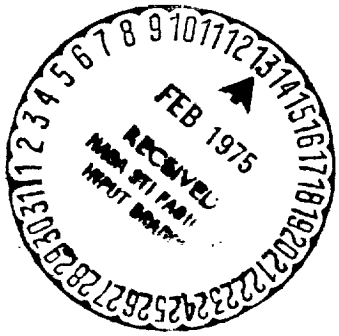
APOLLO - SOYUZ TEST PROJECT

OPERATIONS HANDBOOK COMMAND/SERVICE/DOCKING MODULES

CSM 111/DM 2

OPERATIONAL PROCEDURES FINAL ISSUE



PREPARED BY
ROCKWELL INTERNATIONAL
UNDER DIRECTION
OF
CREW TRAINING AND PROCEDURES DIVISION

CONTRACT NAS9-13100
SD 72-CS-0040
DRL LINE ITEM NO. 9

National Aeronautics and Space Administration

LYNDON B. JOHNSON SPACE CENTER

Houston, Texas

NOTICE

ontains the latest changed pages and all current pages previously issued. Therefore it
te manual and supersedes previous issue JSC-08469 (Vol. 2) dated 20 June 1974.

This issue
is a comple

JSC-08469

APOLLO-SOYUZ TEST PROJECT
OPERATION HANDBOOK

COMMAND/SERVICE/DOCKING MODULES
SYSTEMS OPERATING PROCEDURES
CSM 111/DM 2

APPROVED

C.W. Helms, Chief Program Engineer
CSM Programs, Space Division
Rockwell International Corporation

Contract NAS9-13100

Prepared under direction
of

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

LYNDON B. JOHNSON SPACE CENTER

CREW TRAINING & PROCEDURES DIVISION

APPROVED

T.W. Holloway, Chief
Flight Planning Branch

20 June 1974
Changed 15 October 1974
Document Issue Date

HANDBOOK CHANGE CONTROL

The October 1974 publication of this handbook shall be a complete handbook reissue, identified on the cover as a FINAL publication. All NASA-approved change proposals are in this final published handbook, allowing two weeks cutoff prior to publication date for copy and edit functions. There are two types of changes: RECORD CHANGE and CONTROL CHANGE.

RECORD CHANGE: A record change may be incorporated by the contractor without formal coordination and approval by NASA. Such changes shall consist of non-procedural changes to the format or Remarks column, corrections of an editorial nature, and implementation of specific changes directed by CCB actions where interpretation of procedural intent is clear. Supporting information as appropriate shall be included on Form 482B in the space marked "Reason for Change." Informational copies of all record changes will be directed to JSC Crew Training and Procedures Division (CT&PD), Data Management Office (DMO), Mail Code CG121, on MSC Form 482B.

CONTROL CHANGE: A control change originates on MSC Form 482B as a handbook change proposal, and includes the technical rationale in support of the proposed change, applicable references, etc. The scope of a change proposal shall be of a small enough magnitude to properly lend itself to the intent of change control. Each change submittal shall clearly indicate CSM-111 or CSM-119 effectivity. The initiator shall direct the original copy of Form 482B to CT&PD (DMO), where a control number and suspense date will be assigned (approximately two weeks); the change proposal will be reproduced and distributed to affected organizations for technical review and response within five working days of receipt of the proposed change. A "no response" philosophy is adopted for individual JSC organizations. No reply to CT&PD (DMO) prior to change suspense date indicates change concurrence by the reviewing organization; however Rockwell International shall give positive concurrence or nonconcurrence to CT&PD (DMO) for each change prior to expiration of change suspense date. All change proposals originating within MSFC or contractor organizations must be approved by that originating organization prior to submittal to CT&PD (DMO). During the review cycle (prior to expiration of suspense date), CT&PD (DMO) may modify the change proposal by an "A" revision (new data, change error, effectivity change, etc.), assign a new suspense date and recycle review copies of the modified change. At the expiration of the suspense date, CT&PD ASTP Flight Data Manager (FDM) shall approve or disapprove each change proposal, contingent upon review results. Change approval by NASA is direction to the contractor to incorporate those FDM-approved changes into the final published handbook update -- allowing two weeks cutoff prior to publication date for copy and edit functions.

Every disapproval by CT&PD will be supported by the technical rationale for disapproval, and such rationale will be directed back to the change initiator. If the disapproval is not applicable to the entire change proposal, the change initiator must resubmit the valid portions (if any) of the disapproved change as a new change proposal. If the disapproval by CT&PD (FDM) appears erroneous or unjustified by the change initiator, he may petition

....cont

the CPCB for disposition reversal. NASA approval and release of guidance system program changes for specific vehicle effectivities shall constitute adequate contractor authorization to revise applicable operating procedures accordingly, without additional change control review and approval.

All procedures emphasis and change control subsequent to the October 15, 1974 final Operations Handbook issue shall shift to the ASTP Flight Data File (FDF) and each procedures change (482B) shall be addressed to appropriate FDF article(s). Refer to the Crew Procedures Management Plan (JSC 08466) for change control and FDF development (Crew Procedures Control Board) commencing at launch minus 9 months.

The final published handbook, dated October 15, 1974, shall identify all changes incorporated by control and record change numbers and shall provide change bar identifiers for the technical changes in the text margin. A MSC Form 482B "CREW PROCEDURES CHANGE REQUEST" is included within this handbook for user convenience -- and may be reproduced for multiple change submittals.

CREW PROCEDURES CHANGE REQUEST

INITIATED BY	ORGANIZATION & PHONE #	INITIATORS CPCB MEMBER SIGNATURE	DATE SUBMITTED

DOCUMENT AFFECTED

TITLE	BASIC/CHG DATE	PAGE NUMBER	MISSION	CONTROL NUMBER

DETAIL CHANGE IN EXACT WORDING:

TECHNICAL RATIONALE:

OTHER DATA AFFECTED:

CPD DISPOSITION

CHANGE CLASSIFICATION	BOOK MANAGER APPROVAL	BRANCH CHIEF APPROVAL	FLIGHT DATA MANAGER APPROVAL	ACTIVITY ELEMENT
FORMAT ☐	SIGNATURE/DATE	SIGNATURE/DATE	SIGNATURE/DATE	
TECHNICAL RECORD ☐	DISAPPROVED ☐	DISAPPROVED ☐	DISAPPROVED ☐	COMPLEX ACTIVITY
TECHNICAL INTERIM ☐	IMPLEMENTATION: TRAINING SUPPORT ☐ ROUTINE ☐			DATE: NOT EARLIER THAN ____
TECHNICAL HOLD ☐	MOPS ☐ CPDS ☐ FDF ☐ OH ☐ OTHER____			NO LATER THAN ____

CPCB DISPOSITION

CPCB SCHEDULE DATE	FCOD APPROVAL SIGNATURE	DISAPPROVED ☐	DATE

CHANGE REQUEST INSTRUCTIONS

GENERAL - To effect complete coordination and evaluation, it is necessary to reproduce and distribute copies of each change request. In order to assure all recipients receive legible copies, please print all entries and prepare mark-ups using black ink.

INITIATOR NAME/ADDRESS/PHONE - Use address and phone number where requestor can be reached if different from official address.

INITIATORS CPCB MEMBER SIGNATURE - Must be signed off by the CPCB member of the initiators organization before the change request will be processed by the Flight Data Manager.

DATE - Indicate the date (month, day, year) the change request is submitted.

TITLE - Use only the official title as shown on the cover of the FDF article.

BASIC/CHG DATE - Indicate the latest date of publication or change to the affected article.

PAGE NUMBER - List all pages affected by the change.

MISSION - Denote mission applicability; if valid for all missions - "All."

CONTROL NUMBER - Leave blank. This number will be assigned by the Data Management Control Office.

DETAIL CHANGE IN EXACT WORDING - Self-explanatory.

TECHNICAL RATIONALE - Self-explanatory.

OTHER DATA AFFECTED - Indicate any other data articles, documents or data elements affected by the change.

The remainder of the form will be completed by the Book Manager and/or Flight Data Manager and the Data Management Control Office.

☆ U.S. GOVERNMENT PRINTING OFFICE: 1972—779-479/18

LIST OF CREW PROCEDURE CHANGES

The following Crew Procedure Changes have been incorporated, as applicable, in this issue of the Apollo-Soyuz Test Project Operations Handbook. Unless otherwise indicated, numbers listed refer to NASA-controlled ASTP-OH changes.

Section 1.0: 016, 022, 036, 038, 043, 047, 050

Section 2.0: 022, 047

Section 3.0: None

Section 4.0: 001, 002, 003, 035, 040, 041, 055, 056

Section 5.0: 018, 019, 022, 030, 031, 032, 043, 047, 050

Section 6.0: 004

Section 7.0: None

Section 8.0: None

Section 9.0: None

Section 10.0: None

Section 11.0: None

Section 12.0: 038, 053

Section 13.0: None

Section 14.0: 022, 038, 039, 044

Section 15.0: 011

Section 16.0: None

Section 17.0: 005, 006, 007, 008, 010, 013A, 014, 015, 017A, 020, 021, 022, 024, 025, 026, 027, 042A, 046, 048, 060

Section 18.0: 009, 028, 029, 033, 034, 035, 041, 045, 052

Section 19.0: None

Section 20.0: None

Section 21.0: 049

Appendix A: 010, 021, 023, 030, 036, 043, 051

Appendix B: 035

TABLE OF CONTENTS

STA/T STEP	PROCEDURE	PANEL	REMARKS
	1.0 BACKUP CREW PRELAUNCH CHECKS		
	Prelaunch procedures consist of operational and configuration checks performed by backup flight crew prior to ingress of prime crew. Procedures have been sequenced so they can be more easily compared with other prelaunch documents. In order to keep them closely aligned, redundant switch settings may appear in more than one area and GDC align procedures have been repeated wherever necessary. It is assumed that a complete prelaunch checkout, including loose gear stowage, has been performed by ground support personnel, prior to backup crew ingress into command module, and that all systems are in an active configuration as required at time of ingress. Spacecraft suit circuit shall have been purged and oxygen content verified to be 95% minimum. Backup crew will utilize facility headsets until service structure is clear of vehicle, as there will be no VHF AM or S BAND transmission until that time. Refer to Appendix A for cabin switch/control position prior to backup crew cabin ingress.		
	1.1 C&WS STATUS CHECK		
CP	C/W NORM - NORM	2	
	C/W CSM - CSM		
	C/W PWR - 2 [pause at off (ctr) at least 1 sec]		Excessive switching speed will cause temporary loss of both power supplies, and alarm reset capability.
ALL	MASTER ALARM pb/lt (3) - on, push	1,3,122	
CP	C/W PWR - 1 [pause at off (ctr) at least 1 sec]	2	Excessive switching speed will cause temporary loss of both power supplies, and alarm reset capability.
ALL	MASTER ALARM pb/lt (3) - on, push	1,3,122	
CP	C/W LAMP TEST - 1 (hold)	2	1 position is momentary.
AC	MASTER ALARM pb/lt - on	1	
CP	lh C/W lt (16) - on	2	
	C/W NORM - BOOST		
CP	MASTER ALARM pb/lt - out	1	
AC	C/W NORM - NORM	2	

NORMAL/BACKUP

STA/T	STEP	PROCEDURE	PANEL	REMARKS
CP		C/W LAMP TEST - 2 (hold)	2	2 position is momentary.
AC		MASTER ALARM pb/lt - out	1	
CP		lh C/W lt (16) - out	2	
DP		MASTER ALARM pb/lt - on	3	
CP		rh C/W lt (20) - on	2	
		C/W LAMP TEST - rel		
DP		MASTER ALARM pb/lt - out	3	
CP		rh C/W lt (19) - out	2	If C/W NORM switch not in ACK position, SUIT COMPR C/W light will remain on until compressor is activated.
		C/W NORM - ACK		SUIT COMPR C/W light will go out.
	1.2	EMS PRELAUNCH TESTS		
	1	Initial EMS Prep		
AC		EMS FUNC - OFF	1	
		CAUTION If SPS THRUST lt on, a ground exists on one or both ΔV THRUST circuits.		
		cb EMS (2) - close	8	
		Open EMS GTA cover	1	A 5/32-inch hex driver is required.
		GTA sw - on (up)		GTA switch is used during ground operations only. Setting switch on (up) allows EMS calibration for zero G condition. Switch must be set off (down) and door closed before flight.
		EMS MODE - STBY		

STA/T	STEP	PROCEDURE	PANEL	REMARKS
AC	2	EMS FUNC - ΔV (CW) Adj alphanumeric brightness (option) Wait 5 sec	1	
	3	GTA Null Adj EMS MODE - NORM Adj GTA null adj until ΔV/RNG least significant digit changes <1 per 10 sec		
	4	EMS FUNC - ΔV SET (CW) Slew ΔV ind to +1586.8		ΔV/EMS SET switch used both for slewing G-V scroll and for setting ΔV/RNG indicator. Slew speeds executed by ΔV/EMS SET switch are as follows:
	5	EMS FUNC - ΔV TEST (CW) SPS THRUST lt - on ΔV ind - decr (10 sec)		Light should be fully illuminated, indicating that both filaments are functioning.

