FLAG SET?

.N .Y

#430

IS VHF RANGE FLAG SET?

.Y .N

GO TO "D"

#440

#450

```

++ HAS MORE THAN 1
+16 MINUTE ELAPSED ON
++ THE VHF TIMER SINCE
EDIT THE LAST VHF MARK
WAS PROCESSED?

```

.Y .N

#460

```

.
.
.
.
.
.
.
.
.
.
.
GO TO
"0"
.

```

SET VHF TIMER TO
ZERO

#470

```

.
.
.

```

READ RANGE FROM THE
VHF DATA LINK AND
READ TIME

#480

```

.
.
.

```

IS THE UPDATE FLAG
SET?

```

. Y . N
.
.
.
.
.
.
GO TO
"B"
.
.
.
.

```

#490

IS DATA GOOD DIS-
CRETE PRESENT?

#500

```

. Y . N
.
.
.

```

. LIGHT TRACKER
. FAIL LIGHT

#510

```

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```

500

501

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.
.
.

GO TO
"R"

R22/COLOSSUS

SHUT OFF TRACKER
FAIL LIGHT.

#520

.
.
.

SET SOURCE CODE TO 2

.
.
.
.
.
.
.
GO TO
"C"

#530

CHANGE CONTROL NOTES

LOGIC REV 13 PCR# MIT 54
LOGIC REV 14 PCR MIT 66
LOGIC REV 15 PCR MIT 465
PCR 440
PCR 468
PCR 491
PCR 226
LOGIC REV 16 PCN 570

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BACKUP RENDEZVOUS TRACKING SIGHTING MARK ROUTINE (R23) LOGIC REV 08 11/27/68

PURPOSE: (1) TO PERFORM SIGHTING MARKS IN CONJUNCTION WITH THE RENDEZVOUS NAVIGATION PROGRAM (P20) BY USE OF A BACKUP OPTICAL DEVICE.

ASSUMPTIONS: (1) THE ASTRONAUT KNOWS THE COORDINATES (OPTICS) OF THE ALTERNATE LOS HE MUST USE FOR THIS ROUTINE
 EDIT
 ++ (2) WHEN THE CMC ACCEPTS A MARK IT RECORDS AND STORES THE 3 ICDU'S, THE CONTENTS OF NOUN 94 AND THE TIME OF MARK IN
 +08 POSITION #1 AND MOVES PREVIOUS MARK DATA (IF ANY) TO POSITION #2. IF A MARK IS REJECTED BY KEYING IN V86E THE MARK
 ++ DATA IN POSITION #1 IS ERASED.
 PCR THE RENDEZVOUS TRACKING DATA PROCESSING ROUTINE (R22) ATTEMPTS TO PROCESS THE MARK DATA (IF ANY) IN
 491 POSITION #2 ONCE EVERY 4 SECONDS. IF DATA IS IN POSITION #2, IT IS MOVED TO POSITION #3 FOR PROCESSING BY (R22). IF
 ++ NO DATA IS IN POSITION #2, R22 INTERROGATES POSITION #2 AFTER 4 SECONDS.
 +08
 ++ (3) THIS ROUTINE IS MANUALLY SELECTED BY THE ASTRONAUT BY KEYING IN V54E.

| PROG CONT | CMC | GROUND | CREW | CHECKLIST | TIME | TOTAL TIME |
|---|---|--------|---|-----------|------|---------------|
| | | | .CREW .ROUTINE .SELECTION | | | |
| | ----- START BACK UP REN- DEZVOUS TRACKING SIGHTING MARK ROU- TINE (R23) ----- | ..... | ----- KEY IN V54E ----- | | | #10 |
| | . . . | | | | | |
| ++ +08 + + + + + +08 ++ | ----- IS ANOTHER EXTENDED VERB ACTIVE? ----- N. Y. ----- . TURN ON OPERATOR . ERROR LIGHT ----- | | | | | #20 |
| PCN 586 | | | | | | |

```

.
.
.
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.
.
.
.
.
.
EXIT
.
.

```

#30

