SPS PREGRAM (P40)

LCGIC REV 16 11/27/68

PURPOSE: (1) TO COMPUTE A PREFERRED IMU ORIENTATION AND A PREFERRED VEHICLE ATTITUDE FOR A SPS THRUSTING MANEUVER.

(2) TO CALCULATE AND DISPLAY THE GIMBAL ANGLES WHICH WOULD RESULT WITH THE PRESENT IMU ORIENTATION IF THE VEHICLE WERE MANEUVERED TO THE PREFERRED VEHICLE ATTITUDE FOR A SPS THRUSTING MANEUVER. THE CREW IS THEREBY GIVEN AN OPPORTUNITY TO PERFORM THE MANEUVER WITH:

(A) THE PRESENT IMU CRIENTATION, IF THE MIDDLE GIMBAL ANGLE IS NOT GREATER THAN 45 DEGREES, AND THE IMU HAS BEEN ALIGNED WITHIN THE LAST 3 HRS.

(B) A NEW ORIENTATION ACHIEVED BY SELECTION OF P52.

(3) TO DO THE VEHICLE MANEUVER TO THE THRUSTING ATTITUDE.

(4) TO CONTROL THE GNCS DURING COUNTDOWN, IGNITION, THRUSTING, AND THRUST TERMINATION OF A GNCS CONTROLLED SPS MANEUVER.

ASSUMPTIONS: (1) THE TARGET PARAMETERS HAVE BEEN CALCULATED AND STORED IN THE CMC BY PRIOR EXECUTION OF A PRE-THRUSTING PROGRAM.

(2) THE REQUIREC STEERING EQUATIONS ARE IDENTIFIED BY THE PRIOR PRE-THRUST PROGRAM, WHICH EITHER SET OR RESET THE EXTERNAL DELTA V STEERING FLAG. FOR EXTERNAL DELTA V STEERING, VG IS CALCULATED ONCE FOR THE SPECIFIED TIME OF IGNITION. THEREAFTER BOTH DURING THRUSTING AND UNTIL THE CREW NOTIFIES THE CMC TRIM THRUSTING HAS BEEN COMPLETED THE CMC UPDATES VG ONLY AS A RESULT OF ACCELEROMETER INPUTS.

FOR LAMBERT STEERING VG IS CALCULATED AND UPDATED SIMILARLY, HOWEVER IT IS ALSO UPDATED PERIODICALLY BY LAMBERT SOLUTIONS TO CORRECT FOR CHANGES IN THE CSM STATE VECTOR.

(3) IT IS NORMALLY REQUIRED THAT THE ISS BE ON FOR 15 MINUTES PRIOR TO A THRUSTING MANEUVER.

(4) THE TTE CLOCK IS SET TO COUNT TO ZERO AT TIG.

(5) ENGINE IGNITION MAY BE SLIPPED BEYOND THE ESTABLISHED TIG IF DESIRED BY THE CREW OR IF INTEGRATION CAN NOT BE COMPLETED ON TIME.

(6) THE SPS THRUSTING PROGRAM DOES NOT MONITOR THE SC CONTROL DISCRETE (CHANNEL 31 BIT 15) DURING THRUSTING. THIS MEANS THAT THE CMC WILL CONTINUE TO GENERATE ENGINE ACTUATOR COMMANDS, SPS ENGINE ON DISCRETE, AND FDAI ATTITUDE ERROR NEFDLE COMMANDS UNTIL THE CMC SOLUTION INDICATES ENGINE OFF AT WHICH TIME THESE COMMANDS AND THE ENGINE ON DISCRETE ARE TERMINATED. HOWEVER, THIS PROGRAM IS NOT WRITTEN TO TAKE INTO ACCOUNT THE SITUATION WHERE CONTROL MAY BE TAKEN AWAY FROM THE GNOS AND THEN GIVEN BACK. AND IT IS NOT RECOMMENDED. IN EVENT CONTROL IS TAKEN AWAY FROM THE GNOS, THE CMC WILL ONLY BE RESPONSIBLE FOR COMPUTATION OF POSITION AND VELOCITY.

(7) ROUTINE RO3 HAS BEEN PERFORMED PRIOR TO SELECTION OF THIS PROGRAM. IN ORDER FOR THE GNCS TO PERFORM THE ATTITUDE MANEUVER AND CONTROL THE THRUSTING MANEUVER THE ASTRONAUT MUST KEY IN V46E AT SOME TIME PRIOR TO THE ATTITUDE MANEUVER.

(8) THE VALUE OF DELTA V REQUIRED WILL BE STORED IN THE LOCAL VERTICAL COORDINATE SYSTEM AND IS AVAILABLE DURING THIS PROGRAM UNTIL AVERAGE G TURN ON BY KEYING IN VO6NBL.

(9) THE ORBIT PARAMETER DISPLAY ROUTINE (R30) MAY BE CALLED DURING THIS PROGRAM BY KEYING IN V82E.

(10) THIS PROGRAM IS SELECTED BY THE ASTRCNAUT BY DSKY ENTRY.

P40/COLOSSUS

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PROG Cont	CMC	GR CUND	CREW	CHECKLIST	TIME	TOTAL TIME
			•CREW PROG• •SELECTION •			
			• • • •			#10
	START SPS PROGRAM (P40) DISPLAY PROGRAM 40	• • •	KEY IN SPS PROGRAM (P40) V37E 40E			
		•	MONITOR DSKY: Observe display of			#20
	 • •	•	PROGRAM 40			
	DO IMU STATUS CHECK RCUTINE (RO2)	- • • •	DO IMU STATUS CHECK ROUTINE (RO2)			#30
	IS EXTERNAL DELTA V Flag Set?	- -				
	• • • • • • • • • • • • • • • • • • •					#40
	ECSTEER IN STEFR LAW				P40/COLOSSUS	
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SET CSTEER=0 IN STEER LAW ------. -------------COMPUTE INITIAL THRUST DIRECTION AND INITIAL VALUE OF VG VECTOR AND STORE IN N81 (VG LOCAL VERT-[CAL] . *------------FROM INITIAL THRUST DIRECTION AND ENGINE BELL TRIM ANGLES COMPUTE PREFERRED IMU ORIENTATION: X = UNIT (X)-SM -CSM $Y = UNIT \{X | X | R\}$ -SM -CSM -Z =UNIT (X X Y) -SM -SM -SM WHERE: X = THE CSM X AXIS-CSM AT IGNITION (AT THE PRE-FERRED VE-HICLE ATTI-

R = THE CSM PDS-- ITION RADIUS VECTOR AT TIC.

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SET PREFERRED				
ORIENTATION FLAG				
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•				
STORE DESIRED ATTI- TUDE SPECIFICATION (TRIMMED ENGINE BELL CENTER LINE IN DI- RECTION OF INITIAL THRUST) FOR USE BY ATTITUDE MANEUVER ROUTINE (R60). THE FINAL ATTITUDE WILL BE COMPUTED (VEC- POINT) DURING R60, AND WILL POINT THE			#1	120
TRIMMED ENGINE BELL IN THE INITIAL THRUST DIRECTION. IN ORDER TO CONSERVE RCS FUEL AND NOT CONSTRAIN THE NON- CRITICAL ROLL ATT- TUDE, WINGS MAY NOT BE LEVEL IN THE COM- PUTED FINAL ATTITUDE			4]	130
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ET •5 DEGREE EADBAND IN RCS DAP•				
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DUTINE (P60)	• • • • • •	DD ATTITUDE MANEUVER Routine (R60)	*:	150
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P40/COLOSSUS

HOLD . SNAP .	FLASH VERB-NOUN TO REQUEST PLEASE PER- FORM ENGINE GIMBAL DRIVE TEST ENABLE V50 N25 R1-00204 R2-BLANK	•	MONITOR DSKY OBSERVE VERB-NOUN FLASH TO REQUEST PLEASE PERFORM ENGINE GIMBAL DRIVE TEST ENABLE		#160
	R3-BLANK				
	•		SHALL I ENABLE GIMBAL DRIVE TEST?		#170
	•		•N •Y		
	WAIT FOR KEYBOARC Entry	•	KEY IN ENTER		
	TERMINATE FLASH UPON Receipt of proceed Or enter	•	KEY IN PROCEED		#180
	•ENTER •PROCEED				·
	 INITIALIZE ENGINE GIMBALS TO O DEGREES IN PITCH AND YAW AND PER- FORM GIMBAL DRIVE 	•	MONITOR GIMBAL DRIVE SEQUENCE BY REFER- ENCE TO ANALOG DIALS		#190
	• TEST SEQUENCE AT • 2 SEC/STEP: • PITCH / YAW • 1 2 / 0		•		
	2 -2 / 0 3 0 / 0 4 0 / 2 5 0 / -2 6 0 / 0 . IN DEGREES.				#200
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	WAIT 4 SECONDS			
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				4000
	DRIVE SPS ENGINE		OBSERVE DIAL INDICA-	#220
	BELL TO TRIM PO-	•	TION OF ENGINE BELL	
	SITION		DRIVING TO TRIM	
		•	POSITION	
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HOLD .	DISPLAY ON DSKY:	_	MONITOR DSKY:	
	V06 N40	•	OBSERVE DISPLAY OF	#230
				#2.30
MON .	R1 - TFI	•	TFI, VG, AND DELTA	
	R2 - VG		VM	
	R3 - DELTA VM		**************************************	
	_			
	TFI - TIME FROM			
	SPS IGNITION. IN			
	MIN, SEC TO NEAR-			
	EST SEC. MAX			
	READING IS 59859.			
	ISIGN IS - BEFORE			#240
				PC 10
	NOMINAL TIG, +			
	THEREAFTER).			
	VG - MAGNITUDE OF THE			
	VELOCITY TO BE			
	GAINED BY THRUSTING			
	MANEUVER. IN FPS			
	TO NEAREST .1 FPS			
	DELTA VM-MEASURED			#250
	DELTA V MAGNITUDE			
	IN FPS TO NEAREST			
	1 FPS. THIS DIS-			
	PLAY SHOULD BE			
	00000 UNTIL ULLAGE			
	IS STARTED.			
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	•			#260
	SET TDEC = TIG			
	-30 SEC			
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	RESET TIG FLAG			#270
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	DO STATE VECTOR INTEGRATION (MID TO AVE) ROUTINE (R41).	• •	DO STATE VECTOR INTEGRATION (MID TO AVE) ROUTINE (R41). OBSERVE THAT THE	
	•		COMPUTER ACTIVITY Light is on until	#280
	•		COMPLETION OF Routine 41	
	•			
	•		•	
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	WAIT UNTIL TFI = -35 SEC		•	<i>,</i>
			•	#290
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	BLANK DISPLAY OF VERB-NOUN AND R1, R2, R3 AT TFI > -35 SEC	•	MONITOR OSKY: Observe that display Gdes blank At TFI = -35 SEC	
	•		•	#300
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	WAIT UNTIL THE =		•	
	-30 SEC		•	
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	REDISPLAY VO6N40 NON- Flashing and Call Average g rcutine.		MONITOR DSKY: Observe recisplay of Tfi, Vg, delta VM, At tfi = -30 sec.	#310
	•		TO INDICATE THAT THE	
	•		AVERAGE G ROUTINE IS Turned on. Observe	
	•		THAT THE COMPUTER ACTIVITY LIGHT	
	•		BLINKS ON EVERY 2 SECONDS DURING	#320
	•		PLOUDS DOLLIG	P40/COLOSSUS

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	•	AVERAGE G.	
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	•		#330
	•	MONITOR DSKY:	
		IN THE PERIOD FROM	
WAIT UN TFI =-5		TFI =-30 SEC UNTIL TFI =-25 SEC	
		DOES DELTA VM BECOME	
	•	GREATER THAN 2.0 FPS Indicating excessive	
	•	PIPA BIAS ERRCR?	
	•		#340
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	BURN TO BE		#350
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	• •	THC WHEN INDICATED	
	• •	BY CHECKLIST	
	STORF		
	• BURN • TIME	•	
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	• •	OBSERVE ULLAGE BUILD UP IN R3.	
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HOLD . MON .	CHANGE VERB BUT RE- TAIN PRESENT NOUN AND DISPLAYS IN R1, R2, R3, FLASH VERB- NOUN TO REQUEST PLEASE PERFORM ENG- INE ON ENABLE: V99 N40 R1 - TFI R2 - VG R3 - DELTA VM	•	MONITOR DSKY: OBSERVE VERB-NOUN FLASH TO REQUEST PLEASE PERFORM ENGINE ON ENABLE		380
	WAIT FOR KEYBOARD ENTRY		SHALL I PERMIT	#:	390
			IGNITION OR RE-IGNITION? • • • • • • • •		
		•	KEY IN PROCEED	#4	400
			SHALL I ATTEMPT TO COMPLETE THE Thrusting maneu- Ver by use CF The RCS?		
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SHUT OFF RCS DAP	
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TURN ON TVC DAP	
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	STEERING	•			
	TINE AS DESCRIBED	•			
	SECTION 5.3.3.4	•		#550	
	THIS DOCUMENT.	•			
	NOTE: IF AT ANY	•			
	E DURING THE USTING PERIOD	•			
	ROUTINE DETECTS	•			
	THRUST FAILURE	•			
17.0	ILL CEASE	•			
	RING (RATE COM-	•			
	SET TO ZERO),	•		#560	
	STOP CALCULAT-	•		#200	
	TIME FROM CUTOFF WILL DISABLE	•			
	TRACKING. IT	•			
	TURN ON THE				
	THRUST FAIL	•			
ROUT	FINE (R40) AND	•			
	SET THE TEC	•			
	ISTER EQUAL TO	•			
5985		•		#570	ł
	IN THE EVENT THIS FINE DETECTS VG	•			
	REASING IT WILL	•			
	N CN PROGRAM	•			
	RM LIGHT AND	•			
	RE ALARM CODE	•			
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• [DO THE SPS THRUST	• • •	DO THE SPS		
• '	FAIL ROUTINE (R4C).	* * * * * * * * * * * * * * * *	THRUST FAIL ROUTINE (R40)		
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CHANGE TFI DISPLAY TO TFC IN R1 VO6 N40 R1 - TFC R2 - VG	• ••••• •	MONITOR DSKY: Observe change o TFI DISPLAY TO T IN RI	
R3 - DELTA VM		•	
TFC - TIME FROM		•	
ENGINE CUTOFF.		•	
IN MIN AND SEC TO		•	
NEAREST SEC.		•	
MINUS BEFORE CUTOFF		•	
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•		MONITOR SPS	
•		THRUSTING:	
-		1. DSKY:	
-		R1-TFC	
•		SHOULD BE	
•		DECREASING	
-		DEVICEAJING	
•		R2-VG SHOULD	BE
•		DECREASING	0 C
•		DEGREM3 ING	
•		R3-DELTA VM	
•		SHOULD INCREA	SE
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•		2. FDAI-ATT. ERR	OR
•		SHOULD BE LESS T	
•		OR EQUAL TODE	
•		ATT RATES SHOULD	
•		LESS THAN OR EQU	
•		TO DEGREE/SEC	
- •		is blokely set	-
•		3. SPS CHAMBER	
•		PRESSURE (PC)	
•		SHOULD BE NORMAL	
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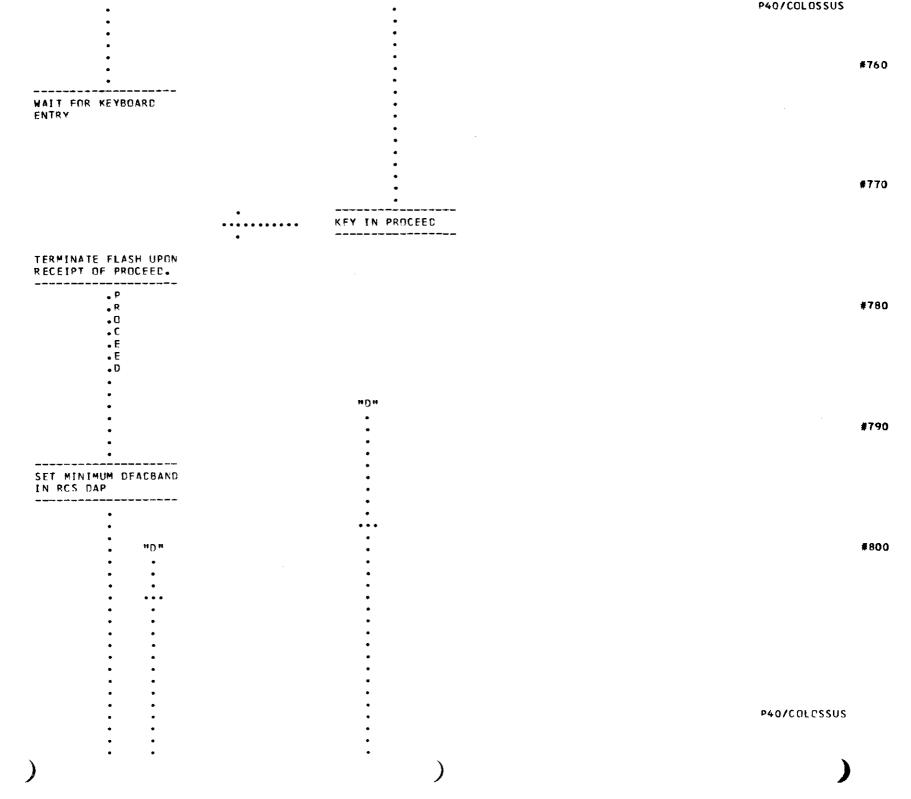
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•	MONITOR DSKY: .	
•	AS TEC AND VG GD .	
•	TO ZERO THRUST .	
•	SHOULD CUTOFF	
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CHC COMMANDS ENGINE	• •	
OFF WHEN INDICATED	• •	
BY CROSS PRODUCT	• •	
STEERING ROUTINE CR	• •	#680
IMPULSIVE THRUST	• •	****
TIMER (SET UP AT	• •	
IGNITION AS DEFINED In Section 5.3.3.3		
OF R5771	• •	
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WAIT ABOUT 2.5	• •	#690
SECONDS	• •	
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TURN OFF TVC	• •	
DAP	• •	
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	SET WIDE DEADBAND		• •	
	IN RCS DAP AND TURN RCS DAP ON.		• •	
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	•		• •	
	•		• •	#720
	•		MOVE MAIN PANEL	# 1 Z Q
	•		SWITCH TO OFF.	
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	•		•	
	MAINTAIN VG		•	
	COMPUTATIONS AFTER		•	
	CUTOFF FOR POSSIBLE		•	
	NULLING BY RCS		•	#730
	TRIMMING MANEUVER		•	VC14
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HOLD	•	•	MONITOR DSKY:	
	FLASH VERB-NOUN TO		OBSERVE VERB-NOUN	
	REQUEST PROCEFD.	•	FLASH TO REQUEST	
	HOLD DISPLAY OF TFC AT ITS VALUE WHEN		PROCEED AND DISPLAY OF TFC, VG AND DELTA	#750
	CMC COMMANDS ENGINE		VM.	*****
	CUTOFF			
	V16 N40		•	
	R1 - TFC R2 - VG		•	
	R3 - DELTA VM		•	
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HDLD . Mon .	FLASH VERB-NOUN TO REQUEST RESPONSE AND DISPLAY: V16 N85 R1-VGX(CSM) R2-VGY(CSM)	• ••••• •	MONITOR DSKY: DBSERVE VERB-NDUN FLASH TO REQUEST RE- SPONSE AND DISPLAY DF VG COMPONENTS.	#610
	R3-VGZ(CSM) (COMPONENTS OF THE VG VECTOR RESOLVED ALONG THE PRESENT		•	
++ +16 ++ ED IT PCR 206	CSM X,Y, AND Z CON- TROL AXES. THE VG VECTOR WILL BE UP- DATED BY THE STEER- ING LOOPS DURING EACH COMPUTATION CYCLE.		TC NULL OUT VG COM- PONENTS COMMAND MAN- UAL TRANSLATIONS AND ROTATIONS. (NOTE: THIS MANEUVER IS AT THE OPTION OF THE CPEW).	#820
	IN FPS TO THE NEAREST .1 FPS). 		•	
	•		•	#830
	WAIT FOR KEYBOARD Entry	•	KEY IN PROCEED	*030