	G-V Display Ft/Sec 1827 Ft/Sec = 1 In. of Scroll	ΔV RNG Indicator Ft/Sec or Nautical Miles
Slow (soft stop) INCR or DECR	30 ft/sec/sec = 0.0164 in./sec	0.25/sec
Fast (hard stop) INCR or DECR	480 ft/sec/sec = 0.263 in./sec	127.5/sec

For negative numbers ΔV/RNG indicator will display a minus sign. No sign will appear for positive numbers.

NORMAL/BACKUP

STA/T	STEP	PROCEDURE	PANEL	REMARKS
AC		SPS THRUST lt - out (at ΔV -0.1 fps) ΔV ind - stops at -0.1 to -41.5 fps EMS MODE - STBY	1	
	6	EMS FUNC - EMS TEST 1 (CCW) (wait 5 sec)		Test 1 checks lower trip point of .05 G comparator.
		EMS MODE - NORM (wait 10 sec)		Ten seconds should be allowed to verify no malfunctions. No other light should come on before or after 10 seconds.
		.05 G lt - out SPS THRUST lt - out Lift vector dn lt - out Lift vector up lt - out RNG ind - 0.0 NM Slew scroll until disp index superimposed upon notch at start of next self-test pattern		EMS scroll reverse slew capability is limited to one inch.
	7	EMS FUNC - EMS TEST 2 (CCW) .05G lt - on (all others out) Wait 10 sec All other EMS lights out		Test 2 checks upper trip point of .05 G comparator. No other light should come on before or after 10 seconds.
	8	EMS FUNC - EMS TEST 3 (CCW)		Test 3 checks corridor verification circuitry associated with lift vector down light (G <.2).
		.05 G lt - on		Light should be fully illuminated, indicating that both filaments are functioning.
		Lift vector dn lt - on (10 sec after .05 G lt) Set RNG ind to 58.0±0.0 NM		For negative numbers RNG indicator will display minus sign in most significant digit. No sign will appear for positive numbers.

EMS PRELAUNCH TESTS

STA/T	STEP	PROCEDURE	PANEL	REMARKS
AC	9	EMS FUNC - EMS TEST 4 (CCW) .05 G lt - on (all others out) G-V trace (during 10-sec period) within test pattern After 10 sec, G-V trace stops at lower right corner of test pattern RNG ind (during 10-sec period) counts toward zero After 10 sec, stops at 0.0±0.2 NM	1	Test 4 checks range-to-go integrator circuits, range-to-go indicator, G-servo circuits, and G-V plotter.
	10	EMS FUNC - EMS TEST 5 (CCW) .05 G lt - on Lift vector up lt - on (10 sec after .05 G lt) RNG ind - resets to 0.0 NM Scribe traces vert line ≈9 G to 0.28±0.1 G & stops (trace within test pattern)		Test 5 checks corridor verification circuitry associated with lift vector up light (G >.2). Enables slewing scroll to start of entry pattern. After scroll is set to <37K fps, it is not permissible to return EMS FUNC switch to EMS TEST 5 position (range integrator and scroll sync would be lost).
	11	Slew scroll until stylus is at 0.28 G tolerance step of ground test pattern 1 & verify ΔV instructions are visible		

NORMAL/BACKUP

STA/T	STEP	PROCEDURE	PANEL	REMARKS
AC	12	EMS FUNC - RNG SET (CCW) Scribe traces vert line from 0.28 G to 0.0±0.1 G & stops EMS MODE - STBY All lts - out	1	
	13	EMS FUNC - OFF (CCW) WARNING GTA sw is for ground tests only & must be set off (down) & door closed for proper flt oper of EMS. GTA sw - off (down) Close GTA cover		A 5/32-inch hex driver is required.
	1.3	GLYCOL LOOP CHECKS		
		Sec Gly Loop Activation		
CP		GLY TO RAD SEC vlv - NORM	377	Secondary glycol loop is checked and activated prior to EPE (MA014) experiment cool down.
		ECS IND sel - SEC	2	
		SEC COOL PUMP - AC1		
		RAD SEC IN TEMP ind - 60°-97°F		
		RAD SEC OUT TEMP ind - 60°-70°F (pegged)		
		SEC GLY EVAP OUT TEMP ind - 60°-75°F (pegged)		
		SEC GLY EVAP STM PRESS ind - 0.25 psia (pegged)		
		SEC GLY DISCH PRESS ind - 39-52 psig		Range shown is for gauge. Comparable corrected range used for prelaunch redlines is 40-80%.
		SEC ACCUM QTY ind - 30-60%		
		SEC COOL PUMP - AC2		
		SEC GLY DISCH PRESS ind - 39-52 psig		

STA/T	STEP	PROCEDURE	PANEL	REMARKS
		ECS IND sel - PRIM	2	
		GLY TO RAD SEC vlv - BYP	377	
		EPE COOLING vlv - COOL (tool E, CW)	165	German electrophoresis experiment (MA014). For stowage refer to NASA-5-74-517 document.
		Prim Gly Loop Activation		
		PRIM GLY DISCH PRESS ind - 39-52 psig	2	GSE flow must be temporarily interrupted (3 minutes maximum) for this check.
		PRIM ACCUM QTY ind - 25-50%		Range shown is for gauge. Comparable corrected range used for prelaunch redlines is 25-55%.
DP		GLY PUMPS - 1 AC1	4	
CP		PRIM GLY DISCH PRESS ind - 39-52 psig	2	
		RAD FLOW CONT PWR - PWR		
		RAD FLOW CONT AUTO - 2		
		ECS RAD tb - 2		2 indicates No. 2 flow proportioning valve controlling flow.
		RAD FLOW CONT AUTO - 1 until ECS RAD tb gray (≈20 sec) then AUTO		
		ECS RAD tb - gray		Gray indicates No. 1 flow proportioning valve controlling flow.
		RAD FLOW CONT PWR - off (ctr)		
AC		DIRECT O2 vlv - OPEN (CCW), adj for	7	
CP		O2 FLOW ind - 0.4±0.1 lb/hr	2	
	1.4	STANDBY INVERTER (NO. 3) CHECK		
DP		FC 2 & 3 PUMPS - AC1	5	To maintain continuous power to the FC pumps during inverter check.
		AC2 RSET - OFF		
		INV 3 - MNB		
		INV 2 AC2 - OFF		
		INV 3 AC2 - on (up)		Rapid performance of inverter switching sequence may initiate MASTER ALARM pb/lt when alternate inverter is connected to bus.

NORMAL BACKUP

STA/T	STEP	PROCEDURE	PANEL	REMARKS
DP		AC2 RSET - RSET	3	RSET position is momentary. Positioning AC1 or 2 RSET switches to RSET and releasing ensures a MASTER ALARM light and tone. Positioning AC1 or 2 RSET switches to center will cause random activation of MASTER ALARM lights and tone.
CP,DP		MASTER ALARM pb/lt (2) - on (push)	3,122	SUIT COMPR C/W light will come on while MASTER ALARM pb depressed.
CP		C/W lts (36) - out	2	
LMP		AC IND sel - BUS 2, ØA, B, C AC VOLTS ind - 113-117 vac	3	
		AC2 RSET - OFF		
		INV 3 AC2 - OFF		
		INV 2 AC2 - on (up)		Rapid performance of inverter switching sequence may initiate MASTER ALARM pb/lt when alternate inverter connected to bus.
		AC2 RSET - RSET		RSET position is momentary. Positioning AC1 or 2 RSET switches to RSET and releasing ensures a MASTER ALARM light and tone. Positioning AC1 or 2 RSET switches to center will cause random activation of MASTER ALARM lights and tone.
DP,CP		MASTER ALARM pb/lt (2) - on (push)	3,122	
CP		C/W lts (36) - out	2	
DP		INV 3 - OFF	3	Inverter 1 powering a-c bus No. 1 and inverter 2 powering a-c bus No. 2.
		AC IND sel - BUS 1 & 2, ØA, B, C AC VOLTS ind - 113-117 vac		
	1.5	FLOAT BAG CHECK		
AC		FLOAT BAG (all) - OFF	8	Lever lock.
		cb FLOAT BAG (all) - close		
		FLOAT BAG (all) - VENT		Lever lock.
		cb FLOAT BAG (all) - open		

FLOAT BAG CHECK

STA/T	STEP	PROCEDURE	PANEL	REMARKS
	1.6	LHEB ECS VALVE STATUS		
CP		GLY TO RAD SEC vlv - BYP (verify)	377	
		PRIM ACCUM FILL vlv - OFF	379	
		PRIM GLY ACCUM vlv - open (CCW), then 1/8 CW	378	One-eighth clockwise will prevent damage to valve in subsequent checks.
		Y-Y strut - retract		Y-Y strut to be retracted to provide attenuation panel access.
		Open coolant cont atten pnl		Covers panel 382.
		WARNING **SUIT FLOW RELF vlv must remain OFF throughout msn or swelling of CO2-odor absorber filters may result.**		
		SUIT FLOW RELF vlv - OFF	382	
		GLY EVAP IN TEMP vlv - MIN (CCW)		
		SUIT HT EXCH SEC GLY - FLOW		
		EVAP H2O CONT (2) - AUTO		
		H2O ACCUM (both) - RMTE		
		Close coolant cont atten pnl		
		Y-Y strut - extend & lock in place		
		Open CO2 cstr atten pnl		Covers CO2 canisters.
		CO2 CSTR DIVERT vlv - ctr	350	
		Close CO2 cstr atten pnl		
		MN REG (2) - OPEN	351	
		H2O/GLY TK sel (2) - BOTH		

NORMAL/BACKUP

STA/T	STEP	PROCEDURE	PANEL	REMARKS
CP		EMER CAB PRESS sel - OFF	351	
		CAB REPRESS vlv - OFF (ccw)		
		WASTE TK SERV vlv - CLOSE	352	Servicing fitting is plugged.
		PRESS RELF sel - RELF		
		POT TK IN vlv - as req		Potable water chlorination port capped.
		WASTE TK IN vlv - AUTO		
		PRESS EQUAL vlv - CLOSE	Fwd Hatch	
		Actr handle sel - stowed		
		Actr handle rel - locked		
		AC UTIL PWR - OFF	201	Connector covered.
		TUNL VENT vlv - DM/CM ΔP	12	
		DM/CM ΔP ind - 0.0 psid		Actual pressure differential across forward hatch will be 0.0 psid. However, indicator specification allows 0.025 psid gage error.
		SUIT FLOW vlv (3) - FULL FLOW	300,301,302	
		Cab ht exch louvers - ctr	303	
		PRIM CAB TEMP vlv - COLD (cw)		
		SEC CAB TEMP vlv - MAX COOL (CW)		
		DRINK H2O SUP vlv - OFF	304	Drinking water unavailable during launch hold periods.
		H2O gun probe safety - push lock		
		H2O gun probe fire extg vlv (red) - lock closed		
	1.7	LEB & TIMER PANEL 306		
		UTIL PWR - OFF	100	Connector covered.
		FLOOD DIM - 1		
		FLOOD FIXED - OFF		
		G/N OPT PWR - OFF		
		G/N IMU PWR - on (up)		Guarded.
		S3 - off (ctr)		
		NUMERICS LTS - as desired		
		INTGL LTS - as desired		

LEB & TIMER PANEL 306

STA/T	STEP	PROCEDURE	PANEL	REMARKS
CP		FLOOD LTS - OFF (CCW)	100	
		MSN TMR - RSET	306	RSET position is momentary.
		MSN TMR ind - zero		
		MSN TMR - START		Mission timer will reset to zero and count up at launch.
		MSN TMR ind - counting up (verify)		
		MSN TMR HRS - ctr		
		MSN TMR MIN - ctr		
		MSN TMR SEC - ctr		
		EVNT TMR START - STOP, then ctr		
		EVNT TMR RSET - RSET		RSET position is momentary.
		EVNT TMR ind - zero		
		EVNT TMR MIN - ctr		
		EVNT TMR SEC - ctr		
		SYS TEST (2) - 5A	101	
		SYS TEST ind - 1.1-1.9 vdc		Equivalent to +45° to +75°F nominal SPS oxidizer engine feedline temperature.
		SYS TEST (2) - 5B		Monitors battery relay bus voltage during launch.
		CM RCS HTRS - OFF		
		WASTE H2O DUMP - HTR A		
		URINE DUMP - HTR A		
		S6 - off (down)		This switch has no function.
		CAUTION		
		OPT ZERO sw must not be moved during prelaunch or inadvertent jett of optics covers could occur.	122	
		OPT ZERO - ZERO		6.1.3, note 4g.
		OPT TELTRUN - SLAVE TO SXT		
		OPT MODE - MAN		
		OPT COUPLING - DIR		