```

-----
IS THE RENDEZVOUS
FLAG SET?
-----

```

```

.Y           .N
.
.
.

```

#40

```

-----
IS TRACK FLAG
SET (SEE P20)?
-----

```

```

.Y           .N
.
.
.

```

```

++
+08
+
+
+
+
+08
++
EDIT
PCR
206

```

```

-----
. TURN ON PRO-
. GRAM ALARM
. LIGHT. (NOTE:
. ALARM CODE
. IF CALLED BY
. ASTRONAUT
. IS:
. V05N09
. R1-
. R2-
. R3-
. EXPECTED
. ALARM CODE
. AT THIS TIME
. IS 406
-----

```

```

-----
MONITOR DSKY:
DOES PROGRAM
ALARM INDICATE
THAT THE RENDEZVOUS
NAVIGATION PROGRAM
(P20) IS NOT IN
PROCESS?
-----

```

#50

```

.Y           .N
.
.
.
.
.
.
.
.

```

#60

```

.
.
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.
.
.
.
.
EXIT
.
.
.
.
.
.
.
.
.
.

```

```

-----
THIS ROUTINE
MAY NOT BE SE-
LECTED AT THIS
TIME. PRESS
ALARM RESET TO
RESET PROGRAM
ALARM
-----

```

#70

```

.
.
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.
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.
.
EXIT
.
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#80