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DATA TO CREW _____

. ---TRANSMIT ORBITAL....RECEIVE ORBITAL DATA

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. FRCM GROUND

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#840

P40/CULUSSUS

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	• •	
DO ROUTINE ROO		DO ROUTINE ROO
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• • •		• • •
•		•
EXIT		EXIT

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CHANGE CONTROL NOTES

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 REV
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 PCR
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 MASA
 151

 REV
 14
 PCR
 401.1

 PCR
 463
 PCR
 206

 REV
 15
 PCR
 206
 EDITOPIAL

RCS PROGRAM (P41)

LCGIC REV 16 11/27/68

PURPOSE: (1) TO COMPUTE A PREFERRED IMU ORIENTATION AND A PREFERRED VEHICLE ATTITUDE FOR AN RCS THRUSTING MANEUVER.

[2] TO CALCULATE THE GIMBAL ANGLES WHICH WOULD RESULT WITH THE PRESENT IMU ORIENTATION IF THE VEHICLE +X-AXIS WERE ALIGNED TO THE THRUST VECTOR. THE CREW IS THEREBY GIVEN AN OPPORTUNITY TO PERFORM THE MANEUVER WITH:

(A) THE PRESENT IMU ORIENTATION (NOT RECOMMENDED IF MIDDLE GIMBAL ANGLE IS GREATER THAN 45 DEGREES), IF THE IMU HAS NOT BEEN ALIGNED WITHIN THE LAST 3 HRS, REALIGNMENT IS DESIRABLE.

(B) A NEW ORIENTATION ACHIEVED BY SELECTION OF P52

(3) TO DO THE VEHICLE MANEUVER TO THE THRUSTING ATTITUDE.

(4) TO PROVIDE SUITABLE DISPLAYS FOR MANUAL EXECUTION OF THE THRUSTING MANEUVER.

ASSUMPTIONS: (1) THE TARGET PARAMETERS HAVE BEEN CALCULATED AND STORED IN THE CMC BY PRIOR EXECUTION OF A PRE-THRUSTING PROGRAM.

(2) THE REQUIREC STEERING EQUATIONS ARE IDENTIFIED BY THE PRIOR PRETHRUST PROGRAM, WHICH EITHER SET OR RESET THE EXTERNAL DELTA V STEERING FLAG. FOR EXTERNAL DELTA V STEERING, VG IS CALCULATED ONCE FOR THE SPECIFIED TIME OF IGNI-TION. THEREAFTER BOTH DURING THRUSTING AND UNTIL THE CREW NOTIFIES THE CMC TRIM THRUSTING HAS BEEN COMPLETED, THE CMC UPDATES VG ONLY AS A RESULT OF ACCELEROMETER INPUTS.

FOR LAMBERT STEERING VG IS CALCULATED AND UPDATED SIMILARLY, HOWEVER IT IS ALSO UPDATED PERIODICALLY BY LAMBERT SOLUTIONS TO CORRECT FOR CHANGES IN THE CSM STATE VECTOR.

(3) IT IS NORMALLY REQUIRED THAT THE ISS BE ON FOR 15 MINUTES PRIOR TO A THRUSTING MANEUVER.

(4) THE TTE CLOCK IS SET TO COUNT TO ZERO AT TIG.

(5) ENGINE IGNITION MAY BE SLIPPED BEYOND THE ESTABLISHED TIG IF DESIRED BY THE CREW OR IF INTEGRATION CAN NOT BE COMPLETED ON TIME.

(6) ROUTINE RO3 HAS BEEN PERFORMED PRIOR TO SELECTION OF THIS PROGRAM. IN ORDER FOR THE GNCS TO PERFORM THE ATTITUDE MANEUVER AND MAINTAIN ATTITUDE CONTROL THE ASTRONAUT MUST KEY IN V46E AT SOME TIME PRIOR TO THE ATTITUDE MANEUVER.

(7) THE VALUE OF DELTA V REQUIRED AT TIG IN LOCAL VERTICAL COORDINATES IS STORED IN NOUN 81 AND MAY BE CALLED UNTIL AVERAGE G IS TURNED ON BY KEYING IN VO6NBLE.

(8) THE ORBIT PARAMETER DISPLAY ROUTINE (R30) MAY BE CALLED DURING THIS PROGRAM BY KEYING IN V82E.

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

		•CREW PROG• •Selection	
		•	
		•	
		•	
START RCS PROGRAM	•	KEY IN RCS PROGRAM	
DISPLAY PROGRAM 41	* * * * * * * * * *	(P41) V37E 41E	
UISPLAT PROCKAM 41	•		
	•	MONITOR DSKY: Obšerve display of Program 41	
		-	
•			
•			
DO IMU STATUS CHECK Reutine (RG2)	• • • • • • • • •	DO IMU STATUS CHECK Routine (RO2)	
•			
•			
•			
SET CSTEER =0.			
•			
•			

COMPUTE INITIAL THRUST DIRECTION AND INITIAL VALUE OF VG VECTOR AND STORE IN NOUN 81 (VG LPCAL VERTICAL)			
•			
•			
•			
•			

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P41/COLOSSUS

268

TIME

CHECKLIST

GROUND

CREW

PROG Cont

CMC

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X = UNIT (X) = -SM -CSM
UNIT (T)
Y = UNIT {Y } = -SM -CSM
UNIT (X X R) -CSM -
Z = UNIT (X X Y) -SM -SM -SM
WHERE: T = INITIAL THRUST - VECTOR
R = THE CSM POSITION - RADIUS VECTOR AT T1G
X • Y = THE CSM -CSM -CSM CONTROL AXIS•
•
SET PREFERRED DRIENTATION FLAG
• •
STORE DESIRED ATTIT- UDE SPECIFICATION FOR USE BY ATTITUDE MANEUVER ROUTINE (R60). THE FINAL ATTITUDE WILL BE COMPUTED DURING R60 AND WILL POINT THE +X TRANSLATION AXIS IN THE INITITAL THRUST DIRECTION. HOWEVER, IN CROFR TC CONSERVE RCS FUEL AND NCT CONSTRAIN THE NONCRITICAL ROLL

#60

#70

#80

#90

	ATTITUDE, WINGS MAY NCT BE LEVEL IN THF Computed Final Attitude.				#110
	•				
	SFT MINIMUM DEADBAND IN RCS DAP				#120
	•				*120
	•				
	DO ATTITUDE MANEUVER ROUTINE (R60)	• • • • •	DO ATTITUDE MANEUVER ROUTINE (R60)		#130
	•				
TEMP HOLD •	•				
MON .	DISPLAY (NO FLASH) VO6N85 R1 VGX(CSM) R2 VGY(CSM) R3 VGZ(CSM)	• •	MONITOR DSKY: OBSERVE NON- FLASHING VERB-NOUN DISPLAY OF VG COM- PCNENTS.		#140
	(VGX(CSM), VGY(CSM) VGZ(CSM) - COMPON- ENTS OF THE VG		 • • •		
	VECTOR AT TIG RE- SOLVED ALONG PRESENT CSM X, Y, AND Z CON- TROL AXES RESPECT-		SELECT A/P AND MODE CONTROL AS DESIRED.		#150
	IVELY. UPDATED W.C.T. VEHICLE ATTITUDE EVERY 2 SECONDS IN FPS TO NEAREST .1		• • •		
	FPS.		• • •		
	• SET TDEC=TIG-30 SEC		• • •		#160
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	RESET TIG FLAG		•	· ·
	*		:	
	•		•	#170
	•	• •	•	
	DO STATE VECTOR IN- TEGRATION (MID TO AVE) ROUTINE (R41).	• • •	DO STATE VECTOR IN- Tegration (MID To AVE) Routine (R41). Observe that the Computer Activity	
	•		LIGHT IS ON UNTIL Completion of	
	:		ROUTINE 41.	#180
	:			
	•		•	
	•		•	
	WAIT UNTIL TFI = - 35 SEC		•	
	- 55 350		•	
	•		•	#190
	:		•	*170
++ +16 ++ EDIT	BLANK DISPLAY AT TFI = - 35 SEC	•	MONITOR DSKY: Observe that display GCES blank at tfi =	,
PCR 206	:		- 35 SEC.	
	•		•	
	WAIT UNTIL TFI = -30 SEC		•	#200
			•	
	•		•	
	•		•	
	CALL AVERAGE G INTEGRATION AND VG UPDATE (IN- STANTANEOUS VG VECTOR).		•	#210
	•		•	
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	DISPLAY VI6885 NON- FLASHING AND DISPLAY THE VALUES OF VG IN CONTROL AXIS COMPUT- ED FOR THE PRESENT TIME (NOT TIG) UP- DATED EVERY TWO SECONDS.	 MONITOR DSKY: OBSERVE DISPLAY OF VG IN CONTROL AXIS AT TFI =- 30 SEC. THE AVERAGE G ROUTINE IS TURNED CN. OBSERVE COM- PUTER ACTIVITY LIGHT	#220
	•	BLINKS ON EVERY 2 SECONDS DURING	#230
	•	AVERAGE G.	#230
	•	•	
	•	•	
	•	•	
		•	
	WAIT UNTIL TFI= ZERO	•	
		•	
	•	•	
	•	•	#240
	•	•	
MON .	FLASH VERB-NOUN TO REQUEST RESPONSE AND DISPLAY: V16N85 R1-VGX(CSM) R2-VGY(CSM) R3-VGZ(CSM)	 MONITOR DSKY: OBSERVE VERB-NOUN FLASH (INDICATING CMC COMPUTED TIG) TO REQUEST RESPONSE AND DISPLAY OF VG COMP- ONENTS AT TFI = 0	#250
++ +16	VGX(CSM), VGY(OSM)		*230
+10	VGZ(CSM) - COMPON-	•	
+	ENTS OF THE VG	•	
+	VECTOR RESOLVED	•	
+	ALONG PRESENT CSM X, Y, AND Z CONTROL	•	
+	AXES RESPECTIVELY.	•	
+	THE VG VECTOR WILL	•	
+	BE UPDATED BY THE Steering Locps dur-	•	#260
+	ING FACH COMPUTATION	•	
+	CYCLE. IN FPS TO	•	
+	NEAREST .1 FPS.	•	
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CHANGE	CONTROL	NOTES

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LOGIC REV	11	PCR MIT 32
LOGIC REV	12	PCR MIT 32
		PCP MIT 34
LOGIC REV	13	PCP MIT 66
		PCR NASA 151
LOGIC REV	14	PCP 401+1
LOGIC REV	15	PCR 206
LOGIC REV	16	PCR 206 EDITORIAL

•		•
•		•
•		•
WAIT FOR KEYBOARD ENTRY	•	KEY IN PROCFED
TERMINATE FLASH UPON RECEIPT OF PROCEED	•	
•		
•		
•		
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•		
•		
• • •	TRANSMIT OPBITAL	RECEIVE ORBITAL DATA
• • • • •	TRANSMIT OPBITAL DATA TO CREW	•••••RECEIVE ORBITAL DATA • FROM GROUND
• • • •	TRANSMIT OPBITAL DATA TO CREW	RECEIVE ORBITAL DATA . FROM GROUND
• • • • • • • • • • • •	TRANSMIT OPBITAL DATA TO CREW	RECEIVE ORBITAL DATA . FROM GROUND
•	TRANSMIT OPBITAL DATA TO CREW	RECEIVE ORBITAL DATA . FROM GROUND
DO ROUTINE ROC	TRANSMIT OPBITAL DATA TO CREW	DU ROUTINE ROO
• • •	TRANSMIT OPBITAL DATA TO CREW	• FROM GROUND
• • •	TRANSMIT OPBITAL DATA TO CREW	• FROM GROUND
DO ROUTINE ROC	TRANSMIT OPBITAL DATA TO CREW	• FROM GROUND
• • • •	TRANSMIT OPBITAL DATA TO CREW	• FROM GROUND

CCMMAND MANUAL TRAN-SLATIONS AND ROTA-TIONS TO NULL VG COMPONENTS WAIT FOR KEYBOARD . KEY IN PROCFED P41/COLOSSUS

#280

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THRUST MONITOR PROGRAM (P47) LCGIC REV 11 06/20/68

PURPOSE: (1) TO MONITOR VEHICLE ACCELERATION DURING A NON GNOS CONTROLLED THRUSTING MANEUVER.