NORMAL/BACKUP

STA/T	STEP	PROCEDURE	PANEL	REMARKS
CP		OPT SPEED - LO	122	
		COND LAMPS - TEST		
		MASTER ALARM lt - on		
		STAR ACQ lt - on		
		COND LAMPS - ON		
		UP TLM - ACPT		
		RETCL BRT tw - as req		
		SCI/UTIL PWR - OFF	163	Switches are located behind closeout panel and are
		SCI PWR - OFF	162	disabled.
		S1 - OFF	164	Connector covered.
		TELEMETRY PWR - ON	400	
		INTRLVR PWR - ON		
		VTR PWR - ON		
		HEADWHEEL DR MOT - ctr		Video tape recorder headwheel drive motor operation
		MOTOR ON lt - out		and record mode initiated by MCCH during final astro
		TAPE MODE - ctr		launch operations comm checks.
		RECORD lt - out		
		PLAYBACK lt-out		
		TAPE DRIVE - ctr		(Deleted).
		TAPE HEAD CLEAN - NORM		Lever lock.
		CLEAN HEAD lt - out		
		LAMP TEST - STATUS		
		TV STA SEL CM/REMOTE - UP TLM	181	
		TV STA SEL CM1/CM2 - UP TLM		
		CM/DM CAMR PWR - OFF		
		CM1 TV STA PWR - OFF		
		TV MONITOR - OFF		
		TV AMPL - ON		
		CM2 TV STA PWR - OFF		

LEB & TIMER PANEL 306

STA/T STEP	PROCEDURE	PANEL	REMARKS
CP 1.8	RHEB & PANEL 601		
	cb pnl 225 - all closed except cb 15	225	This circuit breaker has no function.
	cb 15 - open		
	cb ATSF SYSTEM (2) - open		
	cb pnl 226 - all closed except	226	
	cb COAS/TUNL LTG MNB - open		Prevents exterior spotlight door initiator from operating during launch.
	cb 43, 44 & 45 - open		These circuit breakers have no function.
	cb pnl 229 - all closed except	229	
	cb MN REL (2) - open		Prevents premature main parachutes release.
	cb 02 VAC ION PUMPS (2) - open		
	UV ABSORPTION PWR - OFF	230	
	UV ABSORPTION LAMPS - OFF		
	cb EXP COVERS MNA - close		
	cb EXP COVERS MNB - close		
	EXP COVERS ARM - SAFE		
	EXP COVERS TIE DOWN - off (down)		Guarded.
	X-RAY LV PWR - OFF		
	X-RAY PURGE - ctr		
	UV COVER - ctr		
	He GLOW COVER - ctr		
	EUV COVER - ctr		
	X-RAY COVER - ctr		
	X-RAY HV PWR - off (ctr)		
	X-RAY BU PURGE - ctr		Guarded.
	HGA PITCH cont - 0°		
	HGA YAW cont - 180°		
	ATSF PWR AMPL - off (ctr)		
	ATSF XPNDR - off (ctr)		
	HGA ANT PWR - OFF		
	HGA ANT SERVO ELECT - PRIM		

NORMAL/BACKUP

STA/T	STEP	PROCEDURE	PANEL	REMARKS
CP		HGA ANT BEAM - WIDE	230	
		HGA ANT TRACK - AUTO		
		HELIUM GLOW - OFF		
		HELIUM GLOW He INHIBIT - ctr		
		EUV TELESCOPE PWR - OFF		
		EUV TELESCOPE DET - ctr		
		OMNI SEL - MAN		
		TRDC - ON		
		UP TLM - up tlm (ctr)		
		PCM RELAY - OFF		
		RLY MODE CONT - UP TLM		
		RLY MODE DATA PCM CONT - UP TLM		
		RLY MODE DATA RT/PB CONT - UP TLM		
		DOPPLER RECEIVER - OFF		
		PWR AMPL CONT - UP TLM		
		HGA SCAN - NORMAL		Guarded.
		ATSF RELAY SQUELCH - OFF		
		cb pnl 250 - all closed except	250	
		CAUTION cbs BAT BUS A&B TO PYRO BUS (2) should never be closed when cb PYRO A&B/SEQ A&B (2) are closed. Loss of pyro bat pwr could result.		
		cb BAT BUS A&B TO PYRO BUS (2) - open		Closed only if pyro battery(ies) fail, connects battery buses to pyro buses.

STA/T	STEP	PROCEDURE	PANEL	REMARKS
CP		cb BAT C TO BAT BUS A&B (2) - open	250	Close when battery C is required to back up batteries A and/or B.
		OVBD DRAIN vlv - OFF	251	
		BAT VENT vlv - VENT	252	
		WASTE STOW VENT vlv - VENT		Filter disconnect assembly is mated to waste stowage QD (panel 252) to allow 02 purge through WASTE STOW valve.
		REPRESS 02 VLV - CLOSE	601	Guarded.
	1.9	ORDEAL SWITCH POSITION CHECK		Assumes that ORDEAL box has been interconnected between FDAIs and EDA during installation, and that prime or backup crews will not be required to connect or disconnect ORDEAL cables to stow or unstow ORDEAL.
		CAUTION Before ORDEAL is stowed, or when not being used (whether EARTH/ LUNAR sw is in PWR OFF or not), FDAI 1 & 2 sw must be in INRTL. Otherwise, pitch inertial att cannot be displayed by FDAI ball.		
AC		FDAI sw (both) - INRTL	13	
		EARTH/LUNAR - PWR OFF		
		ALT SET cont - 88 NM		This value determined from planned nominal insertion altitude for the mission.

NORMAL BACKUP

STA/T	STEP	PROCEDURE	PANEL	REMARKS
AC		LTG - OFF MODE - HOLD/FAST SLEW - ctr	13	
	1.10	LH COUCH CHECKS		
		THC & RHC 2 - LOCKED		It is possible to actuate THC clockwise or counter-clockwise while locked.
		LH ECS Vlv Stat		
CP		SRG TK RELF vlv - open (CW)	375	
		PLVC sw - NORM	376	
		DEMAND REG sel - BOTH	380	
		SUIT TEST vlv - OFF		
		SUIT RETURN vlv - close (push)		
		PRIM GLY TO RAD - NORM	325	
		CAB PRESS RELF vlv (2) - BOOST/ENTR (safety latch off)		For ground checks, CAB PRESS is the equivalent of flight term CAB PRESS RELF.
		GLY RSVR IN vlv - OPEN	326	
		GLY RSVR OUT vlv - OPEN		
		GLY RSVR BYP vlv - CLOSE		
		SM 02 SUP vlv - ON		
		SRG TK 02 vlv - ON		
		REPRESS PKG 02 vlv - ON		
		LH Side Pnls		
AC		COAS PWR - OFF	15	
		UTIL PWR - OFF		Connector covered.
		PL BCN LT - off (ctr)		
		DYE MARKER - off (down)		Guarded. Verify safety removed.
		PL VENT - OFF		

STA/T STEP	PROCEDURE	PANEL	REMARKS
AC	AUTO RCS (16) - OFF	8	
	FLOOD DIM - 1		
	FLOOD FIXED - OFF		
	NUMERICS LTS - as desired		
	FLOOD LTS - as desired		
	INTGL LTS - as desired		
	SECS LOGIC (both) - OFF		Lever lock.
	SECS PYRO ARM (2) - SAFE		Lever lock with lock guard.
	cb pnl 8 - all closed except		
	cb CM RCS HTRS (both) - open		Prevents inadvertent CM RCS jet activation.
	cb FLOAT BAG (all) - open		Prevents inadvertent activation of float bag compressors and sea dye marker.
	cb SECS LOGIC (2) - open		Prevents inadvertent activation of SECS functions.
	cb SECS ARM (2) - open		
	cb SPS GAUGING (4) - open		PUGS deactivated.
	EDS PWR - OFF	7	
	CAUTION More than 1 hr of **continuous on-time** for TVC SERVO PWR 1 or 2 sw may be detrimental to SPS gmbl actuators.		
	TVC SERVO PWR (both) - OFF		
	FDAI/GPI PWR - BOTH		
	LOGIC 2/3 PWR - on (up)		
	ELEC PWR - ECA		
	SIG CONDR/DR BIAS PWR (both) - AC1 or AC2		Powers RJEC -4 vdc bias power supplies. To provide increased reliability, switches should not be set on same bus.

STA/T	STEP	PROCEDURE	PANEL	REMARKS
AC		BMAG PWR (both) - WARMUP	7	
		LH MDC & Pnls 600 & 602		
		Set ALT index - 3300	1	Value obtained from LCC.
		CMC ATT - IMU		Normally left at IMU position throughout mission. Selection of GDC position causes total attitude display to be lost on both balls. GDC damage will result if GDC position selected and pitch or yaw rate is >5°/sec, or if GDC yaw Euler angle is >80° and <280°.
		ACCEL - check (+0.75 - +1.25 G)		
		FDAI SCALE - 5/1		
		FDAI SEL - 1/2		
		FDAI SOURCE - CMC		
		ATT SET - GDC		
		MAN ATT ROLL - RATE CMD		
		MAN ATT PITCH - ACCEL CMD		
		MAN ATT YAW - RATE CMD		
		LIM CYCLE - OFF		
		ATT DBD - MIN		
		RATE - HI		
		THC PWR - on (up)		For ground checks, TRANS CONTR PWR, ROT CONTR PWR NORM, and ROT CONTR PWR DIR are the equivalent of flight terms THC PWR, RHC PWR NORM, and RHC PWR DIR respectively.
		RHC PWR NORM (both) - AC/DC		
		RHC PWR DIR (both) - OFF		
		SC CONT - SCS		
		CMC MODE - FREE		
		BMAG MODE (3) - RATE 2		
		SPS THRUST - NORM		Lever lock.

LH COUCH CHECKS

STA/T STEP	PROCEDURE	PANEL	REMARKS
AC	ΔV THRUST (2) - OFF	1	Guarded.
	SPS GMBL tw (2) - 0		
	ATT SET tw (3) - R ____, P ____, Y ____		
	SCS TVC (2) - RATE CMD		
	GMBL MOT (4) - OFF		Flight term GMBL MOT is equivalent of ground check term SPS GMBL MOT.
	ATVC GAIN - LO		
	ELS LOGIC - OFF		Guarded.
	ELS AUTO - MAN		
	CM RCS LOGIC - OFF		
	CM PRPLNT DUMP - OFF		Guarded.
	CM PRPLNT PURG - OFF		Guarded.
	IMU CAGE - off (down)		Guarded.
	EMS ROLL - OFF		
	.05 G sw - OFF		Required at OFF position until .05 G during entry. OFF position powered by LOGIC 2/3 PWR switch.
	Pc IND sw - Pc		
	Pc ind - zero		
	LV IND/GPI sw - GPI		
	TVC GMBL DR (2) - AUTO		
	EVNT TMR START - ctr		Event Timer not counting. Timer resets and starts counting automatically when lift-off occurs. Resets and starts counting up in event of abort initiation.
	EVNT TMR RSET - up (ctr)		
	EVNT TMR ind - zero		
	EVNT TMR MIN - ctr		
	EVNT TMR SEC - ctr		
CP	SUIT CAB ΔP ind - >+2.0 in. H20	2	Crewman in LH Couch perform LH side panel 2 checks.
	O2 FLOW ind - 0.4±0.1 lb/hr		DIRECT O2 valve partially open.
	PROBE EXTD/REL tb (2) - gray		Gray indicates probe fully extended or fully retracted.

NORMAL/BACKUP

STA/T	STEP	PROCEDURE	PANEL	REMARKS
CP		PROBE (3) - OFF	2	PROBE EXTD/REL switch guarded.
		UP TLM CM - ACPT		UP TLM CM switch should be placed to ACPT only as required during updates.
		GUIDE RING (2) - off (ctr)		
		STRUCT LATCH (2) - off (ctr)		Guarded.
		CAPTURE LATCH (2) - off (down)		Momentary switch.
		BACKUP PASSIVE (2) - off (ctr)		Momentary switch (guarded).
		STRUCT LATCH OPEN pb/lt - push, on/rel, out		
		GUIDE RING EXTEND pb/lt - push, on/rel, out		
		GUIDE RING CAPTURE pb/lt - push, on/rel, out		
		PASSIVE pb/lt - push, on/rel, out		
		STRUCT RING CONTACT pb/lt - push, on/rel, out		
		STRUCT LATCH CLOSE pb/lt - push, on/rel, out		
		CM RCS PRESS - off (down)		Guarded.
		RCS Status Check		
		SM RCS PSM He - CLOSE		Close position is momentary.
		SM RCS PSM He tb - bp (verify)		Barber pole indicates at least one of two redundant helium isolation valves closed in propellant storage module. For ground checks PSM He tb is the equivalent of flight term SM RCS PSM He tb.
		SM RCS PSM MANF ISOL - ctr		Positioned to CLOSE prior to backup crew ingress.
		SM RCS PSM MANF ISOL tb - bp (verify)		Barber pole indicates at least one of four (2 oxidizer and 2 fuel) valves closed in the propellant storage module. If gray, ground should be notified. For ground checks PSM MANF ISOL tb is the equivalent of flight term SM RCS PSM MANF ISOL tb.