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.

```

HOLD .. FLASH VERB-NOUN TO
 REQUEST RESPONSE AND
 SNAP .. DISPLAY ALTERNATE
 LOS COORDINATES
 VJ6 N94
 R1 SHAFT
 R2 TRUNNION
 R3 BLANK

 SHAFT-OPTICS SHAFT
 ANGLE IN DEGREES TO
 NEAREST .01 DEGREES
 TRUNNION-OPTICS
 TRUNNION ANGLE IN
 DEGREES TO NEAREST
 .001 DEGREES

MONITOR DSKY:
 OBSERVE VERB-NOUN
 FLASH TO REQUEST
 RESPONSE AND DISPLAY
 NEW OCDU ANGLES.

NOTE: THE VALUE OF
 THESE REGISTERS
 SHOULD CORRESPOND TO
 THE CHOSEN ALTERNATE
 LOS.

(THE NOMINAL ANGLES
 TO BE USED FOR COAS
 SIGHTINGS ARE:
 R1-0000
 R2-57470)

ARE THE DISPLAYED
 ANGLES CORRECT FOR
 THE CHOSEN LOS?

.Y .N

WAIT FOR KEYBOARD
 ENTRY:

KEY IN V24F
 AND LOAD
 ANGLES.

TERMINATE FLASH
 UPON RECEIPT OF NEW
 DATA OR PROCEED

KEY IN
 PROCEED

.NEW .PROCEED
 .DATA .

#90

#100

#110

#120

#130

STORE
NEW DATA

#140

HOLD.
SNAP

FLASH VERB-TO
REQUEST PLEASE PER-
FORM ALTERNATE LOS
SIGHTING MARK
V53 N BLANK
R1-BLANK
R2-BLANK
R3-BLANK

MONITOR DSKY:
OBSERVE VERB
FLASH TO REQUEST
PLEASE PERFORM AL-
TERNATE LOS SIGHTING
MARK.

#150

WAIT FOR KEYBOARD
ENTRY

USING THE ROTATIONAL
HAND CONTROLLER PO-
SITION THE SPACE-
CRAFT SO THAT THE
LM IS PRECISELY
ALONG THE LOS
CHOSEN.

#160

KEY IN ENTER

#170

WAS SIGHTING SATIS-
FACTORY?

.N .Y

#180

#190

TERMINATE FLASH
UPON RECEIPT
OF ENTER, V86E
OR PROCEED

.V .E .P
.8 .N .R
.6 .T .O
.E .E .C
 .R .E
 .E
 .D

ERASE
MARK DATA
IN POSI-
TION #1
(IF ANY)

IS THERE
MARK DATA
IN POSI-
TION #1?

.Y .N

TRANSFER
MARK DATA
FROM POSI-
TION #1 TO
POSITION
#2

.....
. PROCEED
.....

KEY IN V86E

DO I WISH TO
MAKE MORE MARKS?

.Y .N

.....
KEY IN PROCEED

.
.
.
EXIT
R23

#200

#210

#220

#230

#240

STORE 3 ICDU'S,
CONTENTS OF
NC4N 94 AND
TIME IN POSI-
TION #1 AND TAG
DATA AS BACK UP
DATA FOR USE BY
R22

#250

#260

IS THERE MARK DATA
IN POSITION #1?

.Y .N
.
.

#270

TRANSFER
MARK DATA
FROM POSITION
#1 TO POSITION
#2.

.
.
.
...
EXIT EXIT
R23 R23

#280

CHANGE CONTROL NOTES

REV 07 PCR 206
 PCR 487
REV 08 PCR 491
 PCN 586

ORBIT PARAMETER DISPLAY ROUTINE (R30)

LOGIC REV 11 11/27/68

PURPOSE: (1) TO PROVIDE THE ASTRONAUT PERTINENT ORBITAL PARAMETERS COMPUTED BY THE CMC TO SUPPLEMENT ORBITAL INFORMATION PROVIDED HIM BY THE GROUND.

ASSUMPTIONS: (1) THE COMPUTATIONS MADE DURING THIS ROUTINE ARE UPDATED ABOUT EVERY TWO SECONDS ONLY IF THE AVERAGE G ROUTINE IS ON WHEN THIS ROUTINE IS CALLED.

(2) THE VALUE OF TFF OR TF PER WILL BE MADE TO COUNT DOWN IF THE AVERAGE G ROUTINE IS NOT ON WHEN THIS ROUTINE IS CALLED.

++
 +11 (3) IF TFF IS NOT COMPUTABLE (PER ALT IS GREATER THAN 300,000 FT IN EARTH ORBIT OR GREATER THAN 35,000 FT IN LUNAR ORBIT) THE CMC WILL SET TFF EQUAL TO -59859 AND COMPUTE TF PER AND STORE IT IN N32. THE ASTRONAUT MAY CALL IT BY KEYING IN N32E.
 ++
 EDIT
 ++

+10 (4) IF THIS ROUTINE IS CALLED WHILE THE EARTH ORBIT INSERTION PROGRAM (P11) IS ON OR WHEN IN CMC IDLE PROGRAM (P00), +AND THE CMC WILL DISPLAY SPLERROR IN N50 BY KEYING IN N50E. IF THE APOGEE IS ABOVE 300,000 FT ALTITUDE AND THE PERIGEE IS BELOW 300,000 FT ALTITUDE ABOVE THE LAUNCH PAD, SPLERROR WILL BE DISPLAYED AS THE DISTANCE BETWEEN THE PREDICTED AND THE DESIRED ABORT TARGET. IF THESE CONDITIONS ARE NOT SATISFIED, SPLERROR WILL BE DISPLAYED AS THE DISTANCE BETWEEN THE PRESENT POSITION VECTOR AND THE DESIRED ABORT TARGET.