(2) TO CISPLAY THE CELTA V APPLIED TO THE VEHICLE BY THIS THRUSTING MANEUVER.

ASSUMPTIONS: (1) IT IS NORMALLY REQUIRED THAT THE ISS BE ON FOR 15 MINUTES PRIOR TO A THRUSTING MANEUVER.

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+11 ++ (2) THE RESPONSIBILITY OF AVOIDING GIMBAN LOCK DURING EXECUTION OF THIS PROGRAM IS UPON THE ASTRONAUT.

(3) THIS PROGRAM IS NORMALLY USED OURING RENDEZVOUS FINAL PHASE. IF THE CREW DESIRED TO DO ANY FINAL PHASE THRUSTING MANEUVERS AUTOMATICALLY UNDER GNCS CONTROL THEY MUST BE ACCOMPLISHED VIA SELECTION OF TRANSFER PHASE INITIATION (TPI) PROGRAM (P34) AND THEN THE SPS THRUSTING PROGRAM (P40) OR THE RCS THRUSTING PROGRAM (P41).

(4) RANGE, RANGE RATE, AND THETA MAY BE DISPLAYED DURING THIS PROGRAM BY CALLING THE RENDEZVOUS PARAMETER DISPLAY Routine no 1 (R31) with v83e.

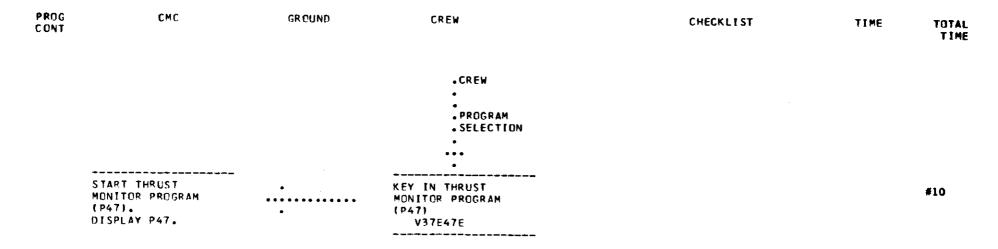
(5) RANGE, RANGE RATE, AND PHI MAY BE DISPLAYED DURING THIS PROGRAM BY CALLING THE RENDEZVOUS PARAMETER DISPLAY Routine no 2 (R34) with v85E.

(6) VI, H AND H-DOT MAY BE CALLED BY KEYING IN V16N62E. THE DISPLAY OF H IN LUNAR ORBIT WILL BE INVALID.

(7) THE ORBIT PARAMETER DISPLAY ROUTINE MAY BE CALLED DURING THIS PROGRAM BY KEYING IN V82E.

(8) THIS PROGRAM SHOULD BE TURNED ON JUST PRIOR TO THE PLANNED THRUSTING MANEUVER AND TERMINATED AS SOON AS POSSIBLE FOLLOWING THE MANEUVER IN ORDER TO KEEP ERRORS OF BIAS AND AVERAGE G AT A MINIMUM.

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



			MONITOR DSKY: OBSERVE DISPLAY OF PROGRAM 47.		#20
	DO IMU STATUS CHECK ROUTINE (RO2)	•	DO IMU STATUS CHECK ROUTINE (RO2)		#30
	SET TIG FLAG				
	DO STATE VECTOR INTEGRATION (MID TC AVE) ROUTINE (R41).	• •	DO STATE VECTOR INTEGRATION (MID TO AVE) ROUTINE (R41). ORSERVE THAT THE COMPUTER ACTIVITY LIGHT IS ON UNTIL THE COMPLETION OF POUTINE 41		#40
	CALL AVERAGE G ROUTINE.		ROUTINE 41.		#50
	FLASH VERB-NCUN TO REQUEST RESPONSE AND DISPLAY DELTA V (CSM): V16NR3 R1-DELTA VX(CSM) R2-DELTA VY(CSM) R3-CELTA VZ(CSM)		MONITOR DSKY: OBSERVE FLASHING VERB-NOUN TO REQUEST RESPONSE AND DISPLAY OF EACH COMPONENT OF DELTA V(CSM).		#60
	• • • • •			P47/COLOSSUS	
276))		

 DELTA VX(CSM) - COM-PENENT OF INTEGRATED ACCELERATION ALONG . CSM CONTROL +X AXIS. IN FPS TO NEAREST . .1 FPS. . DELTA VY(CSM) - CCM-PONENT OF INTEGRATED ACCELERATION ALONG . CSM CONTROL +Y AXIS. IN FPS TO NEAREST . .1 FPS. DELTA VZ(CSM) - CDM-PCNENT OF INTEGRATED ACCELERATION ALONG CSM CONTROL +Z AXIS. • IN FPS TO NEAREST •1 . FPS. NOTE1: R1,R2, AND R3 WILL READ 00000 IN-. ITIALLY AND WILL RE- MAIN SO (EXCEPT FOR ACCELEROMETER BIASES) UNTIL A THRUSTING MANEUVER IS STARTED. . THEY WILL BE UPCATED • EVERY 2 SEC. . NOTE2: IN THE EVENT THIS PROGRAM IS USED TO MONITOR MANEUVERS • WITH A DELTA V . GREATER THAN 9999.9 FPS THIS DISPLAY . WILL CNLY LOSE THE . HIGH ORDER DIGIT. IT WILL OTHERWISE READ . CCRRECTLY.

PERFORM THRUSTING MANEUVER AS DESIRED MONITOR FDAI BALL TO AVOID GIMBAL LOCK

#70

#80

#90

#100

WAIT FOR KEYBOARD Entry		
WAIT FOR KEYBOARD	• • • •	
WALT FOR KEYBOARD ENTRY	• •	
WAIT FOR KEYBOARD ENTRY	• •	
WAIT FOR KEYBOARD ENTRY		
WAIT FOR KEYBOARD Entry		
ENTRY	SHALL I TERMINATE .	
	THIS PROGRAM?	
	•	
	•¥ •N •	
	• • •	
	• • •	#130
	• SHALL I ZERO •	
	 THE DISPLAY IN . 	
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	• BURN? •	
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	• IN •	
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	• • • • • • •	#150
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TERMINATE FLASH UPON	KEY IN PROCEED	
RECEIPT OF PROCEED .	*****	
OR RECYCLE	•	
++	•	
.RECYCLE .PROCEED	•	
• •	•	
	•	#160
	-	#100
-	•	
REINITIAL	•	
IZE ACCEL	•	
	•	
EROMETER .		
EROMETER .	•	
EROMETER • INTEGRA- •	•	
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EROMETER • INTEGRA- • TION •	•	
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EROMETER • INTEGRA- • TION •		#17(
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EROMETER INTEGRA- TION	DP ROUTINE ROO	#17(
EROMETER INTEGRA- TION	00 ROUTINE ROO	#17(
EROMETER INTEGRA- TION	OP ROUTINE ROO	#17(
EROMETER INTEGRA- TION	DD ROUTINE ROO	
EROMETER INTEGRA- TION	DP ROUTINE ROO	#17(₽47/COLOSSUS
EROMETER INTEGRA- TION	OP ROUTINE ROO	#170 P47/COLOSSUS
EROMETER INTEGRA- TION 	OP ROUTINE ROO	
EROMETER INTEGRA- TION 	00 ROUTINE ROO	
EROMETER INTEGRA- TION 	DD ROUTINE ROO	
EROMETER INTEGRA- TION 	OP ROUTINE ROO	

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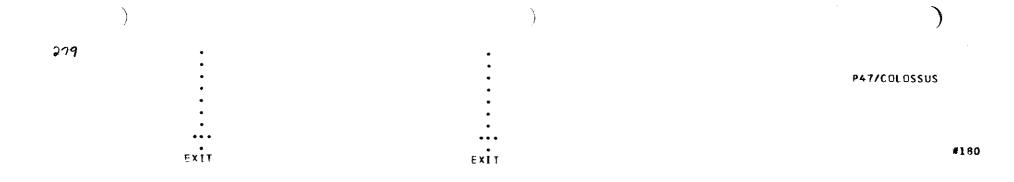
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P47/COLOSSUS



CHANGE CONTROL NOTES

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 PCR
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IMU ORIENTATION DETERMINATION PROGRAM (P51) LOGIC REV 06 04/02/68 (1) TO DETERMINE THE INERTIAL ORIENTATION OF THE IMU USING SIGHTINGS ON TWO CELESTIAL BODIES USING THE SCANNING PURPOSE: TELESCOPE OR THE SEXTANT. ASSUMPTIONS: (1) THE IMU MAY BE: (A) OFF (STANCBY) (B) ON, AND ALIGNED OR NOT ALIGNED SINCE TURN ON. . ++ +06 IF (A) IS TRUE, THE IMU MUST BE TURNED ON BEFORE THIS PROGRAM CAN BE PERFORMED. IF (B) IS TRUE THIS PROGRAM CAN BE COMPLETED. + +06 ++ (2) THERE ARE NO RESTRAINTS UPON THE CSM ATTITUDE CONTROL MODES IN THIS PROGRAM. (3) TIME AND RCS FUEL MAY BE SAVED, AND SUBSEQUENT IMU ALIGNMENT DECISIONS GREATLY SIMPLIFIED IF THIS PROGRAM IS PERFORMED IN SUCH A WAY AS TO LEAVE THE IMU INERTIALLY STABILIZED AT AN ORIENTATION AS CLOSE AS POSSIBLE TO THE OPTIMUM ORIENTATION REQUIRED BY FUTURE CMC PROGRAMS. (4) THE PROGRAM IS SELECTED BY THE ASTRONAUT BY DSKY ENTRY.

PROG CONT	СМС	GROUND	CREW	CHECKLIST	TIME	TOTAL
			•CREW PROG •SELECTION •			
	START IMU ORIENTA- TION DETERMINATION PROGRAM (P51) DISPLAY PROGRAM 51	•	KEY IN IMU ORIENTATION DETERMI- NATION PROGRAM (P51) V37E 51E			#10
	 • •	•	MCNITOR DSKY: Observe display of Program 51	·		#20

P51/COLOSSUS

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 ALARM LICHT AND STARE ALARM CODE CO210. CODE CO210. CODE CO210. CODE CO210. CODES V37 FLASH INDI- CATING THAT THE IMU IS NOT DN? Y N Y N TURN ON THE IMU AND RESELECT P51 VIA R00. TURN ON THE IMU AND RESELECT P51 TURN ON THE R	+06	٠	•				
 ALARM LICHT AND STARE ALARM CODE CO210. CODE CO210. CODE CO210. CODE CO210. CODES V37 FLASH INDI- CATING THAT THE IMU IS NOT DN? Y N Y N TURN ON THE IMU AND RESELECT P51 VIA R00. TURN ON THE IMU AND RESELECT P51 TURN ON THE R	+	•	•				
 ALARM LICHT AND STARE ALARM CODE CO210. CODE CO210. CODE CO210. CODE CO210. CODES V37 FLASH INDI- CATING THAT THE IMU IS NOT DN? Y N Y N TURN ON THE IMU AND RESELECT P51 VIA R00. TURN ON THE IMU AND RESELECT P51 TURN ON THE R	+	•		-		MONITOR DEVY.	
HOL D . FLASH VERB-NDUN TO HOL D . FLASH VERB-NDUN TO K 200 ROUTINE ROO K 200 ROUTINE	+	•					ARM
CODE CO210. DDES V37 FLASH INDI- CATING THAT THE IMU IS NOT DN? Y .N Y .N	+	•			•		
CATING THAT THE IMU IS NOT ON? 	+	•	-	• •			
IS NOT ON? Y N Y N Y N TURN ON THE INU AND RESELECT P51 VIA ROO. VIA ROO. Image: Strate	•	•		_			
HOLD . FLASH VERB-NDUN TO HOLD . FLASH VERB-NDUN TO REQUEST PLEASE PER- SNAP FORM CELESTIAL BOCY ACQUISITION: VSS R1-00315 R2 - 3LANK R3 - BLANK 	+	•	•				
HOLD . FLASH VERB-NDUN TO HOLD . FLASH VERB-NDUN TO REQUEST PLEASE PER- SNAP FORM CELESTIAL BOCY ACQUISITION: VSS R1-00315 R2 - 3LANK R3 - BLANK 	+	•	•				
HOL D FLASH VERB-NDUN TO SNAP FORM CELESTIAL BODY FORM CELESTIAL BODY ACQUISITION: VS CELESTIAL BODY ACQUISITION: VS R1-00015 R2 R3 - BLANK R3 - BLANK R3 - BLANK	+	•	•			• Y	• N
AND RESELECT P51 VIA R00. DD ROUTINE R00 DD ROUTINE R00 HOL D . FLASH VERB-NOUN TO REQUEST PLEASE PER- SNAP FORM CELESTIAL BOCY ACQUISITION: V50 N25 R1-00015 R1-00015 R3 - BLANK R3 - BLANK R3 - BLANK R3 - BLANK	+	•	•			•	•
AND RESELECT P51 VIA R00. DD ROUTINE R00 DD ROUTINE R00 HOL D . FLASH VERB-NOUN TO REQUEST PLEASE PER- SNAP FORM CELESTIAL BOCY ACQUISITION: V50 N25 R1-00015 R1-00015 R3 - BLANK R3 - BLANK R3 - BLANK R3 - BLANK	+	٠	•			•	•
AND RESELECT P51 VIA R00. DD ROUTINE R00 DD ROUTINE R00 HOL D . FLASH VERB-NOUN TO REQUEST PLEASE PER- SNAP FORM CELESTIAL BOCY ACQUISITION: V50 N25 R1-00015 R1-00015 R3 - BLANK R3 - BLANK R3 - BLANK R3 - BLANK	+	•	•			TUDN ON THE THU	•
VIA R00. UD ROUTINE R00	•	•	•				
HOL D FLASH VERB-NOUN TO SNAP FORM CELEST IAL BODY ACQUISITION: V50 N25 R 1-00015 R2 - 3LANK R3 - BLANK R3 - BLANK R3 - BLANK R3 - BLANK R4 - 3LANK R3 - BLANK R3 - BLANK R4 - 3LANK R4 - 3LANK R5	+	•	•				•
HOL D FLASH VERB-NOUN TO REQUEST PLEASE PER- SNAP FORM CELESTIAL BODY ACQUISITION: V50 N25 R1-00015 R2 - BLANK 	+ •	•	•				
HOL D FLASH VERB-NOUN TO REQUEST PLEASE PER- SNAP FORM CELESTIAL BODY ACQUISITION: V50 N25 R1-00015 R2 - BLANK 	+ +	•	•			-	
HOL D FLASH VERB-NOUN TO REQUEST PLEASE PER- SNAP FORM CELESTIAL BODY ACQUISITION: V50 N25 R1-00015 R2 - BLANK 	•					•	•
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COMMAND ISS TO	• •	
COARSE ALIGN .	• •	#19
MODE	• •	
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TUDA ON MNO ATTH		
TURN ON "NO ATT" . LIGHT .	• • ORSERVE "NO ATT" •••••••••••••••••••••••••••••••••••	
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ALIGN MCDE IN		#21
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TURN OFF "NO . Att"Light .	 WAIT FOR "NO-ATT" LIGHT OFF 	#22
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•	•	#23
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SET TARGET FLAG TO	•	
STAR FOR USE BY .	•	
IGHTING MARK ROUTINE.	•	
R531 .	•	
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SET MARK INCEX TO 1 FOR USE BY THE SIGHTING MARK RCUTINE (R53)			
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DO SIGHTING MARK ROUTINE (R53) FOR CELESTIAL BODY =1	• • • •	DO SIGHTING MARK ROUTINE (R53) FOR CELESTIAL BODY =1. TS DOSSIDE LESS SYT	#25(
	· · ·	IF POSSIBLE USE SXT, OTHERWISE SCT. 	
CALCULATE CELESTIAL BODY #1 VFCTOR W.R.T. IMU	· · · · · · · · · · · · · · · · · · ·	• • •	#26
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DO SIGHTING MARK ROUTINE (R53) FOR CELESTIAL BODY =2	• • • • • • • • • • •	DO SIGHTING MARK ROUTINE (R53) FOR CELESTIAL BODY =2. IF POSSIBLE USE SXT.	#27
•	• •	OTHERWISE SCT.	
CALCULATE CELESTIAL BEDY #2 VECTOR W.R.T. IMU	· · · · · · · · · · · · · · · · · · ·		
	• • • • • •	• • •	#21
DO SIGHTING DATA DISPLAY ROUTINE (R54)	· · · · · · · · · · · · · · · · · · ·	DO SIGHTINO DATA Display Routine (R54)	
• F • E • X • X • I • I • T • T	· · · · · · · · ·	 •E •F •X •X •! •! •T •T	#21
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CALCULATE IMU INERTIAL	•		•		#30
OPIENTATION W.R.T.	•		•		
CELESTIAL CCORDIN-	•	• • • • • • • • • •	•		
ATES AS DEFINED BY CELESTIAL BODIES #1					
AND #2. STORE AS					
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SET PEESMMAT FLAG					
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DO ROUTINE ROC .	•	•••• DO R	OUTINE P		#32
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EXIT			EXIT		

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CHANGE CONTROL NOTES

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V = THE INFOTIAL VELOCITY VECTOR AT TIME T (ALICH) SELECTED BY THE ASTOCIMALIT.