LH COUCH CHECKS

STA/T	STEP	PROCEDURE	PANEL	REMARKS
CP		SM RCS QUAD He (4) - ctr SM RCS QUAD He tb (4) - bp (verify)	2	Barber pole indicates at least one of two redundant helium tank isolation valves in each quad closed.
		SM RCS PRIM PRPLNT tb (4) - bp (verify)		Barber pole indicates at least one primary propellant isolation valve (fuel or oxidizer) in each quad closed.
		SM RCS SEC PRPLNT tb (4) - bp (verify)		Barber pole indicates at least one secondary propellant isolation valve (fuel or oxidizer) in each quad closed.
		SM RCS SEC FUEL PRESS (4) - OPEN		OPEN position is momentary. No talkbacks. ACE can confirm helium isolation valves at quad secondary fuel tanks open.
		SM RCS PSM PRPLNT (4) - OPEN		OPEN position is momentary. Opening these valves configures the manifold for filling during SM RCS activation.
		SM RCS PSM PRPLNT tb (4) - gray		Gray indicates both PSM propellant isolation valve (fuel and oxidizer) in distribution manifolds open at quad.
		SM RCS IND sw - He TK TEMP RCS IND sel - SM A, B, C, D SM RCS ENG PKG HTRS (4) - OFF SM RCS PKG TEMP ind - ambient		Check each quad in turn. SM RCS package heaters not operated on pad and during ascent to reduce effects of boost heating on package temperature. Temperature <75° or >205°F illuminates SM RCS status lights.

NORMAL/BACKUP

STA/T	STEP	PROCEDURE	PANEL	REMARKS
CP		SM RCS He TK PRESS ind - 4100-4200 psia (quad)	2	Nominal servicing pressure at 70°F.
		SM RCS SEC FUEL TK PRESS ind - 192-207 psia (quad)		
		SM RCS He TK TEMP ind - record		
		SM RCS IND sw - PRPLNT QTY		
		RCS IND sel - SM A, B, C, D		
		SM RCS PRPLNT QTY ind - 100% (quad)		
		RCS IND sel - PSM		
		SM RCS PKG TEMP ind - zero		Operational only when RCS IND selector at SM A, B, C, or D.
		SM RCS He TK PRESS ind - 4100-4200 psia (PSM)		Nominal servicing pressure.
		SM RCS SEC FUEL PRESS ind - 192-207 psia (PSM)		Servicing helium pressure on fuel and oxidizer tanks at 70°F. Regulated helium pressure common manifold readout.
		SM RCS PRPLNT QTY ind - 85±6% (PSM)		
		SM RCS IND sw - He TK TEMP		
		SM RCS He TK TEMP ind - record (PSM)		
		CM RCS PRPLNT (both) - on (up)		On position is momentary.
		CM RCS PRPLNT tb (both) - gray		Gray indicates fuel and oxidizer isolation valves open.
		RCS IND sel - CM 1, 2		Check both CM RCS systems 1 and 2 in turn.
		CM RCS He TEMP ind - 60-90°F		
		CM RCS He PRESS ind - 4100-4200 psia		Nominal servicing pressure.
		CM RCS MANF PRESS ind - 80-105 psia		GSE servicing pressure monitored until system activated. Pressure varies with temperature and ullage. If manifold pressure drops suddenly, indicating a
		RCS IND sel - CM 2		...cont

STA/T	STEP	PROCEDURE	PANEL	REMARKS
				ruptured burst diaphragm, close CM RCS propellant isolation valves and then perform procedure for preheating jets (14.1.4) for 20 minutes. Procedure vents any propellant trapped between propellant isolation valves and jets by energizing jet valve direct coils.
		(Deleted).		
CP		SYS TEST (2) - 6A, 6B, 6C, 6D, 5C, 5D	101	CM RCS temperature of engine jet valves 12 (-R), 14 (-P), 16 (-Y), 21 (+R), 24 (-P), and 25 (+Y) respectively.
		SYS TEST ind - ambient (vdc)		
		SYS TEST (2) - 5B		
		RCS CMD - ctr		Switch last set to OFF (momentary position) prior to backup crew ingress.
		RCS TRNFR - SM		SM position is momentary.
		EDS AUTO - OFF		
		CSM/DM FNL SEP 1 - OFF (down)		Guarded.
		CSM/DM FNL SEP 2 - OFF (down)		Guarded.
		CM/SM SEP (2) - off (down)		Guarded.
		SIVB/DM SEP - off (down)		Guarded.
		PRPLNT DUMP - AUTO		
		2 ENG OUT sw - AUTO		
		LV RATES sw - AUTO		
		TWR JETT (both) - AUTO		Guarded.
		LV GUID sw - IU		
		MN REL - off (down)		Guarded.
		EMER 02 vlv - CLOSE	600	
		REPRESS 02 RELF - open (CW)	602	
		REPRESS 02 PRESS ind - >865 psig		

STA/T	STEP	PROCEDURE	PANEL	REMARKS
	1.11	RH COUCH CHECKS		
		RHC 1 - LOCKED		
		RHEB & Pnl 16		
DP		SCI PWR - OFF	227	Connector covered.
		S1 - off (ctr)	16	Switch deactivated.
		UTIL PWR - OFF		Connector covered.
		COAS PWR - OFF		
		cb panel 274 - all open except	274	
		cb VIDEO RCDR MNA - close		
		cb VIDEO CAMR/MON MNA - close		
		cb ELECTROPHORESIS/COVERS (2) - close (verify)		Closed after installation of EPE (MA014) experiment.
		TUNL LTS - OFF		
		EXT RUN/EVA LTS - OFF		
		EXT RNDZ LTS - OFF		
		SM RCS QUAD HTRS (4) - OFF		
		cb pnl 275 - all closed except	275	
		cb MNA & B BAT C (2) - open		
		cb FLT/PL BAT BUS A, B, & BAT C (3) - open		
		cb pnl 276 - all closed	276	
		cb pnl 277 - all open	277	
		cb pnl 278 - all closed except	278	
		cb UPR SYS COMPR (both) - open		
		RH Side Pnls		
		FC 1 PUMPS - AC1	5	
		FC 2 & 3 PUMPS - AC2		
		G/N PWR - AC1		
		MN BUS TIE (2) - OFF		
		BAT CHGR - AC1		
		NONESS BUS - OFF		
		INTGL LTS - OFF		

STA/T STEP	PROCEDURE	PANEL	REMARKS
DP	FLOOD LTS - OFF	5	
	FLOOD DIM - 1		
	FLOOD FIXED - OFF		
	cb pnl 5 - all closed except		(Deleted)
	cb 66 & 74 - open		These circuit breakers have no function.
	cb NONESS INST - open		
	cb SC1 EQUIP SEB 1 - open		cb SC1 EQUIP SEB 1 & 2 have no function.
	cb SC1 EQUIP SEB 2 - open		
	cb SC1 EQUIP HATCH noness bus - open		
	cb WASTE DUMP HTRS (2) - open		
	cb ECS PRESS XDUCER 2 MNA - open		
	cb AC UTIL (3) - open		
	cb RAD HTRS OVLD (2) - open		The cb RAD HTRS OVLD (2) are opened at prelaunch and throughout the mission. GSE opens the motor switches at prelaunch to prevent energizing primary and secondary ECS radiator heaters in flight
	SPS GAUGING - OFF	4	
	TELCOM GRP 1 - AC1		
	TELCOM GRP 2 - AC2		
	GLY PUMPS - 1 AC1 (verify)		
	SUIT COMPR (both) - OFF		
	cb pnl 4 - all closed		
	RH MDC Pnls		
	FC RAD (all) - off (ctr)	3	Last set to NORM (momentary) position.
	FC RAD tb (all) - gray		Gray indicates fuel cell radiator panel not bypassing flow.
	FC HTRS (all) - on (up)		
	FC PURG (all) - OFF		
	FC REACS (all) - ctr		Last set to on (up) (momentary) position.
	FC REACS tb (all) - gray		Gray indicates fuel cell reactants valves open.

NORMAL/BACKUP

STA/T STEP	PROCEDURE	PANEL	REMARKS
DP	FC MNA 1 & 3 - OFF, 2 - ctr	3	Fuel cell management will be monitored by ground crew until the gimbal drive and trim check at which time they will be verified on the main buses by the crew.
	FC MNA 1 & 3 tb - bp, 2 tb - gray		Barber pole indicates fuel cells 1 and 3 disconnected from main bus A, gray indicates fuel cell 2 connected to main bus A.
	MNA RSET - ctr FC MNB (all) - OFF FC MNB tb (all) - bp		Last set to RSET (momentary) position. Barber pole indicates all fuel cells disconnected from main bus B.
	MNB RSET - ctr FC IND sel - 2 FC H2 FLOW ind - 0.01-0.08 lb/hr FC 02 FLOW ind - 0.1-0.6 lb/hr		Last set to RSET (momentary) position. Flow limits are proportional to individual fuel cell currents and can be approximated by fuel cell H2 flow ≈(amps x 2.5)/1000, and fuel cell 02 flow ≈(amps x 2.0)/100. GSE is supplying most of the SC power.
	FC SKIN TEMP ind - 390°-440°F FC COND EXH TEMP ind - 150°-175°F FC tb (2) - gray		Gray indicates normal pH factor and normal fuel cell radiator temperature.
	BAT CHG - OFF DC IND sel - FC 2 DC AMPS ind - 5-30 amps DC IND sel - MNA, B DC VOLTS ind - 26.5-31 vdc DC IND sel - BAT BUS A, B, BAT C DC VOLTS ind - 31.5-38 vdc DC AMPS ind - <3.0 amps		

RH COUCH CHECKS

STA/T	STEP	PROCEDURE	PANEL	REMARKS
		CAUTION Do not leave DC IND sel at PYRO BAT A (B) position any longer than req to read DC VOLTS, or PYRO bat chg will be depleted.		
DP		DC IND sel - PYRO BAT A, B DC VOLTS ind - 36.0-37.5 vdc DC IND sel - MNA Dual Inv Stat Check INV 1 - MNA INV 2 - MNB INV 3 - OFF INV 1 AC1 - on (up) INV 2 AC1 - OFF INV 3 AC1 - OFF AC1 RSET - ctr INV 1 AC2 - OFF INV 2 AC2 - on (up) INV 3 AC2 - OFF AC2 RSET - ctr AC IND sel - BUS 1 & 2, ØA, B, C AC VOLTS ind - 113-117 vac SPS Stat Checks SPS PRPLNT TEMP ind - 100°F max SPS FUEL PRESS ind - 170-195 psia SPS OXID PRESS ind - 170-195 psia	3	Switch position verification only. If switch positions must be changed, refer to 5.3.8, step a. Normal operating temperature is +45° to +75°F. Redline is +27 and +100°F. Normal operating pressure after fuel and oxidizer tank is pressurized with He (after He valve is actuated) is 170-195 psia. GSE servicing pressure is 110 psia.

STA/T STEP	PROCEDURE	PANEL	REMARKS
DP	SPS PRESS IND sw - He, N2A, N2B	3	
	SPS He PRESS ind - 3300-3900 psia		GSE servicing pressure is 3600±50 psia.
	SPS N2 PRESS ind - 2200-2800 psia		GSE servicing pressure is 2500±50 psia at 70°F.
	SPS INJ VLV ind (4) - CLOSE		
	SPS OXID VLV upper tb - gray (verify)		PUGS deactivated.
	SPS OXID VLV lower tb - gray (verify)		
	SPS QTY TEST - ctr		PUGS deactivated.
	OXID FLOW VLV INCR - NORM (verify)		PUGS deactivated.
	OXID FLOW VLV PRIM - PRIM		PUGS deactivated.
	PUG MODE - NORM		PUGS deactivated.
	SPS He VLV tb (both) - bp		Barber pole indicates each helium isolation valve is closed.
	SPS He VLV (both) - AUTO		
	SPS LINE HTRS - off (ctr)		
	SPS PRESS IND sw - He		
	VHF ANT - SM LEFT		
	S BD XPNDR - OFF		
	S BD PWR AMPL PRIM - PRIM		
	S BD PWR AMPL HI - off (ctr)		
	S BD MODE VOICE - VOICE		
	S BD MODE PCM - PCM		
	S BD MODE RNG - RNG		
	S BD AUX TAPE - ctr		
	S BD AUX TV - ctr		
	UP TLM DATA - DATA		
	UP TLM CMD - RSET, then OFF		
	PWR AMPL tb - bp		Barber pole indicates power is not applied to S-band power amplifier.
	TAPE MOTION tb - bp		Barber pole indicates no tape motion.