 +11
 +
 +

(5) REFER TO THE NOUN LIST IN THE BACK OF THIS DOCUMENT FOR DEFINITION OF THE CONTENTS OF NOUNS 32 AND 50.

++
 PCRS 509 (6) THIS ROUTINE IS SELECTED BY THE ASTRONAUT BY DSKY ENTRY.
 AND 206

| PROG CONT | CMC | GROUND | CREW | CHECKLIST | TIME | TOTAL TIME |
|--------------|----------------------------|--------|--|-----------|------|------------------------------|
| | | | .CREW .ROUTINE .SELECTION | | | |
| | ----- | ----- | ----- | | | |
| | START ORBIT PARAMETER..... | ..... | KEY IN V 82 E | | | #10 |
| | DISPLAY ROUTINE (R30) | . | ----- | | | |
| | ----- | ----- | ----- | | | |
| | . | | . | | | |
| | : | | : | | | |
| | . | | . | | | |
| ++ | ----- | ----- | ----- | | | |
| +11 | IS ANOTHER EXTENDED | | | | | |
| + | VEPB ACTIVE? | | | | | |
| | ----- | ----- | ----- | | | |
| + | N. | Y. | . | | | |
| + | . | . | . | | | |
| + | . | . | . | | | |
| + | . | . | . | | | |
| + | . | . | . | | | |
| + | . | . | . | | | |
| | | | | | | #20 |
| | | | | | | R30/COLOSSUS R30/SUNDANCE |

+
+
+
+
+
+
+11
++
PCN
586

TURN ON OPERATOR
ERRCR LIGHT

EXIT

IS AVE G ROUTINE ON?

.Y .N

SET CMC ASSUMED
OPTION TO 00001.

HOLD

.....
SNAP

FLASH VERB-NOUN TO
REQUEST RESPONSE AND
DISPLAY OPTION CODE
FOR ASSUMED VEHICLE
V04 N12
R1-00002
R2-0000X
R3-BLANK

R1 IS THE OPTION
CODE FOR ASSUMED
VEHICLE.

R2 IS THE CMC ASSUM-
ED OPTION:
00001-THE VEHICLE
00002-OTHER VEHICLE

IS AVE G ROUTINE ON?

.Y .N

MONITOR DSKY:
OBSERVE VERB-NOUN
FLASH TO REQUEST
RESPONSE AND DISPLAY
OF OPTION CODE FOR
ASSUMED VEHICLE (LM
OR CSM)

#30

#40

#50

#60

#70

IS THE VEHICLE (LM
OR CSM) ASSUMPTION
CORRECT?

.Y .N

#80

WAIT FOR KEYBOARD
ENTRY

KEY IN PRO-
CEED

TERMINATE FLASH UPON
RECEIPT OF PROCEED
OR NEW DATA

.P .NEW
.R .CODE
.D .DATA

.C
.E
.E
.D

STORE CODE
DATA

KEY IN
V22F
AND LOAD
THE
DESIRED
VEHICLE
(LM OR
CSM)
CODE IN-
TO R2.

#90

#100

EXTRAPOLATE SELECTED
VEHICLE STATE VECTOR
TO PRESENT TIME
USING PRECISION
EQUATIONS.

#110

#120

TFF-TIME OF FREE
FALL TO 300,000 FT
FOR EARTH ORBIT
OR 35,000 FT FOR
LUNAR ORBIT.
ALTITUDE DEFINED
ABOVE THE LAUNCH
PAD RADIUS (EARTH
ORBIT) AND ABOVE
THE LUNAR RADIUS
AT THE MOST RECENT-
LY DEFINED LAND-
ING SITE (LUNAR
ORBIT).
IN MIN, SEC TO
NEAREST SEC. MAX
READING IS -59859
(IF PER ALT
IS GREATER
THAN 300,000/
35,000 FT THE TFF
DISPLAY WILL READ
-59859.)

#230

++
+10
++
PCR
524

NOTE: IF PER ALT OR
APD ALT EXCEEDS
SCALE THE DISPLAY
WILL BE 9999.9 NM.

#250

WAIT FOR KEYBOARD
ENTRY

KEY IN
RECYCLE
V32F

#260

TERMINATE FLASH UPON
RECEIPT OF PROCEED
OR RECYCLE

NOTE:
REFER TO ASSUMP-
TIONS FOR DEFINI-
TION OF ADDITIONAL
DISPLAYS AVAILABLE
IN THIS ROUTINE.
WHEN FINISHED WITH
THIS ROUTINE
KEY IN PROCEED

#270

RECYCLE PROCEED
OR AVE G
AUTOMATIC
RECYCLE
.....

#280

515

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EXIT

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.
.
EXIT

R30/COLOSSUS
R30/SUNDANCE
R30/LUMINARY

CHANGE CONTROL NOTES

REV 08 PCR MIT 66
REV 09 PCR 206
REV 09 PCR 490
REV 10 PCR 524
PCR 505
REV 11 PCN 586

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RENDEZVOUS PARAMETER DISPLAY ROUTINE NO 1 (R31)

LOGIC REV 08 11/27/68

PURPOSE: (1) TO DISPLAY AT ASTRONAUT REQUEST CMC CALCULATED RENDEZVOUS PARAMETERS (RANGE, RANGE RATE, THETA)