- SEL COTED BY THE ASTRONAUT

D = THE GEOGENTRIC (EARTH OPRIT) OP SELENOCENTRIC (LINAR ORDIT) RADIUS VECTOR AT TIME T LALIGN)

WHERE:

 $X = U^{N} I T \{ V | X \neq \}$ - SM -SM -SM Y = UNITT(V X P) - 54 $Z = U^{NTT}(-P)$ - SM

(C) NOMINAL OPTENTATION

A SPECIAL CASE OF THE LANDING SITE ORIENTATION OCCUPS WHEN TRALIGNED IS DEFINED AS THE TIME OF LUNAR LANDING TILANDI. THIS CASE MAY OCCUP ONLY IF TILANDI HAS BEEN DEFINED BY THE MSEN, TRANSMITTED TO THE ASTPONAUT AND THE ASTRONAUT HAS THEN DEFINED TEALIGN TO BE TELANDE IN THIS PROGRAM.

-CSM -CSM -CSM

X V 1 AT TIME TIALIGNE SELECTED BY THE ASTRONAUT.

H = THE ANGULAR MOMENTUM VECTOR OF THE CSM (R

ASTRONAUT.

(B) LANDING SITE ORIENTATION

-1.5 Y = UNIT(? X X)

-54 -54

Y = UNTT(R)

R = THE POSITION OF THE MOST RECENTLY DEFINED LANDING SITE AT TIME, T (ALIGN) SELECTED BY THE -1.5

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WHERE: THE ORIGIN IS THE CENTER OF THE MOON.

7 = UNIT(H X X)-54 -CSM -SM

AN OPTIMUM ORIENTATION FOR A PREVIOUSLY CALCULATED MANEUVER. THIS ORIENTATION MUST BE CALCULATED AND STOPED BY A PREVIOUSLY SELECTED PROGRAM.

(A) PREFERRED ORIENTATION

ASTRONAUT USING SIGHTINGS ON TWO CELESTIAL BODIES WITH THE SCANNING TELESCOPE OF THE SEXTANT:

PURPOSE: (1) TO ALIGN THE IMU FROM A "KNOWN" (SEE ASSUMPTION 4) DRIENTATION TO ONE OF FOUR DRIENTATIONS SELECTED BY THE

- S M

-5M

IMU REALIGN PROGRAM (P52)

53

(D) REESMMAT

SEE ASSUMPTION (4)

ASSUMPTIONS: (1) THE DOCKED CENEIGUPATION MAY BE SIVB/CSM, EM/CSM, OP CSM. THE PRESENT CONFIGURATION SHOULD HAVE BEEN ENTERED INTO THE CMC BY COMPLETION OF THE DAP DATA LOAD ROUTINE RO3.

(2) THERE ARE NO PESTPAINTS UPON THE CSM ATTITUDE CONTROL MODES IN THIS PROGRAM.

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 (3) THIS PROGRAM MAKES NO PROVISION FOR AN ATTITUDE MANEUVER TO RETURN THE VEHICLE TO A SPECIFIC ATTITUDE. SUCH A

 +15
 MANEUVER TE DESTRED MUST BE DONE MANUALLY AN OPTION IS PROVIDED HOWEVER TO POINT THE SXT AT ASTRONAUT OR CMC

 ++
 SELECTED STARS FITHER MANUALLY BY GREW INPUT OR AUTOMATICALLY UNDER CMC CONTROL.

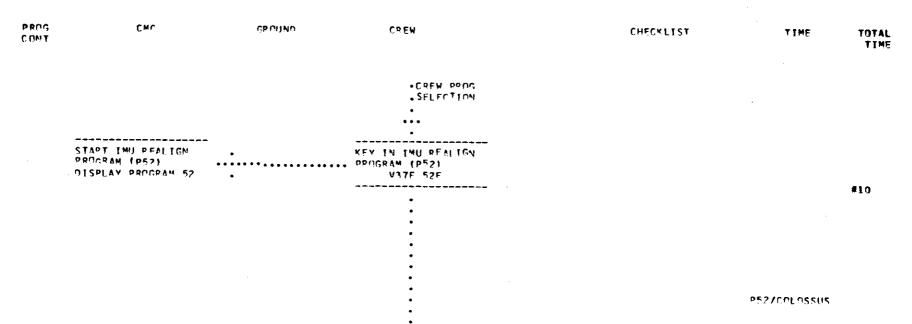
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(4) THE ISS IS ON AND HAS BEEN ALIGNED TO A KNOWN OPIENTATION WHICH IS STORED IN THE OMC (REESMMAT). THE PRESENT IMU ORIENTATION DIFFERS FROM THAT TO WHICH IT WAS LAST ALIGNED ONLY DUE TO GYRO DRIET (I.F. NEITHER GIMBAL LOCK NOR IMU POWER INTERPUPTION HAS OCCURRED SINCE THE LAST ALIGNMENT).

(5) THE LANDING SITE DRIENTATION IS USED FOR:

- (A) ALIGNING THE CSM STARLE MEMBER TO THE SAME OPIENTATION AS THE LM STABLE MEMBER PRIOR TO LM/CSM. SEPARATION
- (3) ALIGNING THE CSM STABLE MEMBER TO THE SAME DRIENTATION AS THE LM STABLE MEMBER PRIOR TO IM ASCENT FROM THE LUNAR SURFACE.

.163 THE PROGRAM IS SELECTED BY THE ASTRONAUT BY DSKY ENTRY.



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DO IMU STATUS CH Routine (RO2)	ECK	DO IMU STATUS CHECK ROUTINE (RO2)		
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SET MARK INDEX T FOR USE BY THE Sighting Mark Routine R53.				
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IS THE PREFERRED ORTENTATION FLAG	SFT?			
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SET OPTION CODE	•			
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+15 ++	IS STORED OPIENTA- TION CODE 00001?			#130
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	 SELECT PREFERRED IMU ORIENTATION FOR 			
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.P .NEW T(ALTCN) TN .P .PATA R1, P2, AND .P .P .R3, .C			•		
SNAP DISPLAY T(ALIGN):	ного 🔹	FLASH VERB-NCUN TO	• •	MONITOR	DSKY:
V06N34 Sprive E MUD DISPLAY R1- TI ALIGNI-HRS GPTIALIGNI-RS R3- TIALIGNI-HRS GPTIALIGNI. R3- TIALIGNI-SECS		REQUEST RESPONSE AND		OBSEP	VE VERB-NOUN
V06N34 Sprive E MUD DISPLAY R1- TI ALIGNI-HRS GPTIALIGNI-RS R3- TIALIGNI-HRS GPTIALIGNI. R3- TIALIGNI-SECS	SNAP .	DISPLAY TIALIGNI:	•	ELASH TO	PENHEST PE-
PI- TIALIGNI-HRS DF TIALIGNI. R2- TIALIGNI-SECS			•		
Q2-T(AL(GN)-HINS R3-T(AL(GN)-SECS T(AL(GN)-SECS T(AL(GN)-WILL APPEAR POSTION AND VELO- C(TY VECTOPS ARE SF- CO0000, 00000, WHICH LECTEN TO DEFINE IMUL AND CSN NOMINAL PR LANDING SITE OPIER- LANDING SITE OPIER- AND SECS TO MEAREST .01 SEC. VIII RE DEFINED AND VIII RE DEFINED AND .01 SEC. VIII RE DEFINED AND VIII RE TO ALIGN VIII RE TO ALIGN VIIII RE TO ALIGN V		• • - • •	•		
R3- T(ALIGN)-SECS T(ALIGN-TIME (GET)) AT WHICH VEHICLE POSITION AND VELO- CITY VECTOPS ARE SE- LECTED TO DEFINE IMU LANDING STE CPIEN- TATION. IN HPS, MINS AND CSECS TO NEAREST .01 SEC. VILL APPENDENCE .01 SEC. .02 SEC. .03 SEC. .04 SEC TO NEAREST .05 SEC. .06 SEC. .07 I WISH TO ALIGN .07 V V WISH TO ALIGN .07 V V V WISH TO ALIGN .07 V V V V V V V V V V			•	OF TIALI	GN1.
R3- T(ALIGN)-SECS T(ALIGN-TIME (GET)) AT WHICH VEHICLE POSITION AND VELO- CITY VECTOPS ARE SE- LECTED TO DEFINE IMU LANDING STE CPIEN- TATION. IN HPS, MINS AND CSECS TO NEAREST .01 SEC. VILL APPENDENCE .01 SEC. .02 SEC. .03 SEC. .04 SEC TO NEAREST .05 SEC. .06 SEC. .07 I WISH TO ALIGN .07 V V WISH TO ALIGN .07 V V V WISH TO ALIGN .07 V V V V V V V V V V		R2- T(ALIGN)-MINS	•		
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••••	REQUEST RESPONSE AND DISPLAY THE PESHLT- ING GIMBAL ANGLES: VO6 N22 P1-00	••••••	DRSERVE VER FLASH TO REO RESPONSE AND DE GIMBAL AN AFTER PROPOS	B-MOUN QUEST D DISPLAY NGLES SED CSM/	
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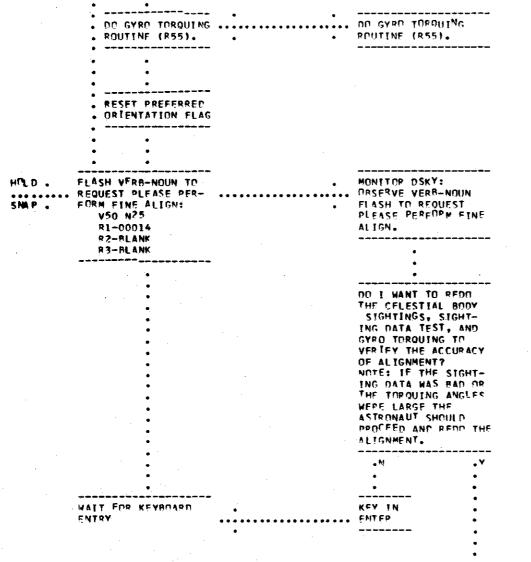
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BACK UP IMU ORIENTATION DETERMINATION PROGRAM (P53) LOGIC PEV 07 11/27/68

PURPOSE: (1) TO DETERMINE THE INFRITAL ORIENTATION OF THE IMU USING A BACK UP OPTICAL DEVICE.

ASSUMPTIONS: (1) THE IMU MAY BE:

(A) HEF (STANDRY)

(B) ON, AND ALIGNED OR NOT ALIGNED SINCE TURN ON.

IF (A) IS TRUE, THE IMU MUST BE TURNED ON BEFORE THIS PROGRAM CAN BE PERFORMED. IF (B) TS TRUE THIS PROGRAM CAN BE COMPLETED.

(2) THIS PROGRAM IS IDENTICAL TO PS1 EXCEPT THAT R56 IS CALLED IN PLACE OF R53

(3) THE CSM ATTITUDE CONTROL MODE SELECTED IS AT THE OPTION OF THE CREW.

(4) TIME AND RCS FUEL MAY BE SAVED, AND SUBSEQUENT IMU ALIGNMENT DECISIONS GREATLY SIMPLIFIED IF THIS PROGRAM IS PERFORMED IN SUCH A WAY AS TO LEAVE THE IMU INERTIALLY STABILIZED AT AN ORJENTATION AS CLOSE AS POSSIBLE TO THE OPTIMUM ORIENTATION REQUIRED BY FUTURE CMC PROGRAMS.

(5) THE PROGRAM IS SELECTED BY THE ASTRONAUT BY DSKY ENTRY.

PROG Cont	CHC	GR OUND	CREW	CHECKLIST	TIME	TOTAL TIME
			•CREW PROG •Selection •			
	START BACK UP IMU ORIENTATION DETERMI- NATION PROGRAM (P53) DISPLAY PROGRAM 53		KEY IN BACK UP IMU OPIENTATION DETERMI- NATION PROGRAM (P53) V37E 53E			#10
		•	MONITOR DSKY: OBSERVE DISPLAY OF PPOGRAM 53			
	• • • •					#20

P53/COLOSSUS

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	TURN ON PROGRAM ALARM AND STORE ALARM CODE 00210		MONITOP DSKY: DOES PROGRAM ALARM LIGHT COME ON AND DOES V37 FLASH INDI- CATING THAT THE IMU IS NOT ON?
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	REQUEST PLEASE PER-		ORSERVE VERA-NOUN
SNAP .	FORM CELESTINE BODY	• ••	FLASH TO REQUEST
	ACOUISITION :	• •	PLEASE PERFORM CELF-
	V50 N25	• •	STIAL BODY ACOUTSI-
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CSM TO POSITION THE IMU INNER GIMBAL AXIS IN A PREFERED DIRECTION? N .Y WITH THE POTATE THE CSM UNTIL THE PITCH AXIS IS IN THE PREFERED DIRECTION SHALL I MANEUVER THE CSM TO AC- OUIRE A CELESITAL BODY? N .Y MONITOR EDAI BALL IS GIMBAL LOCK IMPENDING?		• •
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SIGHTING MARK POU- TINE (P56) FOP GELESTIAL BODY #2 	•	•	
SIGHTING MARK POU- TINE (P56) FOP GELESTIAL BODY #2 	•	•	
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SIGHTING MARK POU- TINE (P56) FOP GELESTIAL BODY #2 			
SIGHTING MARK POU- TINE (P56) FOP GELESTIAL BODY #2 	•	•	
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SIGHTING MARK POU- TINE (P56) FOP GELESTIAL BODY #2 	•		
TINE (P56) FOR CELESTIAL BODY #2 	• •		
CELESTIAL BODY #2 			
DO SIGHTING DATA DISPLAY ROUTINE(R54) 	• •		
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DO ALTERNATE LOS

ROUTINE (856) FOR

CELESTIAL BODY #1

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SIGHTING MARK

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P53/COLOSSUS

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316

SIGHTING MARK

DO ALTERNATE LOS SIGHTING MARK ROU-

CALCULATE CELESTIAL BODY #2 VECTOP W.R.T. IMU

DP SIGHTING DATA

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DISPLAY ROUTINE (R54). .

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TINE (R56) FOR CELESTIAL PODY #2

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DO ALTERNATE LOS

POUTINE (R56) FOR

CELESTIAL BODY #1

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CALCULATE CELESTIAL . BODY #1 VECTOR W.R.T . P537COL055US

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CHANGE CONTROL NOTES

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AND #2. STORE AS PRESENT PLATEORM	•
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V = THE INEDITAL VELOCITY VECTOR AT TIME T (ALIGN) SELECTED BY THE ASTRONAUT.