RH COUCH CHECKS

STA/T	STEP	PROCEDURE	PANEL	REMARKS
DP		S BD ANT OMNI A - C	3	Guarded.
		S BD ANT - B		
		VHF AM SQLCH tw (2) - noise +1		
		VHF AM (2) - off (ctr)		
		VHF AM RCV - off (ctr)		
		VHF BCN - OFF		
		VHF RNG - OFF		
		S BD SQLCH - ENBL		
		FC REAC VLV - NORM		
		H2 PURG LINE HTR - OFF		
		TAPE RCDR PCM - PCM/ANLG		
		TAPE RCDR RCD - RCD		Power to switch is provided by the up-data link or the TAPE RCDR FWD switch in FWD position.
		TAPE RCDR FWD - REWIND		Allow tape to completely rewind before proceeding. TAPE MOTION talkback is gray when tape is in motion.
		TAPE RCDR FWD - off (ctr)		
		SCE PWR - NORM		
		PMP PWR - NORM		
		PCM BIT RATE - HI		
CP		MSN TMR - RSET	2	RSET position is momentary. Crewman in RH couch performs RH side panel 2 checks.
		MSN TMR ind - zero		
		MSN TMR - START		Will reset indicator to zero and count up at lift-off, but not abort initiation.
		MSN TMR ind - counting up		
		MSN TMR HRS - ctr		
		MSN TMR MIN - ctr		
		MSN TMR SEC - ctr		
		C/W NORM - ACK (verify)		
		C/W CSM - CSM		
		C/W PWR - 1 (verify)		
		C/W LAMP TEST sw - ctr		
		PL VENT VLV - push (lock)		

NORMAL/BACKUP

STA/T STEP	PROCEDURE	PANEL	REMARKS
CP	CRYO H2 PRESS ind (both) - 225-260 psia	2	H2 tank 1 and 2 pressures.
	CRYO PRESS IND sw - 1		
	CRYO 02 PRESS ind (both) - 865-935 psia		02 tank 1 and 2 pressures. CRYO 02 PRESS indicator 1 reads tank 1 or SRG tank pressures depending on CRYO PRESS indicator switch position.
	CRYO PRESS IND sw - SRG		
	CRYO 02 PRESS ind - 865-935 psia		02 SURGE pressure.
	CRYO H2 QTY ind (both) - 100%		H2 tank 1 and 2 quantities. 28 pounds nominal at 100 percent (each tank).
	CRYO 02 QTY ind (both) - 100%		02 tank 1 and 2 quantities. 320 pounds nominal at 100 percent (each tank).
	CAB FANS - OFF		
	H2 HTRS (both) - AUTO		
	02 HTRS (both) - AUTO		
	H2 FANS (both) - OFF		
	ECS IND sel - PRIM		
	RAD PRIM IN TEMP ind - 60°-97°F		
	RAD PRIM OUT TEMP ind - 35°-50°F		
	PRIM GLY EVAP OUT TEMP ind - 35°-45°F		
	PRIM GLY EVAP STM PRESS ind - 0.25 psia (pegged)		
	PRIM GLY DISCH PRESS ind - 60 psig max		
	SUIT TEMP ind - 80°F max		
	CAB TEMP ind - 80°F max		
	SUIT PRESS ind - ≈14.9 psia		
	CAB PRESS ind - ≈14.7 psia		
	CO2 PP ind - 0.0 mm Hg		
	RAD FLOW CONT AUTO - AUTO		
	ECS RAD tb - gray		Gray indicates No. 1 flow proportioning valve controlling flow.

RH COUCH CHECKS

STA/T	STEP	PROCEDURE	PANEL	REMARKS
CP		RAD FLOW CONT PWR - off (ctr)	2	
		RAD MAN SEL - RAD 1		When switch is powered, by placing RAD FLOW CONT PWR switch to MAN SEL, center position will close all isolation valves.
		RAD PRIM HTR - off (ctr)		
		RAD SEC HTR - OFF		
		SUIT COMPR ΔP ind - 0.0 psid		
		PRIM ACCUM QTY ind - 25-50%		Range shown is for gauge. Comparable corrected range used for prelaunch redlines is 25-55%.
		H2O QTY IND sw - WASTE		
		WASTE H2O QTY ind - <80%		
		H2O QTY IND sw - POT		
		POT H2O QTY ind - <80%		
		POT H2O HTR - OFF		
		SUIT H2O ACCUM AUTO - ctr		
		SUIT H2O ACCUM ON - ctr		
		SEC COOL EVAP - RSET FOR 58 sec min, then off (ctr)		Ensures secondary loop steam pressure valve closed.
		GLY EVAP IN TEMP - MAN		
		Position prim loop stm press vlv		
		GLY EVAP STM AUTO - MAN		
		GLY EVAP STM INCR - INCR for 58 sec min, then DECR for 8.5±0.5 sec		INCR AND DECR positions are momentary. Steam pressure valve requires 58 seconds from full close to full open.
		GLY EVAP H2O FLOW - off (ctr)		
		CAB TEMP - MAN		**Prior Apollo flight history indicates that MAN provides adequate system operations and is the preferred mode of operation throughout the mission.**
		CAB TEMP tw - max decr		
		CAB PRESS DUMP vlv - close (CW)	Side hatch	

NORMAL/BACKUP

STA/T	STEP	PROCEDURE	PANEL	REMARKS
	1.12	COMMUNICATIONS CHECK		
	1	Comm Activation		
DP		S BD XPNDR - PRIM	3	
		S BD PWR AMPL - PRIM		
		S BD PWR AMPL HI - HI		
		PWR AMPL tb - gray (after 90 sec)		Gray indicates power applied to S-band power amplifier.
		VHF AM B - DUPLEX		
CP		S BD ANT ind - >1/3 scale	2	
ALL		MODE (3) - INTERCOM/PTT	9,10,6	
		VOX SENS tw (3) - as req		
		VHF FM/PAD COMM (3) - T/R		
		VHF FM/PAD COMM VOL tw (3) - as req		
		PWR (3) - AUDIO/TONE		
		MASTER VOL tw (3) - as req		
		SUIT PWR (3) - on (up)		
DP		CM/RMTE INTERCOM - T/R	6	
		CM/RMTE INTERCOM VOL tw - decr		
ALL		VHF AM (3) - T/R	9,10,6	
		VHF AM VOL tw (3) - as req		
		S BD (3) - T/R		
		S BD VOL tw (3) - as req		
		AUDIO CONT (3) - NORM		
AC		VHF RNG - NORM	9	
	2	Comm Checks		
AC,DP		Replace facility headsets with CM headsets		CM headsets and CWG adapters have been connected to communication control head prior to backup crew ingress at which time PWR and SUIT PWR switches were OFF (panels 6, 10, and 9).

STA/T	STEP	PROCEDURE	PANEL	REMARKS
AC,CP		Perform comm checks (pad comm, S-band, & VHF AM)		
AC		Return to facility headset		
DP		Don CP headset & perform S-band & VHF AM comm checks		Ground will switch communication channel such that S-band modes and VHF AM may be verified.
		UP TLM DATA - UP VOICE BU	3	
		Establish 2-way comm on S-band		
		UP TLM DATA - DATA		
		S BD AUX TAPE - DN VOICE BU		
		Establish 2-way comm on S-band		
		S BD AUX TAPE - ctr		
		Return to facility headset		
	3	At Completion of Comm Checks		
ALL		SUIT PWR (3) - OFF	9,10,6	
		PWR (3) - OFF		
CP		MASTER VOL tw - 6	10	
		PHONE/MIC CONNECT - OFF		
		INTERCOM VOL tw - as req		
		S BD VOL tw - as req		
		VHF AM VOL tw - as req		
		(Deleted)		
ALL		Disconnect CM headset & CWG adapter from comm cont head		
CP		C/W PWR - off (ctr)	2	
DP		cb C/W (2) - open	5	
		AC & DP egress CM		
	1.13	VERIFY COUCH CONFIGURATION		
BCP		MDC assist bar - extd & locked		Backup CP (BCP) accomplishes all tasks in 1.13 and 1.14. To eliminate confusion, station callouts for AC and DP locations have not been included.
		Headrests - soft suit position		
		THC armrest in launch position & locked		

NORMAL/BACKUP

STA/T	STEP	PROCEDURE	PANEL	REMARKS
BCP		Inbd arm rests - stowed & contr locked Couches - launch/entry position (Y-Y struts extd & locked) Seat pans - 85° position & locked 02/comm umb - stowed Harnesses & restraints - extd & laid aside Couch stab brace - stowed Egress CM		
	1.14	PRIME CREW PRE-INGRESS PROCEDURE		
BCP		Ingress CM		Backup CP re-enters CM.
		S BD PWR AMPL HI - **off (ctr)**	3	The S-band is powered down to allow GMIL station S-band antenna alignment.
		S BD XPNDR - OFF		
		cb C/W (2) - close	5	
		C/W PWR - 1	2	
		MASTER ALARM pb/lt - on, push	1,3,122	
		Perform Pot Water Chlor		Performed following launch vehicle propellant loading.
		POT TK IN vlv - OPEN	352	
		Attach needle assy to inj port		Use carry-on sterilization kit for chlorination.
		Insert chlor ampoule into casing		
		Conn knob assy & rot (CW) until piston contacts ampoule		
		Install ampoule assy on needle assy (push & turn CW)		
		Rot knob (CW) until ampoule is empty (piston bottoms out)		Requires ≈5-1/2 turns.
		Disconnect ampoule assy from needle assy (push & turn CCW)		
		Rot knob (CCW), remove used ampoule		

STA/T	STEP	PROCEDURE	PANEL	REMARKS
BCP		Repeat chlor inj steps using another chlor ampoule	352	
		Repeat chlor inj steps using buffer ampoule (do not remove empty ampoule after inj)		Needle assembly to remain on inject port.
		Wait 10 min. Then rot inject barrel (CCW) four turns while holding bayonet section in locked position (CW)		Withdraws one ampoule of water.
		Rot knob (CCW), remove filled ampoule		
		Remove needle assy from inject port		
		Allow 30-45 min after buffer ampoule injection before proceeding to drink gun and food prep valves cycle, 2.1		
		DIRECT 02 vlv - OPEN (CCW), adj for	7	
		02 FLOW ind - 0.7-0.9 lb/hr	2	
		SUIT COMPR 1 - AC1	4	
		SUIT COMPR P ind - 0.5-0.9 psid		
		SUIT CAB P ind - +2.0 in. H20		
		MASTER ALARM pb/lt - push then release	1,3	
		c/w lights (all) - out		Verifies that suit compressor is operating above C/W limits.
		Verify P02		
		SECS PYRO ARM (2) - SAFE (remove guard)	8	
		S BD XPNDR - PRIM	3	
		S BD PWR AMPL HI - HI		
		Ingress LEB for prime crew ingress support		

NORMAL/BACKUP

STA/T STEP	PROCEDURE	PANEL	REMARKS
	2.0 PRIME CREW PRELAUNCH CHECKS		
	2.1 INGRESS AND STATUS CHECKS		
BCP	Drink gun & food prep valves cycle		
	Attach H2O sampling container to food prep unit H2O probe		
	FOOD PREP HOT H2O vlv - push, rel until 40 oz water withdrawn	305	
	FOOD PREP COLD H2O vlv - push, rel until 20 oz water withdrawn		
	Remove H2O sampling container from food prep unit and attach to drink gun nozzle		
	DRINK H2O SUP vlv - ON	304	
	Actuate drink gun control until 2-4 oz removed		
	DRINK H2O SUP vlv - OFF		
	POT TK IN vlv - as req at closeout	352	
	WASTE TK IN vlv - AUTO		
	Remove H2O sampling container from drink gun nozzle	304	
	Remove sterilization kit from CM		
	2.1.1 AC Ingress to LH Couch		
AC	Ingress LH couch		
	AC comm umbilical - connect to PGA		
	SUIT PWR - on (up)	9	
	PWR - AUDIO/TONE		
Tech	lh SUIT FLOW vlv - OFF	301	
	AC O2 umbilicals - connect to PGA		Connect red to red and blue to blue. Suit hose interconnect removed from CM.

STA/T	STEP	PROCEDURE	PANEL	REMARKS
		1h SUIT FLOW vlv - FULL FLOW	301	
		AC O2 ventilator - shut off and disconnect		PGA gas connector plugs installed. Ventilator removed from CM.
		Assist AC in position; connections and adjustments completed		Restraints connected and tightened, and arm rests, torso and life vest adjusted. Helmet protector removed from CM.
AC		CAB FANS - ON	2	
		Verify switch positions as follows		
		FLOAT BAG (all) - VENT	8	Lever lock.
		THC - neutral (LOCKED)		
		MAN ATT ROLL - RATE CMD	1	
		MAN ATT PITCH - ACCEL CMD		
		MAN ATT YAW - RATE CMD		
		SCS TVC (2) - RATE CMD		
		ATVC GAIN - LO		
	2.1.2	DP Ingress to RH Couch		
DP		Ingress RH couch		
		DP comm umbilical - connect to PGA		
		SUIT PWR - on (up)	6	
		PWR - AUDIO/TONE		
Tech		rh SUIT FLOW vlv - OFF	300	
		DP O2 umbilicals - connect to PGA		Connect red to red and blue to blue. Suit hose interconnect removed from CM.
		rh SUIT FLOW vlv - FULL FLOW		
		DP O2 vent - shut off & disconnect		PGA gas connector plugs installed. Ventilator removed from CM.