ASSUMPTIONS: (1) RANGE AND RANGE RATE ARE CALCULATED BY THE CMC ON THE BASIS OF THE STORED LM AND CSM STATE VECTORS AND DO NOT REQUIRE THAT THE ISS BE ON. THE ISS MUST BE ON AND ALIGNED TO A "KNOWN" ORIENTATION IF A CORRECT DISPLAY OF THETA IS DESIRED. THE RANGE/RANGE RATE/ THETA DISPLAY IS NOT INHIBITED HOWEVER IF THE IMU IS NOT ON AND ALIGNED.

(2) THE ROUTINE IS SELECTED BY THE ASTRONAUT BY DSKY ENTRY.

| PROG CONT | CMC | GROUND | CREW | CHECKLIST | TIME | TOTAL TIME |
|--------------|-----|--------|------|-----------|------|---------------|
|--------------|-----|--------|------|-----------|------|---------------|

.CRFW
.ROUTINE
.SELECTION
.
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| | | |
|-----------------------|-------|-------------|
| ----- | . | ----- |
| START | | KEY IN V83E |
| RENDEZVOUS PARAMETER | . | ----- |
| DISPLAY ROUTINE (R31) | . | |
| ----- | . | |

#10

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+08
+
+
+
+
+
+
+08
++
PCN
586

IS ANOTHER EXTENDED
VERB ACTIVE?

N. Y.
.
.
.

TURN ON OPERATOR
ERROR LIGHT

#20

EXIT

#30

R31/COLOSSUS
R31/SUNDANCE
R31/LUMINARY

319

R31/COLOSSUS
R31/SUNDANCE
R31/LUMINARY

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. . .
. . . EXTRAPOLATE LM
. . . STATE VECTOR TO
. . . TF FROM T USING
. . . COASTING INTE-
. . . GRATION ROUTINE.

#90

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+08
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EDIT

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#100

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. . . CALCULATE RANGE,
. . . RANGE RATE AND
. . . THETA

HOLD

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. . .

MON

. . .
. . . FLASH VERB-NOUN TO
. . . REQUEST RESPONSE AND
. . . DISPLAY RENDEZVOUS
. . . PARAMETERS:
. . . V16 N54
. . . R1-RANGE
. . . R2-RANGE RATE
. . . R3-THETA

. . .
. . . MONITOR DSKY:
. . . OBSERVE VERB-NOUN
. . . FLASH TO REQUEST
. . . RESPONSE AND DISPLAY
. . . OF RENDEZVOUS
. . . PARAMETERS.
. . . (NOTE: THESE PARA-
. . . METERS WILL BE
. . . UPDATED EVERY TWO
. . . SECONDS.

#110

. . .
. . . RANGE-CALCULATED
. . . RANGE TO LM. IN
. . . NAUTICAL MILES TO
. . . NEAREST .01 NM.

#120

. . .
. . . RANGE RATE-
. . . CALCULATED RANGE
. . . RATE BETWEEN CSM AND
. . . LM. NEGATIVE SIGN
. . . INDICATES CLOSING
. . . IN FPS TO NEAREST
. . . .1 FPS

#130

R31/COLOSSUS
R31/SUNDANCE
R31/LUMINARY

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. .
. .
. .
. THETA-ANGLE BETWEEN
. CSM +X AXIS AND THE
. LOCAL HORIZONTAL
. PLANE AT THE PRESENT
. TIME. FROM 0 TO 360
. DEGREES. IN DEGREES
. TO NEAREST .01
. DEGREE

#140

PCR
511
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+07
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#150

WAIT FOR KEYBOARD
ENTRY

#160

TERMINATE FLASH UPON
RECEIPT OF PROCEED

WHEN FINISHED WITH
THIS DISPLAY KEY IN
PROCEED

. PROCEED
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EXIT R31

. . .
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EXIT R31

#170

521

CHANGE CONTROL NOTES

LOGIC REV 5 PCR MIT 66
REV 6 PCR 495
REV 7 PCR 511
REV 8 PCN 586

00203000
00204000
00204001
00204002

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