- SELECTED BY THE ASTRONAUT

R = THE GEOGENTRIC (EARTH BRRIT) OR SELENDERNTRIC (LUMAR ORBIT) RADIUS VECTOR AT TIME T (ALIGN)

-5M

— CM

V = UNIT(V ¥ P } -∽M = -7 = UNIT(-R)

COLUMNIAL OPERNTATION

X = UNTT(Y Y 7)

A SPECIAL CASE OF THE LANDING SITE OPIENTATION OCCURS WHEN T (ALIGN) IS DEFINED AS THE TIME OF LUNAR LANDING T (LAND). THIS CASE MAY OCCUR ONLY IF T (LAND) HAS BEEN DEFINED BY THE MSEN, TRANSMITTED TO THE ASTRONAUT, AND THE ASTRONAUT HAS THEN DEFINED T (ALIGN) TO BE T (LAND) IN THIS PROGRAM.

H = THE ANGULAR MOMENTUM VECTOR OF THE CSM (R X V) AT TIME T (ALIGN) SELECTED BY THE ASTRONAUT) -CSM -CSM

H = THE ANGULAR MOMENTUM VECTOR OF THE CSM (R X V) AT TIME T (ALIGN) SELECTED BY THE ASTRONAUT.

P = THE POSITION OF THE MOST RECENTLY DEFINED LANDING SITE AT TIME, T(ALIGN) SELECTED BY THE ASTRONAUT

WHEPE: THE ORIGIN IS THE CENTER OF THE MOON.

7 = UNTT(H X X) -SM -CSM -SM

Y = UNIT(7 X X) -SM -SN -SN

-15

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X = UNIT(P, 1)

-5*

-LS

(B) LANDING SITE ORIENTATION

STOPED BY A PREVIOUSLY SELECTED PROGRAM.

AN OPTIMUM ORIENTATION FOR A PREVIOUSLY CALCULATED MANEUVER. THIS OPTENTATION MUST BE CALCULATED AND

(A) PREFERRED OPTENTATION

ASTRONAUT USING SIGHTINGS ON THE CELESTIAL BODIES WITH A BACK-UP OPTICAL DEVICE:

PURPOSE: (1) TO ALIGN THE IMU FROM & "KNOWN" (SEE ASSUMPTION 4) OPIENTATION TO ONE OF FOUR ORIENTATIONS SELECTED BY THE

BACKUP THU REALTON PROGRAM (P54)

LOGIC 2EV 16 12/26/68

SEE ASSUMPTION (4)

76

ASSUMPTIONS: (1) THE DOCKED CONFIGURATION MAY BE STUB/CSM, EM/CSM, OR CSM. THE PRESENT CONFIGURATION SHOULD HAVE BEEN ENTERED INTO THE CHC BY COMPLETION OF THE DAP DATA LOAD ROUTINE RO3.

(2) THERE ARE NO RESTRAINTS UPON THE CSM ATTITUDE CONTPOL MODES IN THIS PROGRAM.

(3) THIS PROGRAM MAKES NO PROVISION FOR AN ATTITUDE MANEUVER TO RETURN THE VEHICLE TO A SPECIFIC ATTITUDE. SUCH A MANEUVER, IF DESTRED, MUST BE DONE MANUALLY. AN OPTION IS PROVIDED HOWEVER TO POINT THE SXT AT ASTRONAUT OR CHC SELECTED STARS EITHER MANUALLY BY CREW INPUT OR AUTOMATICALLY UNDER CMC CONTROL.

(4) THE ISS IS ON AND HAS BEEN ALIGNED TO & KNOWN ORIENTATION WHICH IS STORED IN THE CMC (REESMMAT). THE PRESENT IMU ORIENTATION DIFFERS FOON THAT TO WHICH IT WAS LAST ALIGNED ONLY DUE TO GYRD DRIFT IT.E. NEITHER GIMBAL LOCK NOR IMU POWER INTERRUPTION HAS OCCURRED SINCE THE LAST ALIGNMENTI.

(5) THE LANDING SITE ORIENTATION IS USED FOR:

- (A) ALIGNING THE CSM STABLE MEMBER TO THE SAME ORIENTATION AS THE LM STABLE MEMBER PRIOR TO LM/CSM SEPARATION
- (B) ALIGNING THE CSM STABLE MEMBER TO THE SAME OPIENTATION AS THE LM STABLE MEMBER PRIOR TO LM ASCENT FREM THE LUNAR SURFACE.

(6) THIS PROGRAM IS IDENTICAL TO P52 EXCEPT THAT R56 IS CALLED IN PLACE OF R52 AND R53.

.(7) THE PROGRAM IS SELECTED BY THE ASTRONAUT BY DSKY ENTRY.

PROG CONT	CMC	GRICUND	CREW	CHECKLIST	TIME	TOTAL TI ⁿ e
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P54/C01 055US

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		•	MONITOR DSKY OBSERVE DISP PROGRAM 54	/: PLAY OF		ş ¹	·
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P54/CPLOSSUS

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IS STOPED ORIENTA-TION CODE 00002 OP 000047

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P54/COLOSUS

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P54/COLOSSUS

P54/COLOSSUS

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FLASH VERR-N	IOUN TO	*	MONITOP DSKY;	
REQUEST RESP	ONSE AND	• •	OBSERVE VE	P-NOUN
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P54/COLOSSUS

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FLASH VERB-NOUN TO

P54/CPLOSSUS

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P547C01 OSSUS

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P54/CPLOSSUS

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RECEIPT DE OR NEW DAT	rA 	-  	KEY IN V25E AND LOAD THE CORPECT COORDINATES AND SET P3 FOUAL TO			#3
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READ VEHTC TUDE EREM ANGLES						
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	• • •				PE4/COLOSSUS	#31
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	. PRESENT VEHICLE			
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SNAP +	ING GIMBAL ANGLES:		RESPONSE AND DIS	DE AV
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054/COLOSSUS

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P54/CP1 PSSUS

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	. TERMINATE FLASH UPON			
	RECEIPT OF PROCED	SELECT NEW PRO- GRAM AS DESIRED		
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		. GO TO PROGRAM SELECTED		
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η Γ. ΝΑΡ.	ELASH VEPR PEQUEST PL EQBM CELSS ACQUISITIO VSO M75 PL-OOOL P2-PLAN	FACE DER. (T. [7] BOOY () () () () () () () () () ()	· · · · · · · · · · · · · · · · · · ·	• • • • • • • • • • • • • • • • • • • •	MONITOR CONSERVE FLASH TO DIFASE ( ESTIAL ) ACOUTSI THE CMC TO SELED	VERB- RECI PERFOR PERFOR PERFOR TION: TION:	-NOIN T JEST 2M CEL- MOTE: ATTEMP	•

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			•	USF OF THE OPTICS. SINCE THE OPTICS APF NOT BEING USFN THE ROUTINE MAY HAVE NO VALUE.	
		•	•	• •	
		• • • •	• • • •	DO I WISH TO HAVE THE CMC ASSIST ME IN SELECTING TWO CEL- ESTIAL BODIES SUIT- ARLE FOR ALIGNMENT?	
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	WAIT FOR FNTRV	KEYBOARD	• • • •	KEY IN ENTER	
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	• • •		• • • • • • • • • • • • • • • • • • •	MANFUVER VEHICLE UN- TIL SUITABLE CEL- ESTIAL BODIES MAY BE ACQUIRED. MONITOR FOAT BALL TO AVOID GIMBAL LOCK. (NOTE: ASTRONAUT MAY USE OPTICS TO ASSIST ATTITUDE CHOICE OR MAY MANEUVEP AT PANDOM.)	
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	DO STAP SELECTION		•	
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PO\$\$ •	•	•	<ul> <li>DOES ALARM</li> </ul>	
HOLD ++	. FLASH VEPR-NOUM	• •	<ul> <li>CODE DISPLAY</li> </ul>	
	<ul> <li>TO REQUEST RES-</li> </ul>		<ul> <li>INDICATE THAT TWO</li> </ul>	0
SNAP	. PONSE AND DIS-		. STARS ARE NOT AV	ATE-
	. PLAY ALAPH CODE:		. ABLE IN THE SCT	
•	V05N09		. FIELD OF VIEW?	
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	<ul> <li>EXPECTED ALARM</li> </ul>	•	• • •	
	. CODE AT THIS	•	• • •	
	. TIME IS 405			
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•	• •	•	. SHALL I BYPASS .	
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	REG	DUEST P	ESPONS	E AND	•••••		BSERVE VERB-	
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	REG	DUEST P SPLAY C DY CODE	ESPONS FLESTI	E AND	•••••	•••••• C • F	DRSERVE VERB-1 NASH TO REQUING SPONSE AND 1	ST .
	REG	00851 P SPLAY C NY CODE VO1870	ESPINS FLESTI	E AND	•••••	•••••• C • F	DRSERVE VERB-1 HASH TO REQUING FSPONSE AND 1 CELESTIAL BODY	ST .
	REG	DUEST P SPLAY C NY CONE VOLN70 P1-000	ESPONS FLESTI	E AND	••••••••••••••••••••••••••••••••••••••	•••••• C • F	DRSERVE VERB-1 NASH TO REQUING SPONSE AND 1	ST .
	REG	DUEST P SPLAY C DY CODE VOLN70 P1-000 P2-P14	ESPONS FLESTI	E AND		•••••• C • F	DRSERVE VERB-1 HASH TO REQUING FSPONSE AND 1 CELESTIAL BODY	ST .
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• •	•	DO I WISH TO STORT	· • •
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• •		• SARY TO CHANGE	• •
• •		. CODE AT THIS	• •
• •		<ul> <li>TIME SINCE THIS</li> <li>DISPLAY IS FOR</li> </ul>	* * * *
		INFORMATION	• • •
• •	•	. ONLY. HOWEVER,	• •
• •		- TE IT IS CHANGED - NOW IT WILL NOT	
		HAVE TO BE	• •
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P54/CPLOSSUS

TERMINATE FLASH UPON KEY IN PROCEED RECEIPT OF PROCEED OR NEW DATA .NEW ۰, +DATA • R .0 . .0 . • E STORE NEW DATA • E . r --------IS CELESTIAL BODY CODE 00? • N . ۷ . . _ _ _ IS THE CELESTIAL BODY CODE 46, 47 OR 50? -• N • Y . OBTAIN STAP VECTOR FROM STORED EPHEMRIS CALCULATE CEL- -ESTIAL RCDY . VECTOP FOR THE . . BODY DEETHER . BY THE CELES-TTAL BODY CODE

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HOLD	• •	FLASH VERR-NEUN	• • • • • • • • • • • • • • • • • • • •	MONITOR DSKY:	• •
*******	• •	TO REQUEST RE-	• •	OBSERVE VERB-NOUN	• •
SNAP ++	• •		•	FLASH TO REQUEST	
•	• •	. PLAY PLANET	•	RESPONSE AND DISPLAY	
	•	<ul> <li>POSITION</li> </ul>		OF PLANET POSITION	
		VECTOR:	•	VECTOR.	•••
•	• •	V06N88	•	AT. TAKE	• •
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•	• •	PROCEED OR NEW	•	POSITION VECTOR	
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## P54/CPLOSSUS

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		DO SIGHTING DATA	••••••	DO SIGHTING DATA		
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#### P547E0LOSSUS

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•	RESET PREFERRED			
•	ORTENTATION FLAG.			
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н©LD .	FLASH VERB-NOUN TO	•	MONITOR DSKY:	
*******	REQUEST PLEASE PER-	***************	OPSERVE VERB-NOUN	
SNAP .	FORM FINE ALIGN	•	FLASH TO REQUEST	_
	CHECK		PLEASE PEPEDEM EIN	IE
	V50 N25		ALIGN CHECK.	
	R1-00014			
	P2-PLANK		•	
	93-BLANK		•	
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	•		DO I WANT TO REDO	
	•		THE CELESTIAL BODY	,
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	· •		SIGHTINGS, SIGHTIN	
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	•		TORQUING TO VERIEV	,
			THE ACCURACY OF	
	•		AL TONMENT?	
			NOTE: IF THE SIGHT	·
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	•		THE TOROUTNG ANGLE	
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	•		WEPE LARGE THE	
	•		ASTRONAUT SHOULD	
	•		PROCEED AND REDUCT	ΉĒ
	•		ALIGNMENT.	
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	WATT FOR KEYBOARD	•	KFY IN .	
	ENTRY	••••	ENTER +	
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 PEV
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 REV
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 PCR
 MIT
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 PCR
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 PEV
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 REV
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#### CHANGE CONTROL MOTES

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ABOVE		
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P :	74	P 54

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KEY IN

PROCEED

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TERMINATE FLASH UPON RECEIPT OF PROCEED OR ENTER

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#990

#980

#970

P54/COLOSSUS

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95-

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#### ENTRY-PREPARATION PREGRAM (P61) LEGIC REV 13 11/27/68

PURPOSE: (1) TO START NAVIGATION, CHECK IMU ALIGNMENT, AND PROVIDE ENTRY MONITOR SYSTEM INITIALIZATION DATA.

ASSUMPTIONS: (1) THE PROGRAM IS ENTERED WITH ADEQUATE FREE FALL TIME TO COMPLETE THE MANEUVERS FROM A WORST CASE STARTING ATTITUDE.

(2) THE ISS IS ON AND PRECISELY ALIGNED TO A SATISFACTORY ORIENTATION.

(3) THE PROGRAM IS SELECTED BY THE ASTRONAUT BY DSKY ENTRY.

PROG Cont	CMC	GR OUND	CREW	CHECKLIST	TIME	TOTAL TIME
			•CREW PROG •SELECTION			
			•			
			•••			
	START ENTRY-PREPAR- ATICN PROGRAM (P61) DISPLAY PROGRAM 61	• ••••••••••	KEY IN ENTRY PREPAR- Ation program (P61)			
			V37E 61E			#10
		•	MONITOR DSKY: Observe display of Program 61			
	•					#20
	DO IMU STATUS CHECK RCUTINE (RO2)	• •	DO IMU STATUS CHECK Routine (RO2)			
	•					
	SET TIG FLAG					#30
	•					
	•				P61/COLOSSUS	
	•					

	DO STATE VECTOR INTEGRATION (MID TO AVE) ROUTINE (R41) 		• •	DO STATE VECTOR INTEGRATION (MID TO AVE) ROUTINE (R41) OBSERVE THAT THE COMPUTER ACTIVITY LIGHT IS ON UNTIL COMPLETION OF ROU- TINE 41.
	IS UNIT (V X R) WITHIN 30 DEG OF +Y -SM			e de la construcción de la constru La construcción de la construcción d
		N 		
	WITHIN 30 DEG -Y ? -SM			
++ POSS TEMP	· · · · · · · · · · · · · · · · · · ·	• N • •		
SNAP . + + + + + + 13 ++ EDIT	COMMAND PROGRAM ALARM AND DISPLAY V05 N09 R1- R2- R3- EXPECTED ALARM CODE AT THIS TIME IS 01427	• • • • •	•	OBSERVE PROGRAM ALARM LIGHT ON DSKY AND DISPLAY OF ERROR CODE (IMU RE- VERSED. ZERO ROLL ON FDAI BALL WILL MEAN LIFT DOWN)
PCR 206	      			
342	•••	• • •		,