STA/T	STEP	PROCEDURE	PANEL	REMARKS
		Assist PLT in position; connections and adjustments completed		Restraints connected and tightened, and arm rests, torso and life vest adjusted.
		Verify the following		
DP		SPS GAUGING - OFF	4	PUGS deactivated.
		GLY PUMPS - 1 AC1		
		VHF ANT - SM LEFT	3	
		OXID FLOW VLV INCR - NORM		PUGS deactivated.
		MNA RSET - RSET		RSET position is momentary.
		MNB RSET - RSET		RSET position is momentary.
		SPS He VLV (both) - AUTO		
		S BD ANT OMNI A - C		
		S BD ANT - B		
		VHF BCN - OFF		
		SCE PWR - NORM		
		AC1 RSET - RSET		RSET position is momentary.
		AC2 RSET - RSET		RSET position is momentary.
	2.1.3	CP Ingress to Center Couch		
CP		Ingress ctr couch		
		CP comm umbilical - connect to PGA		
Tech		SUIT PWR - on (up)	10	
		PWR - AUDIO/TONE		
		ctr SUIT FLOW vlv - OFF	302	
		CP 02 umbilicals - connect to PGA		Connect red to red and blue to blue. Suit hose interconnect removed from CM.
		ctr SUIT FLOW vlv - FULL FLOW		
		CP 02 ventilator - shut off and disconnect		PGA gas connector plugs installed. Ventilator removed from CM.
		Assist CP in position; connections and adjustments completed		Restraints connected and tightened, and arm rests, torso and life vest adjusted. Helmet protector removed from CM.

NORMAL/BACKUP

STA/T	STEP	PROCEDURE	PANEL	REMARKS
		Perform final crew verification		Helmets, umbilicals, PGA diverter valves and wrist disconnects, foot restraints, and life vests rechecked.
		Verify the following		
CP		PRPLNT DUMP - AUTO	2	
		C/W NORM - ACK		
		MSN TMR - START		
		SUIT H2O ACCUM AUTO - 1		
		SUIT COMPR ΔP ind - 0.7-0.9 psid (not pegged)		
		Technician egress CM		
DP		UP TLM CMD - NORM	3	
CP		UP TLM CM - BLOCK	2	
BCP		VHF FM/PAD COMM - OFF	10	PAD COMM can be used after launch for intercom backup with PAD COMM VOL thumbwheel decreased.
		Egress CM		
	2.1.4	EDS Checkout and Countdown Test		Crew participation in EDS test directed by ground personnel. Test requires ≈30 minutes.
AC		cb EDS (all) - close (verify)	8	
		EDS PWR - on (up)	7	
CP		EDS AUTO - on (up)	2	
AC		ABORT lt operation - verify	1	AC will verify ABORT light operation as it is activated by ground.
DP		UP TLM CMD - OFF	3	
AC		S BD - OFF	9	AC will participate in EDS test on PAD COMM.
		INTERCOM - OFF		
		VHF AM - OFF		
DP		VHF FM/PAD COMM - OFF	6	

EDS CHECKOUT AND COUNTDOWN TEST

STA/T	STEP	PROCEDURE	PANEL	REMARKS
CP	2.1.5	TV Camr Checkout		
CP		Verify TV camr mounted in launch position & connected to CM 1 TV STA receptacle CM/DM CAMR PWR - POWER CM 1 TV STA PWR - ON MCC-H evaluate TV picture	181	Adjust camera if required.
	2.1.6	Cabin Closeout		
-01:40:00				
CP		Side hatch closing		
Tech		Verify external tool stowed on outside of hatch Remove hatch seal protector Verify safety pin has been removed from actr handle sel Gear box sel - N (neutral) Actr handle sel - N (neutral) GN2 vlv handle - push (outboard) Verify piston chamber pressurized	Side hatch	Squeeze handle to unlock.
		xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx		
Tech		If piston chamber is not pressurized GN2 charge No. 1 - CW (tech)	Side hatch	
		xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx		

STA/T	STEP	PROCEDURE	PANEL	REMARKS
Tech		Hatch open lock - rel	Side hatch	
		Push hatch to near closed position		
CP		Lock pin rel knob - UNLOCK (verify)		
		Hold hatch closed		
Tech		Insert tool B, (handle in 9 o'clock position) into external hatch actuation socket, rotate CW to stops and hold		
CP		Press and hold LOCK PIN reset button		
Tech		Relax torque & remove tool B		Obtains lock pin engagement. Mechanism should rotate ≈14 degrees CCW because of spring pressure.
CP		LOCK PIN reset button - rel		
		LOCK PIN ind - not extended (rh couch) &/or white ind is opposite white mark (ctr and lh couch)		
		Lock pin rel knob - LOCK (verify)		
		xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx		
		If lock pin is not engaged		
Tech		Insert tool B into external hatch actuation socket & slowly rotate CCW until DP verifies lock pin engagement		
		xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx		
		NOTE		
CP		If RED lock pin extended ≈ >0.5 inch, lock pin has been sheared.		

STA/T STEP	PROCEDURE	PANEL	REMARKS
CP	GN2 press ind - green (verify)	Side hatch	
	Configure hatch for rapid egress		
	Gear box sel - UNLATCH		
	Actr handle sel - U (unlatch)		
	BPC JETT knob - arrow on knob pointing to BPC JETT decal		
-01:35:00	If rapid hatch opening req, refer to 20.1.1		
	Strut unlock lanyard (2) - unstow and attach handle ends to MDC 2		
	Ground performs cabin purge & hatch leak test		
	Cabin purge to 60% 02/40% N2 (launch atmosphere)		GSE verifies 60:40 ratio.
	Ground performs hatch leak test		Requires ≈20 minutes.
	CAUTION During this check, established SUIT/CAB ΔP should be maintained by DIRECT 02 valve.		
	2.1.7 Change Launch Azimuth (if necessary)		
CP	Key V78E	2	
	FL V06 N29		
	Xsm launch azimuth XXX.XX DEG		Xsm - X stable member.
	Key V21E, load new azimuth		
	PRO		
	CAB FANS - OFF		

STA/T	STEP	PROCEDURE	PANEL	REMARKS
		2.1.8 EDS Test Complete		
-01:21:00				
		Set controls after test		
AC		INTERCOM - T/R	9	
		VHF AM - T/R		
		S BD - T/R		
DP		VHF FM/PAD COMM - T/R	6	
AC		EDS PWR - OFF	7	
CP		EDS AUTO - OFF	2	
		2 ENG OUT sw - AUTO (verify)		
		LV RATES sw - AUTO (verify)		
		DC IND sel - BAT C	3	
		DC VOLTS ind - 32.0 vdc min		
		DC IND sel - MNA		
AC		Pc ind - ____%	1	
-01:13:00				
		2.2 FINAL VERIFICATION AND SYSTEMS CHECKS		
		2.2.1 G&C Verification		
	1	Gyro Powerup		
CP		C/W NORM - NORM	2	
		BMAG TEMP lt (both) - out		
AC		FDAI/GPI PWR - OFF	7	If FDAIs powered when BMAGs come up to speed, rate needles will oscillate full scale.
		ELEC PWR - GDC/ECA		
		BMAG PWR (both) - ON		
		FDAI/GPI PWR - BOTH		
CP		C/W NORM - ACK	2	

STA/T	STEP	PROCEDURE	PANEL	REMARKS
	2	GDC Alignment		
AC		FDAI SEL - 1	1	
		FDAI SOURCE - ATT SET		
		ATT SET tw (3) - R 162°, P 90°, Y 0°		Nominal angles for a 72° launch azimuth and agree with prelaunch TCP. Only roll affected by variable launch azimuth.
		GDC ALIGN pb - push		
		FDAI 1 - errors null		
		ATT SET tw (3) - R 168°, P 84°, Y 354°,		These Euler inputs result in 5° body axes errors from alignment angles.
		FDAI 1 - errors full scale (verify) R right, P up, Y right		
		FDAI SEL - 2		
CP		FDAI 2 - ind same as FDAI 1 (verify)	2	
AC		GDC ALIGN pb - push	1	
		FDAI 2 - errors null	2	
		ATT SET tw (3) - R 162°, P 90°, Y 0°	1	
CP		FDAI 2 - errors full scale (verify) R left, P down, Y left	2	
AC		FDAI SEL - 1	1	
		FDAI 1 - ind same as FDAI 2 (verify)		
		GDC ALIGN pb - push		
		FDAI 1 - total att (verify) R 162°, P 90°, Y 0°		
		WARNING Sequencers in SECS should be deactivated to preclude an inadvertent abort.		
		SECS PYRO ARM (2) - SAFE (verify)	8	Lever lock.
		SECS LOGIC (both) - OFF (verify)		Lever lock.

NORMAL/BACKUP

STA/T STEP	PROCEDURE	PANEL	REMARKS
	2.2.2 Gimbal Drive and Trim Check		Verifies trim control and manual (MTVC) control capability of primary and secondary gimbal control system. SPS gimbal angle settings based on CSM c.g. and vary with propellant loading. PITCH and YAW GMBL caution/warning lights (panel 2) indicate overcurrent to gimbal motors. Otherwise, no indication to crew, except for switch selection, that a gimbal motor not operating or auto switchover (THC-CW) has taken place. GMBL POS indicator response opposite to RHC commands as follows: RHC: + Pitch, - Pitch, + Yaw, - Yaw IND: - Pitch, + Pitch, - Yaw, + Yaw
	1 Initialization FC on main buses (verify)		Fuel cells are placed on main buses by crew prior to primary TVC check per ground crew instructions.
DP	FC MNA 1 & 2 - ctr, 3 - OFF FC MNA 1 & 2 tb - gray, 3 tb - bp	3	Gray indicates fuel cells 1 and 2 connected to main bus A; barber pole indicates fuel cell 3 disconnected from main bus A.
	FC MNB 1 & 2 - OFF, 3 - ctr FC MNB 1 & 2 tb - bp, 3 tb - gray		Barber pole indicates fuel cells 1 and 2 disconnected from main bus B; gray indicates fuel cell 3 connected to main bus B.

GIMBAL DRIVE AND TRIM CHECK

STA/T	STEP	PROCEDURE	PANEL	REMARKS
DP		MN BUS TIE BAT A/C - on (up)	5	Verification of current increase for appropriate battery bus via DC AMPS indicator (panel 3) confirms successful operation of main bus tie motor switches.
		Verify bat bus A current incr &/or bat volts decr	3	
		MN BUS TIE BAT B/C - on (up)	5	
		Verify bat bus B current incr &/or bat volts decr	3	
AC		SCS TVC (2) - RATE CMD (verify)	1	
		CAUTION More than 1 hr of continuous on-time for TVC SERVO PWR 1 or 2 sw may be detrimental to SPS gmbl actuators.		
		TVC SERVO PWR 1 - AC1/MNA	7	
		TVC SERVO PWR 2 - AC2/MNB		
		LV IND/GPI sw - GPI (verify)	1	
		RHC PWR NORM 2 - AC		
		RHC 2 - ARMED		
	2	Prim TVC Check		
		GMBL MOT P1, Y1 - START		START position is momentary. Start SPS gimbal motors sequentially at ≈1-second intervals to avoid power surge. For ground checks, GMBL MOT PITCH or YAW are the equivalent of flight terms GMBL MOT P or Y.
		Confirm trim cont on inds SPS GMBL tw (2) - + & -		Gimbals drive in response to SPS pitch and yaw thumbwheel movement. Verifies primary gimbal trim control.
		RHC 2 - perform MTVC check		Gimbals drive in response to RHC movement, and return to set-in values when RHC is neutral. Verifies primary MTVC loops.

NORMAL/BACKUP

STA/T	STEP	PROCEDURE	PANEL	REMARKS
	3	Sec TVC Check		
AC		SCS TVC (2) - AUTO	1	
		GMBL MOT P2, Y2 - START		START position is momentary.
		THC - CW		
		Confirm trim control on inds		
		SPS GMBL tw (2) - + & -		Verifies secondary gimbal trim control.
		RHC 2 - perform MTVC check		Verifies secondary MTVC loops.
	4	Auto Switchover Check		
DP		DC IND sel - FC 3	3	
		DC AMPS ind - monitor for amps decr after each No. 2 gmbl mot shutdown		Decrease verifies gimbal motor shutdown.
AC		GMBL MOT P2, Y2 - OFF	1	Shut off gimbal motors sequentially to avoid power surge. Shutdown of No. 2 motors first minimizes switching in servo logic.
		Verify no MTVC		
		THC - neut		
		SPS GMBL tw (2) - P___°, Y___°		Gimbals are trimmed to thrusting values. These values are derived from Operational Trajectory, Table VIIIa, and include gimbal offset of ____ in pitch and ____ in yaw from spacecraft axis.
DP		DC IND sel - FC 1 (2)	3	
		DC AMPS ind - monitor for amps decr after each No. 1 gmbl mot shutdown		Decrease verifies gimbal motor shutdown.
AC		GMBL MOT P1, Y1 - OFF	1	
DP		DC IND sel - MNA	3	
AC		RHC PWR NORM 2 - AC/DC	1	
		RHC 2 - LOCKED		
DP		MN BUS TIE (2) - OFF, then AUTO	5	Positioned to OFF to allow motor switches to cycle and remove batteries from main buses, then to AUTO in case of a pad abort.
AC		TVC SERVO PWR (both) - OFF	7	
		LV IND/GPI sw - SIVB		

GIMBAL DRIVE AND TRIM CHECK

STA/T STEP	PROCEDURE	PANEL	REMARKS
	2.2.3 FDAI Verification		
AC	FDAI SEL - 1/2 FDAI SOURCE - CMC FDAI 1 - total att R X°; P 90°; Y 0°	1	FDAI 2 is drifting as a function of earth rate.
	2.2.4 RSI Test & Setup		For ground checks, EMS RAI is the equivalent of flight term RSI.
	EMS ROLL - on (up) GDC ALIGN pb - push & hold ATT SET YAW tw - adj thru 45° angle, observe RSI tracks ±45°, then adj until RSI points up GDC ALIGN pb - rel EMS ROLL - OFF Align GDC to IMU		Avoid FDAI gimbal lock region. Ensures that GDC is aligned to actual IMU angles, rather than calculated values. Attitude reference comparison (in orbit) will be more accurate.
	FDAI SEL - 1 FDAI SOURCE - ATT SET		Constraint: If CMC is on, an overload in IMU resolver circuitry may cause an ICDU oscillation and trigger ISS warning light. FDAI must be used as a null meter in this mode of operation. If not, large errors will result because of impedance mismatch.
	ATT SET - IMU ATT SET tw (3) - null FDAI 1 err ATT SET - GDC		Enables attitude set inputs to GDC.
	GDC ALIGN pb - push & hold until GDC aligned FDAI SOURCE - CMC FDAI SEL - 1/2		Enables attitude set inputs to GDC and disables BMAG inputs.

STA/T STEP	PROCEDURE	PANEL	REMARKS
	2.2.5 EMS Preparation		
AC	Set EMS ΔV EMS MODE - STBY (verify) EMS FUNC - ΔV SET Set ΔV ind - 1999.9 fps EMS FUNC - ΔV	1	
-55:00			
CP	C/W NORM - BOOST	2	Inhibits master alarm light on panel 1.
DP	UP TLM CMD - NORM	3	
	2.2.6 Pad Abort Enable		
	WARNING After pad abort enable, operation of THC - CCW will initiate an abort.		
-44:00			
AC	EDS PWR - on (up)	7	
CP	Gear box sel - LATCH	Side hatch	
	Actr handle sel - U (unlatch) (verify)		
	Monitor cabin press		Required to preclude pressure buildup due to DIRECT 02 vlv purge flow.
	CAB PRESS ind - >15.8 psia	2	
	rh CAB PRESS RELF vlv - Dump for 12 sec, then BOOST/ENTRY	325	
ALL	Shoulder harness - locked		
AC	CM RCS LOGIC - on (up)	1	
	cb SECS ARM (2) - close	8	
	cb SECS LOGIC (2) - close		
	SECS LOGIC (both) - on (up)		Lever lock.

STA/T	STEP	PROCEDURE	PANEL	REMARKS
AC		Report logic arm After GO from STC		STC (Systems Test Conductor).
		SECS PYRO ARM (2) - on (up)		Both lever lock pyro arm switches must be operated. LES pad abort capability enabled; SECS LOGIC and PYRO buses are armed.
	2.2.7	SM RCS Activation		
CP		SM RCS PSM PRPLNT tb (4) - gray (verify)	2	Gray indicates both PSM propellant isolation valves (fuel and oxidizer) in distribution manifolds open at quad.
		SM RCS PSM He tb - bp (verify)		Barber pole indicates at least one of two helium isolation valves closed in propellant storage module.
		SM RCS PSM MANF ISOL - OPEN		OPEN position is momentary. Opening PSM 1 manifold isolation valves fills the SM RCS manifold with propellant to the engine interface.
		SM RCS PSM MANF ISOL tb - gray		Gray indicates both fuel and both oxidizer isolation valves open in propellant storage module.
		SM RCS PSM PRPLNT (4) - CLOSE		CLOSE position is momentary.
		SM RCS PSM PRPLNT tb (4) - bp		Barber pole indicates at least one of four PSM propellant isolation valves (fuel or oxidizer) in PSM manifold is closed.
-45:00 to -15:00		SM RCS QUAD He (4) - OPEN		OPEN position is momentary.
		SM RCS QUAD He tb (4) - gray		Gray indicates both helium tank isolation valves open in each quad.

NORMAL/BACKUP

STA/T	STEP	PROCEDURE	PANEL	REMARKS
CP		RCS IND sel - SM A, B, C, D	2	
		SM RCS SEC FUEL PRESS ind - 192-207 psia (quad)		
		SM RCS PRPLNT QTY ind - 100% (quad)		
		SM RCS SEC FUEL PRESS (4) - CLOSE		CLOSE position is momentary. No talkbacks. ACE can confirm helium isolation valves at quad secondary fuel tanks closed.
		SM RCS PRPLNT (4) - OPEN		OPEN position is momentary.
		SM RCS PRIM PRPLNT tb (4) - gray		Gray indicates primary fuel and oxidizer isolation valves open.
		SM RCS SEC PRPLNT tb (4) - gray		Gray indicates secondary fuel and oxidizer isolation valves open.
	2.2.8	SM RCS Status Check		
		SM RCS IND sw - He TK TEMP		Check each quad in turn.
		SM RCS PKG TEMP ind - ambient		SM RCS package heaters not operated on pad or during ascent, to reduce effects of boost heating on package temperature. Temperature <75° or >205°F illuminates SM RCS status lights.
		SM RCS He PRESS ind - 4100-4200 psia (quad)		Nominal servicing pressure at 70°F.
		SM RCS SEC FUEL PRESS ind - 192-207 psia (quad)		
		SM RCS He TK TEMP ind - record		
		SM RCS IND sw - PRPLNT QTY		

SM RCS STATUS CHECK

STA/T STEP	PROCEDURE	PANEL	REMARKS
CP	RCS IND sel - SM A, B, C, D SM RCS PRPLNT QTY ind - 100% (quad) RCS IND sel - PSM	2	
	SM RCS PKG TEMP ind - zero		Operational only when RCS IND selector at SM A, B, C, or D.
	SM RCS He PRESS ind - 4100-4200 psia (PSM) SM RCS SEC FUEL PRESS ind - 130-150 psia (PSM) SM RCS PRPLNT QTY ind - 85 ± 6% (PSM) SM RCS IND sw - He TK TEMP (PSM) SM RCS He TK TEMP - record		Nominal servicing pressure. Servicing helium pressure on fuel and oxidizer tanks at 70°F. Nominal pressures for fully loaded PSM. Partial loads results in higher pressures.
	RCS IND sel - SMD		
	2.3 LAUNCH PREPARATION		
-25:00	Change launch azimuth (if necessary) Key V78E FL V06 N29 Xsm launch azimuth XXX.XX DEG Key V21E, load new azimuth PRO		Xsm - X stable member.
	Align GDC to IMU		Ensures that GDC is aligned to actual IMU angles, rather than calculated values. Attitude reference comparison (in orbit) will be more accurate.
	CAB FANS - OFF		
AC	FDAI SEL - 1 FDAI SOURCE - ATT SET	1	Constraint: If CMC on, an overload in IMU resolver circuitry may cause an ICDU oscillation and trigger ISS warning light. (Reference ICD MH01-01325-216) FDAI must be used as a null meter in this mode of operation. If not, large errors will result because of impedance mismatch.

NORMAL/BACKUP

STA/T STEP	PROCEDURE	PANEL	REMARKS
AC	ATT SET tw (3) - null FDAI 1 errors	1	
	ATT SET - GDC		Enables attitude set inputs to GDC.
	GDC ALIGN pb - push & hold until GDC aligned		Enables attitude set inputs to GDC and disables BMAG inputs.
	FDAI SOURCE - CMC		
	FDAI SEL - 1/2		
	AUTO RCS A/C ROLL (4) - OFF (verify)	8	
	AUTO RCS B/D ROLL B1 & B2 - MNA		
	AUTO RCS B/D ROLL D1 & D2 - MNB		
	AUTO RCS PITCH A3 & C4 - MNB		
	AUTO RCS PITCH C3 & A4 - MNA		
	AUTO RCS YAW B3 & D4 - MNA		
	AUTO RCS YAW D3 & B4 - MNB		
	FDAI 1 - total att	1	FDAI 2 drifting as a function of earth rate.
	R ___°, P ___°, Y ___°		
	FDAI SCALE - 5/5		Roll attitude error is scaled in P11. Roll full scale deflection will be 20° not 5° as position indicates.
	RATE - HI		
	THC PWR - on (up)		
	RHC PWR DIR (both) - MNA/MNB		
	CMC MODE - FREE		
	BMAG MODE (3) - RATE 1		This position provides most reliable configuration in event a rate gyro fails during boost.
	RHC 2 - ARMED		
-15:00	CTE update/verification		
DP	DC IND sel - BAT C	3	
	DC VOLTS ind - 35-37.5 vdc		
	DC IND sel - MNA		

STA/T	STEP	PROCEDURE	PANEL	REMARKS
CP		EDS AUTO - on (up)	2	
		2 ENG OUT sw - AUTO (verify)		
		LV RATES sw - AUTO (verify)		
		RCS CMD - OFF, then ctr		Switch last ret to OFF (momentary position) prior to backup crew ingress.
AC		TVC SERVO PWR 1 - AC1/MNA	7	
		TVC SERVO PWR 2 - AC2/MNB		
-10:00				
DP		FC REAC VLVS - LATCH	3	
-08:00		Systems status report		
		Astro Launch Operation Voice Check		
DP		S BD - OFF	6	
AC		VHF AM - OFF	9	
		MCCH Voice Check		
DP		S BD - T/R	6	
AC		VHF AM - T/R	9	
		SPS THRUST - NORM (verify)	1	Lever lock.
		ΔV THRUST (2) - OFF (verify)		Guarded.
		Pc IND sw - Pc (verify)		
-06:00		Systems GO/NO GO for launch		
-04:10				
AC		LV ENG lts (all) - on		Launch vehicle engine lights on T -04:10 minutes.
		Astro Launch Operation Voice Check		MCCH initiates VTR operation.
CP		Verify PO2		
		CAUTION Do not press ENTR after keying V75. If ENTR is pressed, G&C system will receive incorrect liftoff time.		

NORMAL BACKUP

STA/T	STEP	PROCEDURE	PANEL	REMARKS
CP		Key V75	2	Used in case hardware does not set proper bit (for P11 selection) when umbilical is removed.
-03:00				
DP		TAPE RCDR FWD - FWD	3	
		TAPE MOTION tb - gray		Gray indicates tape in motion.
-02:15				
AC		PRIM GLY TO RAD - BYP (pull)	325	Accomplished immediately after GSE water-glycol pump deactivated (T -02:15).
CP		PRIM GLY DISCH PRESS ind - 39-52 psig	2	
		PRIM ACCUM QTY ind - 25-50%		Range shown is for gauge. Comparable corrected value used for prelaunch redlines 25-55%.
-01:15				
DP		MN BUS TIE A/C - on (up)	5	Verification of current increase for appropriate battery bus via DC AMPS indicator (panel 3) confirms successful operation of main bus tie motor switches.
		Verify bat bus A current incr &/or bat volts decr	3	
		MN BUS TIE BAT B/C - on (up)	5	
		Verify bat bus B current incr &/or bat volts decr	3	
-01:00				
AC,DP		VHF FM/PAD COMM (2) - OFF	9,6	PAD COMM can be used after launch for intercom backup with PAD COMM VOL thumbwheel decreased.
		VHF AM/PAD COMM VOL tw - incr to above listening level		Compensate for increased noise environment during boost.
-00:45				
AC		GDC ALIGN pb - push, hold	1	
CP		FDAI 2 total att - no motion	2	
AC		GDC ALIGN pb - rel	1	
		READY FOR IGNITION		
		Refer to Appendix A for cabin switch/ control position at vehicle liftoff.		

STA/T STEP	PROCEDURE	PANEL	REMARKS
	3. BOOST AND INSERTION		
	3.1 BOOST		
-00:03	Ignition		LV engines lights (8) go on at T -4:10 min when S-IB indicating circuits are armed.
AC -00:01	LV ENG lts (all) - out	1	Indicates all eight engines have achieved over 90 percent of rated thrust.
00:00	LIFT OFF lt - on & NO AUTO ABORT lt - out	00:00 ↑ MODE 1A	Time base 1 initiate T +0.2 sec. Additional lift-off cues: Event timer start Voice communications from STDN DSKY displays program 11
	WARNING Do not press LIFT OFF/NO AUTO ABORT pb if LV RATE or any LV ENG lts on.		Manual abort initiation may be required. (Refer to mission rules.)
	Liftoff verified If LIFTOFF lt off - push If NO AUTO ABORT lt on - push		Guarded. Guarded.