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#40

#50

#60

#70

#80

P61/COLOSSUS

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343	)		)	)	-
	· · · · · · · · · · · · · · · · · · ·			P61/COLOSSUS	
	• • • • • • • • • • • • • • • • • • •		OBSERVE PROGRAM		
	<ul> <li>ALARM AND</li> <li>DISPLAY</li> <li>V05 N09</li> <li>R1-01426</li> <li>R2</li> <li>R3-</li> </ul>	•••••	ALARM LIGHT ON DSKY AND DISPLAY OF ERROR CODE (IMU UNSATIS- FACTORY)		<b>#</b> 90
	· · · · · · · · · · · · · · · · · · ·				
	WAIT 10 SEC				#100
			•••••		
HOLD . SNAP .	FLASH VERB-NOUN TO REQUEST RESPONSE AND	•	MONITOR DSKY:		
++ +13 ++ EDIT	DISPLAY STORED DATA VO6 N61 R1-IMPACT LAT R2-IMPACT LONG R3-HEACS UP/DOWN	• • • • • • • • • • • • •	OBSERVE VERB-NOUN FLASH TO REQUEST RESPONSE AND DISPLAY OF S/C ENTRY DATA. NOTE: LAT AND LONG SHOULD HAVE		\$110
PCR 206	IMPACT LAT - LATI- Tude of desired Impact point. In Degrees to nearest	•	BEEN LOADED BEFORE . ENTERING THIS . PROGRAM		
	.01 DFG. + IS NORTH	• • •			#120
	ITUDE OF CESIRFD Impact point. In Degrees to nearest .01 deg. + is east	• • •			
	HEADS UP/DOWN - Defines Entry Roll Attitude +00001 For Heads UP/	• • • •			#130
	LIFT DOWN -00001 FOR FEADS DOWN /LIFT UP	•	· · · · · ·		
	•	•	AM I SATISFIEC WITH . THESE VALUES?		
	• • •	• • •	• • • • •	P61/COLOSSUS	#140

	WAIT FOR KEYBOARD ENTRY		KEY IN PROCEED
	TERMINATE FLASH UPON RECEIPT OF PROCEED OR NEW DATA PNEW RDATA C C E		KEY IN V25E AND LOAD DESIRED PARAMETERS
HOLD . SNAP .	FLASH VERB-NOUN TO REQUEST RESPONSE AND DISPLAY: VO6 N60 R1 - G MAX R2 - VPRED R3 - GAMMA EI G MAX - MAX PRECICTEC G FOR FREE FALL ANC ENTRY AT NOMINAL BANK ANGLE (L/D = .18) IN GS TO NEAREST .01 G. VPRED- PRECICTED INERTIAL VELOCITY AT 4CC,00C FT ALTITUDE ABOVE THE FISCHER ELLIPSOID. IN FPS TO NEAREST FPS.	•	MONITOR DSKY: DBSERVE VERB-NOUN FLASH TO REQUEST RESPONSE AND CISPLAY OF G MAX, VPRED AND GAMMA EI

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#150

#160

#170

#180

#190

P61/COLOSSUS

		-			
		•			
GAMMA EI - FLIGHT		•			
PATH ANGLE. ANGLE		•			
BETWEEN INERTIAL		•			
VELOCITY AND THE		•		•	
LOCAL HORIZONTAL					
AT THE ENTRY INTER-		•			
		•			
FACE ALTITUDE AT		•			
400,000 FT ALTIT-		•			
UDE ABOVE THE		•			
FISCHER ELLIPSOID.		_			#20
IN DEGREES TO		•			#201
		•			
NEAREST .01 DEG.		•			
		•			
MINUS INDICATES		•			
FLIGHT PATH IS BELOW		•			
THE HORIZONTAL PLANE.		_			
		•			
		•			
•		•			
•					
•		RECORD DATA IF			#210
•		NECESSARY			
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-		•			
•		•			#220
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•		•			
WAIT FOR KEYBOARD	•	KEY IN PROCEED			
ENTRY					
TERMINATE FLASH UPON	•				
					#230
RECEIPT OF PROCEEC					
•					
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•				P61/COLOSS	US
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OLD		MONITOR DSKY:	
NAP . TO REQUEST RESPONS	• F	OBSERVE VERB-NOUN	#240
AND DISPLAY:		FLASH TO REQUEST	
V06 N63	•	RESPONSE AND DISPLAY	
R1 - RTOGO		OF EMS INITALIZATION	
R2 - VIO		PARAMETERS	
R3 - TFE			
RTOGO - RANGE TO	Ċ0	•	
FROM A PRELOADED	80	•	
	E)	•	
ALTITUDE (SEE NOT		•	#25
ABOVE THE FISCHER			#23
ELLIPSOID TO THE		RECORD DATA FOR	
SPLASH POINT. IN		EMS INITIALIZATION	
NAUTICAL MILES TO			
NEAREST +1 NM+		•	
		•	
VIO - PREDICTED		•	
INERTIAL VELOCITY		•	
AT A PRELOADED AL		•	
TITUDE (SEE NOTE)		•	
ABOVE THE FISCHER		•	#26
ELLIPSOID IN FPS	TO	•	
NEAREST FPS.		•	
		•	
TFE - TIME FROM NO	W	•	
TO A PRELOADED AL	T-	•	
ITUDE (SEE NOTE)		•	
ABOVE THE FISCHER		•	
ELLIPSOID IN MIN		•	
AND SEC TO NEARES	т	•	
SEC. MAX READING		•	#27
59859 ABOVE +		•	
BELOW ALTITUDE.		•	
NOTE: THE ALTITUDE			
IS PRELCADED IN			
ERASABLE.			
FOR EARTH			
ORBIT = 284 + 643		•	
FOR LUNAR		•	
MISSION = 297+431		•	\$28
		•	#20
		•	
•		•	
•		•	
•	*=	•	
WAIT FOR KEYBOARD		KEY IN PROCEED	
ENTRY	•	NC) IN FNULLP	
C 14 1 15 1		· · · · · · · · · · · · · · · · · · ·	
TERMINATE FLASH UP	• CN		
RECEIPT OF PROCEED			400
REGERVIOR PROCEED			#290
•			
•			P61/COLOSSUS
•			
•			
46 *			
)		$\lambda$	

REV 09 PCR MIT 32 DELETE ASSUMPTION 5 REV 10 PCR MIT 42 REV 11 PCR 50 REV 12 PCR MIT 149 REV 13 PCR 206 EDITORIAL

CHANGE CONTROL NOTES

_____ TERMINATE PROGRAM MONITOR DSKY: ٠ OBSERVE TERMINATION 61 AND GO ON TO ..... ENTRY - CH/SH SEP-OF POL AND DISPLAY . ARATION AND PRE-DF P62 ENTRY MANEUVER -----PROGRAM (P62) • ------. . . . ... ... EXIT P61 EXIT P61

P61/COLOSSUS

#310

#300

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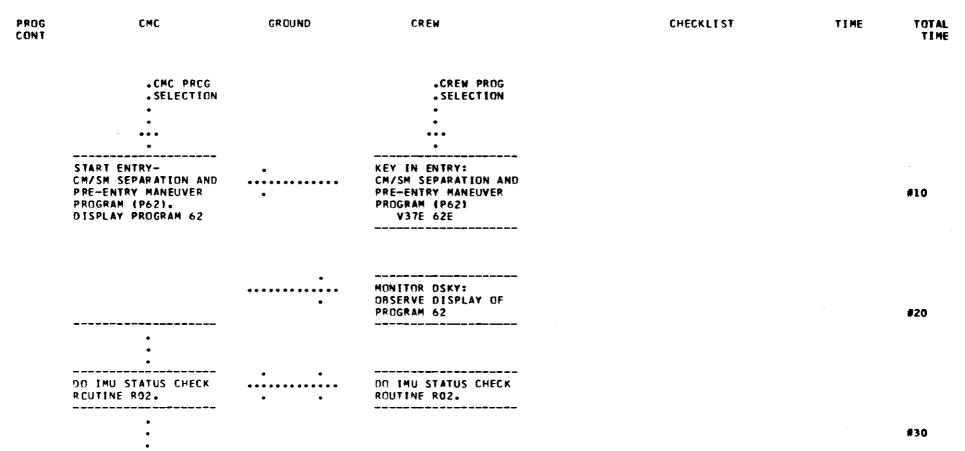
PURPOSE: (1) TO NOTIFY CREW WHEN THE GNOS IS PREPARED FOR CM/SM SEPARATION.

(2) TO ORIENT THE CM TO THE CORRECT ATTITUDE FOR ATMOSPHERIC ENTRY.

ASSUMPTIONS: (1) THE PROGRAM IS ENTERED WITH ADEQUATE FREE FALL TIME TO ACCOMPLISH CM/SM SEPARATION AND TO COMPLETE THE MANEUVER FROM A WORST CASE STARTING ATTITUDE.

(2) THE IMU IS SATISFACTORILY ALIGNED FOR ENTRY.

(3) THE PROGRAM IS AUTOMATICALLY SELECTED BY THE ENTRY-PREPARATION PROGRAM (P61) OR IT MAY BE SELECTED MANUALLY.



#50

#40

#60

#70

#80

P62/COLOSSUS

	CALL THE A	VERAGE	
-	G ROUTINE		
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₩IT + Y -S		OF	
. Y		• N	
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•		•	
•	IS UNIT ()	/ X R)	
•			
•	•		
•	WITHIN 30		
•	WITHIN 30 -Y ?		
•	WITHIN 30		
•	WITHIN 30 -Y ? -SM	DEG CF	
•	WITHIN 30 -Y ?		
•	WITHIN 30 -Y ? -SM	DEG CF	
• • • • • • • • • • • • • • • • • • • •	WITHIN 30 -Y ? -SM	DEG CF	
• • • • • • • • • • • • • • • • • • • •	WITHIN 30 -Y ? -SM	DEG CF	
•	WITHIN 30 -Y ? -SM	DEG CF	
• • • • • • • • • • • • • • • • • • • •	WITHIN 30 -Y ? -SM	DEG CF	
• • • • • • • • • • •	WITHIN 30 -Y ? -SM	DEG CF	
• • • • • • • • • •	WITHIN 30 -Y ? -SM	DEG CF	
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• • • • • • • • • • • • •	WITHIN 30 -Y ? -SM	DEG CF	
	WITHIN 30 -Y ? -SM	DEG CF	

HAS THIS PROGRAM BEEN ENTERED AUTO+ MATICALLY FROM P61?

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(MID TO AVE) ROUTINE

DO STATE VECTOR

OBSERVE THAT THE

COMPUTER ACTIVITY

LIGHT IS ON UNTIL

THE COMPLETION OF

------

INTEGRATION

ROUTINE 41.

(P41).

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. SET TIG FLAG

. DO STATE VECTOR

INTEGRATION

. (MID TO AVE)

. ROUTINE (R41).

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351	· • •		)	
	• • •			
	• •			
	•••••			
	COMMAND PRO- GRAM ALARM AND DISPLAY V05 N09	• • • • • • • • • • • • • • • • • • • •	OBSERVE PROGRAM Alarm Light on DSKy And Display of Error Code (IMU Reversed.	
	R1-01427 . R2- R3-		ZERO ROLL ON FDAI Ball Will Mean Lift Down+}	
	• • • • •			
++	• • •			
POSS TEMP	• • • •			
HOLD SNAP	COMMAND PROGRAM     ALARM AND DIS-     PLAY     V05 N09		OBSERVE PROGRAM Alarm Light on Dsky And Display of Error Code (Imu Unsatis-	
+	• • R1-		FACTORYJ	
<b>+</b> ▲	• • R2 • • R3-			
+11	. EXPECTED ALARM			
++ EDIT PCR	• CODE AT THIS • TIME IS 01426			
206	• • •			
	• • •			
	• • •			
	. WAIT 10 SEC			
	• •			
	• •			
	INITIALIZE ENTRY DAP AND BODY ATTITUDE CALCULATIONS AND LEAVE IN STANDBY STATE.			
	JIMIL# #=#=================================			
	•			
	CALCULATE THE RE- QUIRED GIMBAL ANGLES TO GIVE CORRECT ANGLE OF ATTACK OF THE CM INTO THE AT- MOSPHERE AT THIS TIME AND CONTINUE CALCULATION EVERY			
	TWO SECONDS UNTIL			

.

COMPLETION OF THIS PROGRAM. THESE GIM-

P62/COLOSSUS

#90

#100

#110

#120

#130

	BAL ANGLES ARE Stored in Noun 22.					
	•					#140
HOLD . SNAP .	FLASH VERB-NOUN TO REQUEST PLEASE PERFORM CM/SM SEPAR- ATION: V50 N25	REQUEST PLEASE	MONITOR DSKY: ORSERVE VERB-NOUN FLASH TO REQUEST PLEASE PERFORM CM/SM SEPARATION			
	R1 - 00041 R2 - BLANK R3 - BLANK		CM/SM. NDT. SEPA	•CM/SM •SEPAR- •ATED		#150
	•		RATED.	•		
	•		PRIOR TO COMMANDING CM/SM SEPAR-	•		414.0
	• • •			•		#160
	• • •			•		
	•		AFTER SEPA- RATION 	•		#170
	•		MOVE CM/SM	•		
	•		SEP SWITCH TO UP ON CREW SAFETY PANEL	•		
	• • •		•	•		#180
	• • •		• • •	• • •		
	• • •		•	•		
	•		•	•		P62/COLOSSUS
352	) :		•	: )		

353	)		)		) .
	• • •			P62/COLOSSU	S
	WAIT FOR KEYBOARD ENTRY TERMINATE FLASH UPON RECEIPT OF PROCEED. .P .R .O .C .C .E .E .E .D	• •	WHEN SATISFIED THAT CM/SM SEPARATION HAS SATISFACTORILY OCCURRED WAIT SEC FOR ADEQUATE SEPARA- TION DISTANCE AND KEY IN PROCEEC.		#190
	TURN OFF CSM RCS DAP				#200
	• • • •				
	TURN ON ENTRY DAP AND MAINTAIN ATTI- TUDE HOLD.				#210
	• • • • • •	•	••••	•	
SNAP .	.FLASH VERB-NOUN TO REQUEST RESPONSE AND DISPLAY STORED DATA . V06 N61	•	MONITOR DSKY: OBSERVE VERB-NOUN FLASH TO REQUEST RESPONSE AND DISPLAY		#220
++ +11 ++ FOIT PCR 206	RI-IMPACT LAT R2-IMPACT LONG R3-HFADS UP/DOWN IMPACT LAT - LATI- TUDE OF DESIRED IM- PACT POINT. IN DEGREES TO NEAREST .01 DEG. + IS NORTH		OF S/C ENTRY CATA NDTE: LAT AND LONG SHOULD HAVE BEEN LOADED BEFORE ENTERING THIS PRO- GRAM		#230

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MPACT LONG - LONG-	•	•	
TUDE OF DESIRED IM-	•	•	
ACT POINT. IN	•	•	
EGREES TO NEAREST	•	•	
O1 DEG. + IS EAST	•	•	
	•	•	
EADS UP/DOWN - DE-	•	•	
INES ENTRY ROLL TTITUDE	•	•	
00001 FOR HEADS UP/	•	•	
IFT DOWN	•	•	
00001 FOR HEADS	•	•	
OWN/LIFT UP	•	•	
	•	*	
	•	AM I SATISFIED	WITH
•	•	THESE VALUES?	<b>M T</b> 4 ( )
•	•	THESE VALUES P	
•	•	.Y	
•	•	•••	
	-	-	-
ATT FOR KEYBOARD	•		
ITRY	••	KEY IN PROCEED	
	• •		
	••		
	•		•
ERMINATE FLASH UPON	•• • •		• •
ERMINATE FLASH UPON ECEIPT OF PROCEED	••	KEY IN V25E	
ERMINATE FLASH UPON ECEIPT OF PROCEED R NEW DATA	•• • • • • • • • • • • • • • • • • • • •	LOAD DESIRE	
ERMINATE FLASH UPON ECEIPT OF PROCEED R NEW DATA	•• • • • • • •		
ERMINATE FLASH UPON ECEIPT OF PROCEED R NEW DATA PNEW	•• • • • • • •	LOAD DESIRE	
ERMINATE FLASH UPON ECEIPT OF PROCEED R NEW DATA PNEW RDATA	•• • • • • • • •	LOAD DESIRE	
ERMINATE FLASH UPON ECEIPT OF PROCEED R NEW DATA PNEW RDATA O	••	LOAD DESIRE	
ERMINATE FLASH UPON ECEIPT OF PROCEED R NEW DATA PNEW RDATA O C	•• • • • • • • • • • • • • • • • • • • •	LOAD DESIRE	
ERMINATE FLASH UPON ECEIPT OF PROCEED R NEW DATA PNEW RDATA O C E	• • • • • • • • • • • • • • • • • • • •	LOAD DESIRE	
RMINATE FLASH UPON CEIPT OF PROCEED NEW DATA PNEW RDATA O C E E. STORE DATA	• • • • • • • • • • • • • • • • • • • •	LOAD DESIRE	
ERMINATE FLASH UPON ECEIPT OF PROCEED R NEW DATA PNEW RDATA O C E	• • • • • • • • • • • • • • • • • • • •	LOAD DESIRE	
PNEW RDATA PNEW RDATA O C E. STORE DATA	• • • • • • • • • • • • • • • • • • • •	LOAD DESIRE	
P. NEW R. DATA P. NEW R. DATA O. C. E. STORE DATA	• • • • • • • • • • • • • • • • • • • •	LOAD DESIRE	
RMINATE FLASH UPON CEIPT OF PROCEED NEW DATA PNEW RDATA O C E	• • • • • • • • • • • • • • • • • • • •	LOAD DESIRE	
ERMINATE FLASH UPON ECEIPT OF PROCEED R NEW DATA PNEW RDATA O C E E. STORE DATA	• • • • • • • • • • • • • • • • • • • •	LOAD DESIRE	
ERMINATE FLASH UPON ECEIPT OF PROCEED R NEW DATA PNEW RDATA O C E	• • • • • • • • • • • • • • • • • • • •	LOAD DESIRE	
ERMINATE FLASH UPON ECEIPT OF PROCEED R NEW DATA PNEW RDATA O C E	• • • • • • • • • • • • • • • • • • • •	LOAD DESIRE	
ERMINATE FLASH UPON ECEIPT OF PROCEED R NEW DATA PNEW RDATA O C E	• • • • • • • • • • • • • • • • • • • •	LOAD DESIRE	
ERMINATE FLASH UPON ECEIPT OF PROCEED R NEW DATA PNEW RDATA O C E E. STORE DATA D STABLISH ATTITUDE DMMANDS FOR ENTRY AP NECESSARY TO	• • • • • • • • • • • • • • • • • • • •	LOAD DESIRE	
RMINATE FLASH UPON CEIPT OF PROCEED NEW DATA PNEW RDATA O C E		LOAD DESIRE	
ERMINATE FLASH UPON ECEIPT OF PROCEED R NEW DATA P. NEW R. DATA O. C. E. C. E. STORE DATA D. STABLISH ATTITUDE DMMANDS FOR ENTRY AP NECESSARY TO IVE CORRECT ANGLE F ATTACK INTO ATMC-		LOAD DESIRE	
RMINATE FLASH UPON CEIPT OF PROCEED NEW DATA P. NEW R. DATA O. C. E. STORE DATA D. STORE DATA D. STORE DATA D. STORE DATA D. STABLISH ATTITUDE MMANDS FOR ENTRY AP NECESSARY TO VE CORRECT ANGLE ATTACK INTO ATMC- PHERE:		LOAD DESIRE	
ERMINATE FLASH UPON CEIPT OF PROCEED NEW DATA PNEW RDATA O C E. STORE DATA D		LOAD DESIRE	
ERMINATE FLASH UPON ECEIPT OF PROCEED R NEW DATA PNEW RDATA O C E		LOAD DESIRE	
ERMINATE FLASH UPON ECEIPT OF PROCEED R NEW DATA PNEW RDATA O E		LOAD DESIRE	
ERMINATE FLASH UPON ECEIPT OF PROCEED R NEW DATA PNEW RDATA O C E		LOAD DESIRE	
ERMINATE FLASH UPON ECEIPT OF PROCEED R NEW DATA P. NEW R. DATA O. C. E. STORE DATA D. STORE DATA		LOAD DESIRE	
RMINATE FLASH UPON CEIPT OF PROCEED NEW DATA P. NEW R. DATA O. C. E. STORE DATA D. STORE DATA D. STORE DATA D. STORE DATA D. STORE DATA D. STORE DATA D. SED CORRECT ANGLE ATTACK INTO ATMC- HERE: ROLL COMMAND - SED ON PREVIOUS FINITION OF HEADS /DOWN ALPHA COMMAND - IM ANGLE OF ATTACK		LOAD DESIRE	
RMINATE FLASH UPON CEIPT OF PROCEED NEW DATA P. NEW R. DATA O. C. E. STORE DATA D. TABLISH ATTITUDE MMANDS FOR ENTRY P NECESSARY TO VE CORRECT ANGLE ATTACK INTO ATMC- HERE: ROLL COMMAND - SED ON PREVIOUS FINITION OF HEADS /DOWN ALPHA COMMAND -		LOAD DESIRE	

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P62/COLOSSUS

#240

#250

#260

#270

#280

P62/COLOSSUS

	FOR LIFT DOWN THIS ATTITUDE WILL BE OBTAINED AFTER A SIMPLE PITCH DOWN MANEUVER FROM THE SEPARATION ATTITUDE. FOR LIFT UP AN ADDI- TIONAL 180 DEGREES OF ROLL IS REQUIRED.		·		#290 #300
	•				
	TURN ON ENTRY DAP				
	•				
TEMO	•				#310
TEMP HOLD . MON .	DISPLAY ON DSKY DE- SIRED FINAL GIMBAL ANGLES: VO6 N22	•	MONITOR DSKY: Observe display Of final gimbal Angles.		#31 <b>0</b>
	R1— OG ROLL R2— IG PITCH R3— Mg YAW	• • • • • • • • • • • • • • • • •	• •		
	IN DEGREES TO		•		
	NEAREST .01 DEG.		•		#320
	•		•		
	•		•		
	•		•		
	IS THE ANGLE ALPHA ALREADY WITHIN 45 DEGREES?		•		
	~~~~~~		•		#330
	• ¥ • N		•		
	• •		•		
	. WAIT UNTIL CM		•		
	 ANGLE OF ATTACK (ALPHA) IS WITH- 		•		
	IN 45 DEGREES		•		
	 AND THEN WAIT AN ACDITIONAL 		•		#340
	• 21 SECCNDS.		•		
	• •		•		
	• •		•	P62/COLOSSUS	
	• •		•		

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•	•		•
•	•		•
•	•		•
TERMINA	ATE PROGRAM	•	MONITOR DSKY:
62 AND	GO TO ENTRY-		OBSERVE TERMINATION
INITIAL	IZATION	•	OF P 62 AND DISPLAY
PROGRAM	4 (P 63)		OF P 63
	•		•
	•		•
	•		•
	•••		• • •
	•		•
	EXIT P62		EXIT P62

CHANGE CONTROL NOTES

 REV
 07
 PCR
 MIT
 32

 REV
 08
 PCR
 MIT
 41

 REV
 09
 PCR
 MIT
 66

 REV
 10
 PCR
 MIT
 152

 REV
 11
 PCR
 206
 EDITORIAL

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#350

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ENTRY-	INITIAL	IZATION	PREGRAM	(P63)	

LOGIC REV 06 04/09/68

PURPOSE: (1) TO INITIALIZE THE ENTRY EQUATIONS.

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(2) TO CONTINUE TO HOLD THE CM TO THE CORRECT ATTITUDE WITH RESPECT TO THE ATMOSPHERE FOR THE ONSET OF ENTRY DECELERATION.

(3) TO ESTABLISH ENTRY DSKY DISPLAYS.

(4) TO SENSE .05G AND DISPLAY THIS EVENT TO THE CREW BY SELECTING THE ENTRY-POST 0.05G PROGRAM (P64).

ASSUMPTIONS: (1) THE PROGRAM IS AUTOMATICALLY SELECTED BY THE ENTRY-CM/SM SEPARATION AND PRE-ENTRY MANEUVER PROGRAM (P62).

(2) THE ASTRONAUT FAY FONITOR N64(G,VI,R TO TARC) DURING THIS PROGRAM BY KEYING IN V16 N64E. HE ALSO MAY MONITOR N68 (BETA, VI, HCOT) BY KEYING IN V16N68E.

PROG Cont	CMC	GROUND	CREW	CHECKLIST	TIME	TOTAL TIME
	.CMC PROG .SELECTION START ENTRY - INITIALIZATION PROGRAM (63) DISPLAY PROGRAM 63	•	MONITOR DSKY: OBSERVE DISPLAY OF PROGRAM 63			#10
	PERFORM ENTRY INITIALIZATION ROUTINE WHICH INCLUDES:	•				#20

	A-CONTINUE CALCU- LATION OF INITIAL ROLL ANGLE BASED ON THE LATERAL RANGE OF THE LANDING TARGET AND HEADS UP/HEADS DOWN AS SPECIFIED. B-CONTINUE CALCULATIO OF DESIRED CM PITCH AND YAW ATTITUDE AS DETERMIN	_			#30
	NED BY THE VEHICLES POSITION AND VEL- DCITY W.R.T. THE ATMOSPHERE. PRIOR TO .05G THIS ATTITUDE IS ZERO SIDESLIP AND ANGLE OF ATTACK NEAR TRIM VALUE.				#40
	MAINTAIN CH ATTITUCE FOR LIFT VECTOR UP/ DOWN, AS SELECTED, ZERO SIDESLIP,				#50
	AND TRIM ANGLE OF ATTACK 				#60
TEMP HOLD . MON .	• DISPLAY ON DSKY: VO6 N64 R1-G R2-VI R3-R TE GO	•	MONITOR DSKY: OBSERVE DISPLAY OF G, VI AND R TO GO		#70
			•	P63/COLOSSUS	
' ~ \$)		:	P637C0E0SS0S	

P63/COLOSSUS

	•
G-ACCELERATION IN G	•
TC NEAREST .01G	
	MONITOR GNCS CONTROL
VI-INERTIAL VELOCITY	OF PRE05G CM
IN FPS TO NEAREST	ATTITUDE:
FPS	
	(1) DSKY:
R TO GO - RANGE TO	
GO TO THE DESIRED	R 1-G-INCREAS ING
SPLASH POINT	
	R 2-V I-NOM INAL
ASSUMING SPLASH	KZ-VI-NUMINAL
POINT LOCATED AT	
CALCULATED IMPACT	R3-R TO GO
TIME. IN NAUTICAL	NEGATIVE AND
MILES TO NEAREST	COUNTING DOWN
.1 NM. NEGATIVE AND	WHEN APPROACHING
COUNTING DOWN WHEN	TARGET, POSITIVE
	AND COUNTING UP
APPROACHING TARGET,	
POSITIVE AND COUNT-	WHEN LEAVING
ING UP WHEN LEAVING	T AR GET .
TARGET.	
	(2) FDAI:
_	
-	ATTITUDE RATES
•	LESS THAN-DEG./
•	
•	SEC •
•	
•	ATTITUDE ERRORS
•	LESS THANDEG.
WAIT FOR .05G	
INDICATION	
•	
•	
•	
ENTRY LOGIC DETECTS	
• 05G	
•	
•	
•	
CHANGE ENTRY DAP	
FROM ATTITUDE HOLD	
IN ALPHA AND BETA TO	
RATE DAMPING IN	
PITCH AND YAW, ROLL	
UNCHANGED.	
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P63/COLOSSUS

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•		
ERMINATE P63 AND GO O ENTRY-POST 0.05G ROGRAM (P64)	 MONITOR DSK Observe ter Of P63 AND Of P64	MINATION
•	.Y	 •N
•	• *	• '1
	•	•
•	• • •	•
•	•	•
•	EXIT P63	•
•		•
-		
•	HAS 0.05 G YET ACCORDI	
•	•¥	 • N
-	•	•
•	•	•
•		
•	GO TO BACK	
-		
•		•
•		•
• • •	HAS .05G CC YFT ACCORDI SEAT OF P	NG TO
•		• N
•	•	•
•	•	• • • • • •
•	•	
•	•	
•	GO TO BACKU	_ Р
•	PROCEDURES	-
•		
•		
• • •		
FXIT P63		

EXIT P63

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CHANGE CONTROL NOTES

REV 06 PCR MIT 66

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(1) TO START ENTRY GUIDANCE AT .05G SELECTING ROLL ATTITUDE, CONSTANT DRAG LEVEL, AND DRAG THRESHOLD, KA, WHICH ARE PURPOSE: KEYED TO THE .05G POINT.

- (2) SELECT FINAL PHASE (P67) IF V <27000 FPS WHEN .2G OCCURS.
- (3) ITERATE FOR UPCONTROL SOLUTION (P65) IF V >27000 FPS AND IF ALTITUDE RATE AND DRAG LEVEL CONDITIONS ARE SATISFIED
- (4) SELECT FINAL PHASE (P67) IF NO UPCENTROL SOLUTION EXISTS WITH VL >18000 FPS.
- (5) TO ESTABLISH THE 0.05 G MODE IN SCS.
- (6) TO CONTINUE ENTRY CSKY DISPLAYS.

- ASSUMPTIONS: (1) THE PROGRAM IS AUTOMATICALLY SELECTED BY THE ENTRY INITIALIZATION PROGRAM (P 63).
 - (2) THE ASTRONALT MAY MONITOR N64(G,VI,R TC TARG) DURING THIS PROGRAM BY KEYING IN VI6N64E. HE ALSO MAY MONITOR N68 (BETA, VI, HDOT) BY KEYING IN V16 N68E.

PROG Cont	CMC	GROUND	CREW	CHECKLIST	TIME	TOTAL TIME
	•CMC PROG. •Selection •	1				
	•••		,			
	START ENTRY-POST 0.05 G PRCGRAM (P 64)					#10
	•					
	DISPLAY PROGRAM 64	•	MENITOR DSKY:			
	•	•	OBSERVE DISPLAY OF Program 64			
	•					
	•		•			#20
	•		•			
	•		•			
	•		•		P64/COLOSSUS	

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SFT 0.05 G ENTRY SWITCH ON SCS CONTROL PANEL TO ON

TEMP	•			
HOLD . MON .	DISPLAY ON DSKY: VO6 N68 R1-BETA R2-VI R3-H DOT	• • • • • •	MON OF 1	ITOR G+N CONTROL
	BETA-COMMANDED BANK ANGLE. IN DEGREES TO NEAREST .01 DEGREE VI - INERTIAL VELOCITY. IN FPS TC NEAREST FPS			ATT RATES LESS THANDEG/SEC BALL INDICATES LIFT VECTOR DIRECTION COR- RELATION WITH BETA
++ +07 +07 ++ EDIT PCR 206	H DOT - RATE OF CHANGE OF ALTITUDE ABOVE PAC RADIUS. IN FPS TO NEAREST FPS. PLUS FOR INCREASING ALTITUDE, MINUS FOR DECREASING ALTITUDE.		(8)	DSKY: RI-BETA VARIES TO LIMIT G AND CONTROL LIFT VECTOR
	•			R2 - VI DECREASING R3-H DOT
	COMMAND CM ATTITUEE IN ACCORDANCE WITH CMC ENTRY LEGIC			•
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364)			.)

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P64/COLOSSUS

#30

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#60

P64/COLOSSUS

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	P64/COLOSSUS
	-047C0E03303
•	
	#70
TERMINATE P64 AND GO .	-
TO ENTRY-UP CONTROL .	
PHASE PROGRAM (P65) .	
IF V EQUAL TO OR .	
GREATER THAN 27000	
FPS AND CONSTANT	
DRAG CONTROL HAS	
BROUGHT RANGE PRE-	
DICTION TO WITHIN	
25 NM OF DESIRED	#80
RANGE. IF V < 27000 FPS, DSKY WILL DIS-	
PLAY P67	
FLAT FOT *	
•	
•	
•	#90
•	
•••	
• •	
EXIT P64 EXIT P64	

CHANGE CENTROL NOTES

REV 06 PCR MIT 66 REV 07 PCP 206 EDITCPIAL THIS PAGE INTENTIONALLY LEFT BLANK

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ENTRY - UP CONTRCL PRCGRAM (P65) LOGIC REV 08 11/27/68

PURPOSE: (1) TO EXECUTE ENTRY - UP CONTROL GUIDANCE WHICH STEERS THE CM TO A CONTROLLED EXIT (SKIP OUT) CONDITION.

(2) TO ESTABLISH ENTRY - UP CONTROL DISPLAYS WHICH ARE USED IN CONJUNCTION WITH THE EMS TO DETERMINE FOR THE ASTRO-NAUT IF THE BACKUP PROCEDURES SHOULD BE IMPLEMENTED.

2 (3) TO SENSE EXIT (CRAG ACCELERATION LESS THAN Q7 FPS) AND THEREUPON TO SELECT THE ENTRY - BALLISTIC PHASE PROGRAM (P66).

- (4) WHERE RDOT IS NEGATIVE AND THE V IS SUFFICIENTLY LOW (V-VL-C18 NEG), PROGRAM WILL EXIT DIRECTLY TO P67 (FINAL PHASE).
- ASSUMPTIONS: (1) THIS PROGRAM IS AUTOMATICALLY SELECTED BY THE ENTRY POST 0.05G PROGRAM (P64) WHEN CONSTANT DRAG CONTROL HAS BROUGHT RANGE PREDICTION TO WITHIN 25 N.M. OF THE DESIRED RANGE. IT IS SKIPPED IN EARTH ORBIT MISSIONS.
 - (2) THE ASTRONAUT MAY MONITOR N64(G,VI,R TO TARG) CURING THIS PROGRAM BY KEYING IN V16N64E. HE ALSO MAY MONITOR N68 (BETA, VI, HOOT) BY KEYING IN V16 N68E.
 - (3) MANUAL RESPONSE TO N69 IS NOT NECESSARY TO TERMINATE P65. SELECTION OF EITHER P66 OR P67 BY ENTRY GUIDANCE PRO-VIDES AUTOMATIC TERMINATION.

PROG CONT	CMC	GROUND	CREW	CHECKLIST	TIME	TOTAL TIME
	.CMC PREG .Selection					
	START ENTRY - UP Control Phase Program (65)					
	•					#10
	:		MONITOR DSKY: •• OBSERVE DISPLAY OF			
	DISPLAY PROGRAM 65	·	PROGRAM 65			#20

P65/COLOSSUS

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#70

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	• • •			P65
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	•			
	• E • D •			
	• C • C • E			
•	• P • R			
08 +	RECEIPT OF PROCEEC OR FLASH IS AUTO- MATICALLY TERMINATEC UPON RECEIPT BY ENTRY GUIDANCE OF P66 OR P67.			
	WAIT FOR KEYBOARD Entry Terminate Flash upon	•		
+ 08	DO EITHER:	•	KEY IN PROCEED	
	•		•	
	* *		•	
	VL - SKIP OUT VELOCITY. IN FPS TO NEAREST FPS.		RECORD CONTENTS OF R1, R2, AND R3 FOR LATER USE WITH EMS	
	0.01 G (Q7)		•	
	DL - DRAG ACCELERA- TION AT SKIP OUT IN GS TO NEAREST		•	
	REES TO NEAREST 0.01 Degree		•	
	BETA - COMMANDED Bank Angle. In Deg-		•	
	R2 – DL R3 – VL		•	
	V16 N69 R1 - Beta		OF BETA, CL, AND VL	
DN .	REQUEST RESPONSE AND DISPLAY PRE-COMPUTED EXIT CONDITIONS		OBSERVE VERB-NOUN FLASH TO REGUEST RE- SPONSE AND DISPLAY	
	DEDUCET DECODEC AND		ODECOVE VEDO ACUN	

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	• • •			P65/COLOSSI	is
TEMP HOLD . MON .	DISPLAY ON DSKY: V06 N68 R1 - BETA R2 - VI R3 - H DOT BETA - COMMANDED BANK ANGLE. IN DEGREES TO NEAREST 0.01 DEGREE	• 01	DNITOR GEN CONTROL F ENTRY: A) FDAI: ATT ERRORS LESS THAN DEG ATT RATE LESS THAN DEG/SEC.		#80
	VI - INERTIAL VELO- CITY. IN FPS TO NEAREST FPS H DOT - RATE OF CHANGE OF ALTITUDE ABOVE PAD RADIUS IN FPS TO NEAREST FPS. PLUS FOR INCREASING ALTITUDE MINUS FOR DECREASING ALTITUDE.				# 90
	COMMAND CM ATTITUDE IN ACCORDANCE WITH CMC ENTRY LCGIC	(8	B) DSKY: R1 — BETA VARIES TO LIMIT G AND Control Lift Vector		#100
		DU IM DS EM EN	R2-VI DECREASING R3-H DOT TE: BACKUP PROCE- JRES SHOULD BE PLEMENTED IF THIS SKY DISPLAY AND/OR IS INDICATE CIVERG- ICE FROM ACCEPTABLE		\$110
	• • • • • • • • • • • • • • • • • • • •		YERATIONAL IVELOPE • • • • • • • • • • • • • • • • • • •		#120
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P65/COLOSSUS

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• • • • • • • • • • • • • • • • • • • •		FOR A NOMINAL LUNAR MISSION ENTRY CMC WILL GO DIRECTLY TO P66 WHEN DRAG ACCEL- ERATION FALLS BELOW EXIT (SKIP OUT) THRESHOLD OF Q7 FPS SQUARED.
• • •		•
WHEN RDOT IS NEGATIVE AND THE VELOCITY IS SUFFICIENTLY LOW (V-VL-C18 NEG) GO DIRECTLY TO P67	•	MCNITOR DSKY: DESERVE TERMINATION DF P65 AND DISPLAY DF P66
•		•
TERMINATE P65 AND GO TO ENTRY - BALLISTIC PHASE PROGRAM (P66)		•
•		• • •
EXIT P65		EX IT P65

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CHANGE CONTROL NOTES

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 06
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 REV
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 PCR
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 RFV
 07
 PCR
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 08
 EDITORIAL

PURPOSE: (1) TO MAINTAIN CM ATTITUDE DURING BALLISTIC (SKIP OUT) PHASE FOR ATMOSPHERIC RE-ENTRY.

(2) TO SENSE RE-ENTRY (DRAG ACCELERATION BUILDS UP TO Q7 + 0.5 FPS OR APPROX. 0.2G) AND THEREUPON TO SELECT THE ENTRY - FINAL PHASE PROGRAM (P67).

- ASSUMPTIONS: (1) THIS PROGRAM IS AUTOMATICALLY SELECTED BY THE ENTRY UP CONTROL PROGRAM (P65) WHEN DRAG ACCELERATION BECOMES
 - (2) THE ASTRONAUT MAY MONITOR NE4 (G, VI, R TC TARG) DURING THIS PROGRAM BY KEYING IN V16 NE44. HE ALSO MAY MONITOR NEB (BETA, VI, HODTI BY KEYING IN V16 NE88.

PROG Cont	CMC	GROUND	CREW	CHECKLIST	TIME	TOTAL TIME
	• CMC PRCG • Selection					
	•••					
	START ENTRY - BAL- LISTIC PROGRAM (P66)					
	•					#10
	DISPLAY PROGRAM 66	•	MONITOR DSKY: Observe display of			
	•	•	PROGRAM 66			
	•		• •			#20
	ESTABLISH ATTITUDE COMMANDS FOR ENTRY DAP NECESSARY TO		•			
	GIVE CORRECT ANGLE OF ATTACK INTO THE ATMOSPHERE:		•			
++ +07 +	ROLL COMMAND- MAINTAIN LAST COMPUTED VALUE		•			#30
+ + +			• •		P66/COLOSSUS	

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+ + +

+		•	
+	FROM ENTRY	•	
,	GUIDANCE UNLESS	•	
	ACCELERATION GOES		
	BELOW .05 G IN		
	WHICH CASE MAIN-	•	
	TAIN ZERC DEGREES	•	
~7		•	
07	UNTIL TERMINATION	•	
+	OF P66.	•	
	ALPHA COMMAND-	•	#4
	TRIM ANGLE OF	•	**
	ATTACK (TRIM	•	
	ALPHA)	•	
	BETA COMMAND-	•	
	ZERO.	•	
		•	
	•	•	
	•	•	
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	CALCULATE FINAL	•	#5
	GIMBAL ANGLES RE-	•	
	QUIRED BASEC ON PRE-	•	
	SENT STATE VECTOR.	•	
	REPEAT CALCULATION	•	
	EVERY TWO SECONDS	•	
	UNTIL TERMINATION CF	•	
	P66.	•	
		•	
	•	•	
	•	•	#6
	•	•	
EMP		•	· · · ·
OLD .	DISPLAY ON DSKY:	•	
	THE DESIRED GIMBAL	• • • • • • • • • • • • • • • • • • • •	
ON .	ANGLES TO WHICH THE	MCNITOR GNCS CONTROL	
	ENTRY DAP WILL ORI-	• OF ENTRY:	
	ENT THE CM		
	V06 N22	FDAI: ATTITUDE	
	R1-CG ROLL	ERROR NEEDLES -	
	R2-IG PITCH	DIFFERENCE BETH-	#
	R3-MG YAW	EEN THE TOTAL DE-	
		SIRED ATTITUDE	
	ALL COMMANDED GIMBAL	AND THE ACTUAL	
	ANGLES IN DEGREES TO	ATTITUDE (FLY TO	
	NEAREST 0.01 DEGREE.	POLARITY).	
	•	BALL: ACTUAL GIMBAL	
	•	ANGLES READ ON BALL	
	•	SHOULD AGREE WITH	
		COMMANDED GIMBAL	#
	•	ANGLES READ ON DSKY.	
	-		
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	-	•	P66/COLOSSUS
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COMMAND CM ATTITUDE IN ACCORDANCE WITH CMC ENTRY - BALLIS-TIC PHASE LOGIC ----RCLL ANGLE IS HELD AT EXIT ROLL ATTI-TUDE, PITCH AND YAW ATTITUDE IS DETER-MINED BY THE VEHICLE POSITION AND VELO-CITY W.R.T. THE ATMOSPHERE. THIS ATTITUDE IS ZERO SIDESLIP AND ANGLE OF ATTACK NEAR THE TRIM VALUE. NOTE: THREE AXIS DAP CONTROL WAS REGAINED WHEN LESS THAN 0.05 G WAS SENSED AND WILL BE RELINQUISHED WHEN 0.05 G IS AGAIN SENSED. -----TERMINATE P66 AND GC MONITOR DSKY: TO ENTRY-FINAL PHASE **OBSERVE TERMINATION** . PROGRAM (P67) WHEN OF P66 AND DISPLAY DRAG ACCELERATION . BUILDS UP 2 TO 07 + 0.5 FPS _____

 #90

#100

#110

#120

 REV
 06
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APOLLO COMPUTER LOGIC CHECKLIST INTERFACE

ENTRY - FINAL PHASE PROGRAM (P67)	L 06 10	SEA 0a	11/29/68
	CHECKLIST	REV 10	04/27/68

2

- PURPOSE: (1) TO CONTINUE ENTRY CUIDANCE AFTER 07 + 0.5EPS (OR APPROX. 0.2G) UNTIL TERMINATION OF STEERING WHEN THE CM VELOCITY WRT FARTH = 1000 FT/SEC (ALTITUDE IS APPROXIMATELY 65,000 FT.).
 - (2) TO CONTINUE ENTRY CSKY DISPLAYS.
- ASSUMPTIONS: (1) THE PROGRAM IS AUTOMATICALLY SELECTED BY:

(A) P65 WHEN ADOT IS NEGATIVE AND THE V IS SUFFICIENTLY LOW (V-VL-C18 NEG)

(B) P66 WHEN DRAG ACCELERATION BUILDS UP TO 07 + 0.5 FPS. (OR APPROX. 0.2G)

- (C) P64 JF NO UPCONTROL SOLUTION EXISTS WITH VL > 18000 FPS
- (2) THE ASTPONAUT MAY MONITOR N64 (G.VI, R TO GO) DUPING THIS PROGRAM BY KEYING IN V16 N64E. HE ALSO MAY MONITOR N68 (BETA, VI, HODT) BY KEYING IN V16N68E.

PROG Cont	CMC	GR QU ND	CREW	·	CHECKLIST	TIME	TOTAL TIME
	•CMC PROG •SELECTION •						
·	START ENTRY-FINAL PHASE PROGRAM (P 67)						#10
							*10
	DISPLAY PROGRAM 67	•	MONITOR DSKY: DRSERVE DISPLAY OF PROGRAM 67				
	• • •		***-*				#20
	• • •						
	•					P67/COLOSSUS	

TEMP	•			
HOLD .	DISPLAY ON DSKY:	•	MONITOR G+N CONTROL	
		• • • • • • • • • • • • • • • • • • • •	OF ENTRY:	
MUN .	R1-BETA R2-X RNG ERR	•	(A) FDA1:	
	RZ-A KING ERR R3-DWN RNG ERR		ATT ERRORS LESS	
			THANDEG	
			ATT RATES LESS	#30
			THANDEG/SEC.	
	BETA-COMMANDED		BALL INDICATES	
	BANK ANGLE. IN		LIFT VECTOR	
	•01 DEGREES TO NEAREST		DIPECTION COR- Relation with	
	AUI DEORFE		RETA	
	X RNG ERR - CMC		(B) DSKY:	
	SOLUTION FOR CROSS		R1-RETA VARIES	
	RANGE ERROR. POS-		TO LIMIT G AND	#40
	ITIVE IF ON THE		CONTROL LIFT	
	SOUTH OF THE		VECTOR.	
	TARGET PLANE. NEG- Ative if on the			
	NORTH OF THE TARGE	Ŧ		
	PLANE. IN NAUTICAL			
	MILES TO THE NEAR-			
	EST +1 NM+			
	DWN RNG ERR - CMC			#50
	SOLUTION FOR DOWN			
	RANGE ERROR (DEC-		R3- DWN RNG ERR	
	REASING) POSITIVE		- DECREASING	
	FOR OVERSHOOT, NEGATIVE FOR UN-			
	DER SHODT. IN NAUT-			
	ICAL MILES TO			
	NEAREST . I NM.			
	(PREDANGLE-THETA)			# / 0
++ +09	NOTE: THE DWN RNG Err Display Will			# 6 0
+09 ++	BE 9999.9 NM ONCE			
PCR	THE TAPGET HAS			
528	BEEN OVERSHOT.			
	•			
	•			
	•			
	COMMAND CM ATTITUDE			#70
	IN ACCORDANCE WITH			
	CMC ENTRY LOGIC			
	•			
	•			P67/COLOSSUS
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	•		P67/COLOSSUS
	•		
	•		
	WAIT UNTIL CM VELOCITY WRT EARTH =		
	1090 FPS		. #80
	•		
	•		
HOLD.	FLASH VERB-NOUN TO	MONITOR DSKY:	
MON .	REQUEST RESPONSE AND	OBSERVE VERB-NOUN FLASH TO REQUEST RE+	
	V16 N67	SPONSE AND DISPLAY	
	R1-RTOGO	PRESENT POSITION AND	#90
		RANGE TO GO	
	R3- LONG		
	RTOGO-RANGE TO GO TO	•	
	TARGET. IN NAUTICAL	•	
	MILES TO NEAPEST -1 NM- NEGATIVE AND	•	
	DECREASING WHEN AP-	•	
	PROACHING TARGET,	•	
	POSITIVE AND IN-	•	#100
	CREASING WHEN LEAV- Ing target.	•	
	LAT - LATITUDE OF	•	
	PRESENT POSITION. IN	•	
	DEGREES TO NEAREST •01 DEG.	HOLD CONSTANT ATTI-	
	(+ IS NORTH)	TUDE MANUALLY (FULL	
		LIFT UP OR DOWN, DF-	
	LONG - LONGITUDE DF PRESENT POSITION. IN	PENDING ON RTOGO)	
	DEGREES TO NEAREST	UNTIL CHUTE DEPLOY- Ment.	#110
	.01 DEG.		
	(+ IS EAST)	•	
		•	
	•	•	
	•		
	•	MONITOR ALTIMETER AND STANDBY TO BACK-	
	•	UP MESC FOR CHUTE	#120
	•	DEPLOYMENT	
	•		
	•		
	•	•	
	•	•	
		•	
	•	•	
	•	•	



PCP MIT 66 REV 07 REV 08 PCR 206 **REV 09** PCR 528

CHANGE CONTROL NOTES.

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TURN DEE ENTRY DAP -------

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TERMINATE FLASH UPON RECEIPT OF PROCEED

ENTRY

WAIT FOR KEYBOARD

-----WHEN CM IS ON THE CHUTES KEY IN PROCEED

#130

P67/COLOSSUS

#140

#150

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