STA/T	STEP	PROCEDURE	PANEL	REMARKS
			RATES ±4°/sec P,Y ±20°/sec R	
AC		Verify EVNT TMR ind resets to zero & starts counting up	1	
		EVNT TMR START - START		START position is momentary.
CP		Verify MSN TMR ind resets to zero & starts counting up	2	
		MSN TMR - RSET/START		RSET position is momentary.
		Verify P11 (auto)		P11 calculations based on pad-loaded data representing the nominal attitude profile for boost to earth orbit insertion. V82, N32, and N50 available during P11. However, a meaningful display of N32 and N50 is available only during R30 (V82E). V82 should not be selected during P02 or P11 within 5 seconds of lift-off time (this applies to any extended verb which sets bit 1 of flagword 4).
		No P11 - Key ENTR	MODE 1A	V75 inserted in P02 prior to lift-off.

STA/T	STEP	PROCEDURE	PANEL	REMARKS
CP		V06 N62 VI XXXXX. FPS H dot XXXXX. FPS H pad XXXX.X NM	2	Dynamic, non-flashing display parameters updated throughout ascent. VI = Inertial velocity. H dot = Altitude rate. H pad = Altitude above pad radius.
AC		If LV GUID lt - on, from T +0 to T +01:40	1	
CP		LV GUID sw - CMC	2	Allows CMC automatic steering (polynomial guidance) for S-IB stage, and attitude hold commands only, for SIVB stage. Also provides capability of issuing RHC commands via CMC, provided configuration digit in N46 is 3 and V46E is keyed.
		If man cont req Key V46E	MODE 1A	Disables CMC steering and activates Saturn DAP; RHC provides discrete rate (steering) commands to IU for booster control. The attitude error needles are not designed to provide meaningful "fly to" information in manual mode.
AC				
+00:10		Roll/Pitch prog report		
+00:55		Roll prog - complete		
CP				
13K' to 15K'		CAB PRESS ind - starts decr		Relieves high CM-to-atmosphere ΔP. Assuming that cabin pressure at lift-off is 14.47 to 14.87 psia, the cabin pressure relief valve could begin modulating at 13K'.

NORMAL/BACKUP

STA/T	STEP	PROCEDURE	PANEL	REMARKS
		xxxxxxxxxxxxxxxxxxxxxxxxxxxxxx		
		If no decr by 25K'		
AC		rh CAB PRESS RELF vlv -	325	
CP		DUMP (safety latch off until CAB PRESS ind - 8 psia, then	2	
AC		NORM (safety latch on)	325	
		If still no decr	MODE 1A	
CP		CAB PRESS DUMP vlv - open (CCW) until CAB PRESS ind - 8 psia, then close (CW)	Side hatch 2	
		xxxxxxxxxxxxxxxxxxxxxxxxxxxxxx		
	+01:01	PRPLNT DUMP - RCS CMD MODE 1B - report	01:01 MODE 1B	
	+01:14	MAX Q		
	+01:40	If all engines GO 2 ENG OUT sw - OFF LV RATES sw - OFF EDS AUTO - OFF (report)		
		xxxxxxxxxxxxxxxxxxxxxxxxxxxxxx		
		GND verifies 1 eng out prior to 01:40		
		Immediately 2 ENG OUT sw - OFF		Inhibits subsequent 2 engine out auto abort.

STA/T	STEP	PROCEDURE	PANEL	REMARKS
CP		At 02:00 LV RATES sw - OFF EDS AUTO - OFF (report)	2	
		xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx		
+01:47		MODE 1C - report (R3 = 16.5 NM)	01:47 MODE 1C	
AC				
+02:10		CMC BOOST POLYNOMIAL ends Report GO/NO GO for staging		
+02:16		IECO (LV ENG 5, 6, 7, & 8 lts - on) LIFT OFF lt - out (IECO +0.6 sec)	1	Inboard engines cutoff.
+02:19		OECO (LV ENG 1, 2, 3, & 4 lts - on)		Outboard engines cutoff. T +02:20.6.
+02:21		All eng lts - out		S-IB/SIVB separation.
			RATES ±10° sec P,Y ±20° sec R	
+02:22		LV ENG 1 lt - on	MODE 1C	SIVB engine ignition.
+02:26		LV ENG 1 lt - out		SIVB engine 65 percent rated thrust.
CP				
+02:51		TWR JETT (both) - on (up) (TFF >1+20) (OECO +32 sec, nom or 1 eng out) (OECO +34 sec, 2 eng out)	02:51 MODE II	2 Guarded. On position is momentary.

STA/T STEP	PROCEDURE	PANEL	REMARKS
	xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx		
CP	No tower jett Go to EMER PROCEDURES, 20.2.7	2	
	xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx		
	TWR JETT & MODE II - report Activate Saturn DAP		Activating DAP early will prevent an overspeed if a guidance failure occurs near insertion.
	V46E, V46E, N62E	MODE II	V46E keyed twice to properly activate DAP (if not keyed twice, DAP may not be properly activated because of possible unfavorable internal timing).
	If man cont req LV GUID sw - CMC		RHC provides discrete (steering commands to IU for booster control. Attitude error needles not designed to provide meaningful "fly to" information in manual mode.
AC	MAN ATT PITCH - RATE CMD GLY EVAP STM AUTO - AUTO GLY EVAP H2O FLOW - AUTO	1 2	
+02:55	LV guidance init	MODE II	
+03:25	Guidance good		
+04:00	Report status		
DP +05:00	Report status		

STA/T	STEP	PROCEDURE	PANEL	REMARKS
	AC			
	+06:00	Report status		
	DP			
	+06:15	S BD ANT - A/C	3	
	CP			
	+07:00	Report status		
	AC	LV IND/GPI sw - GPI	1	Ground will monitor LV-FTP during time GPI displayed and will inform crew of any problem.
	DP	Monitor main bus voltages during gmbl mot start	3	
	AC	GMBL MOT (4) - START Check GPI	1	START position is momentary. Start SPS gimbal motors sequentially at 1-second intervals to avoid power surge.
		LV IND/GPI sw - SIVB		
	DP			
	+08:00	Report status		
	+09:00	GO/NO GO for orbit - report		
	+09:34	MODE IV - report		
	AC	If CMC takeover exercised during thrusting go to backup for SECO		SIVB cutoff must be manually initiated at a TBD time calculated during the boost.
	+09:42	Monitor SECO LV ENG 1 lt - On		SIVB engine cutoff (auto).
	CP	Begin TB4 SECO - report		Timebase 4.

MODE II

09:24
MODE IIIA

09:34
MODE IV

09:32
MODE IIIB

3.1

BOOST

NORMAL/BACKUP

STA/T STEP	PROCEDURE	PANEL	REMARKS
	xxxxxxxxxxxxxxxxxxxxxxxxxxxx		
	If late SECO		
CP	or LV GUID sw - CMC	2	
	WARNING	MODE IV / MODE IIIB	
AC	THC must be returned from CCW position before 3.0 sec or CSM SLA sep will occur.		
	THC - CCW, return within 1 sec SECO LV ENG 1 lt - on Begin TB4	1	
	xxxxxxxxxxxxxxxxxxxxxxxxxxxx		
		INSERTION	
CP	Rcd from DSKY	2	
	VI XXXXX. FPS		VI = Inertial velocity.
	H dot XXXXX. FPS		H dot = Altitude rate.
	H pad XXXX.X NM		H pad = Altitude above pad radius.
	(R30, Orbital Parameters)		Displays orbital parameters (N44). A meaningful display of N32 and N50 is available only during R30.

STA/T	STEP	PROCEDURE		PANEL	REMARKS
CP		Key V82E		2	
		FL V16 N44			
		Ha	XXXX.X NM		Ha = Apogee altitude.
		Hp	XXXX.X NM		Hp = Perigee altitude.
		TFF	XXBXX MIN-SEC		TFF = Time of free fall to 49.4 NM (300,000 feet).
		Key N50E			
		Splash err	XXXX.X NM		Negative for undershoot, positive for overshoot.
		Hp	XXXX.X NM		
		TFF	XXBXX MIN-SEC		
		KEY REL			
		FL V16 N44			
		Ha	XXXX.X NM		
		Hp	XXXX.X NM		
		TFF	XXBXX MIN-SEC		If TFF = -59B59, TF perigee is available by keying N32E.
		PRO			
		V06 N62			
		VI	XXXXX. FPS		
		H dot	XXXXX. FPS		
		H pad	XXXX.X NM		
		SAFE ORBIT			
		Key V37E 00E			

NORMAL/BACKUP

STA/T	STEP	PROCEDURE	PANEL	REMARKS
		3.2 POSTORBITAL INSERTION CHECK		
AC		Monitor LV TK PRESS ind (4) from orbit insertion to CSM/SIVB sep for the following limits ΔP <36 psid (oxid > fuel) ΔP <26 psid (fuel > oxid) LOX and FUEL TK PRESS <50 psia	1	Refer to mission rules concerning SIVB fuel and oxidizer tank pressures. Venting after engine cut-off will normally result in LOX tank pressure decrease to ≈32 psia and fuel tank pressure decreasing.
		xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx		
		If ΔP, LOX or FUEL tank pressures exceeded verify/accomplish following		Provides CSM/LV separation if LV tank pressures exceeded. Control positions verified in the event status checklist or separation preparation performed prior to contingency.
		cb SECS ARM (2) - close	8	
		SECS LOGIC (both) - on (up)		Lever lock.
		SECS PYRO ARM (2) - on (up)		Lever lock.
		THC PWR - on (up)	1	
		RHC (both) - ARMED		
		RHC PWR DIR (both) - MNA/MNB		
		SC CONT - SCS		
		AUTO RCS B/D ROLL (4) - MNA	8	
		AUTO RCS PITCH (4) - MNA		
		AUTO RCS YAW (4) - MNA		
00:00		THC - CCW (4 sec)		CSM/LV separation.
DP		MN BUS TIE (2) - on (up)	5	
AC		TVC SERVO PWR 1 - AC1/MNA	7	
		TVC SERVO PWR 2 - AC2/MNB		

STA/T	STEP	PROCEDURE	PANEL	REMARKS
AC		BMAG MODE (3) - ATT 1/RATE 2	1	
		GMBL MOT (4) - START		START position is momentary. Start SPS gimbal motors sequentially at 1-second intervals to avoid power surge.
		THC - ARMED		
	00:04	THC - neutral & +X		
		ΔV THRUST A - NORM		Guarded.
	00:06	THRUST ON pb - push		SPS ignition.
		THC +X - release		
	00:11	ΔV THRUST A - OFF		Guarded.
		xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx		
		3.2.1 Status Checklist		
DP		DC IND sel - FC 3	3	
		DC AMPS ind - monitor amps decr after each No. 2 gmbl mot shutdown		Decrease verifies gimbal motor shutdown.
AC		GMBL MOT P2, Y2 - OFF	1	Shut off gimbal motors sequentially to avoid power surge. Shutdown of No. 2 motors first minimizes switching in servo logic.
DP		DC IND sel - FC 1 or 2	3	
		DC AMPS ind - monitor amps decr after each No. 1 gmbl mot shutdown		Decrease verifies gimbal motor shutdown.
AC		GMBL MOT P1, Y1 - OFF	1	
		cb ELS/CM SM SEP (2) - open	8	
DP		DC IND sel - MNA	3	
		MN BUS TIE (2) - OFF	5	
AC		RHC PWR DIR (both) - OFF	1	

STA/T	STEP	PROCEDURE	PANEL	REMARKS
AC		THC PWR - OFF	1	
		RHC (both) - LOCKED		
		CM RCS LOGIC - OFF		
		SECS PYRO ARM (2) - SAFE		Lever lock.
		SECS LOGIC (both) - OFF		Lever lock.
		cb SECS ARM (2) - open		
		EDS PWR - OFF	7	
		TVC SERVO PWR (both) - OFF		
DP		PCM BIT RATE - LO	3	
		FC REAC VLVS - NORM		Setting switch to NORM removes holding voltage from open side of FC reactant valves.
AC		EMS FUNC - OFF	1	
CP		LV STAGE - OFF (verify)	2	Guarded.
		UP TLM IU - as req		
		C/W NORM - NORM		
DP		**SM RCS ENG PKG HTRS (4) - 1**	274	
		SM RCS QUAD HTRS (4) - PRIM		
		Remove & stow cb CSM/DM FNL SEP actuation device	277	
		cb CSM/DM FNL SEP (2) - open (verify)		
		WARNING If BPC JETT knob cannot be positioned 180° away from the BPC JETT position before opening side hatch, a pin in the plunger may be sheared possibly allowing press seal to be broken. Cabin repressurization may not be possible due to overboard venting around the BPC plunger.		

STA/T	STEP	PROCEDURE	PANEL	REMARKS
CP		BPC JETT knob - turn arrow on knob 180° away from BPC JETT decal Gear box sel - LATCH (verify) Actr handle sel - N (neut) Vent piston chamber GN2 handle - pull (inbd) GN2 press ind - min	Side hatch	Disarms boost cover hatch release mechanism, preventing BPC JETT plunger from actuating during inflight operation of hatch.
ALL		MODE (3) - as desired	9,10,6	
CP		Crew couch strut unlock lanyards (2) - stow Couch to docking position Rcd 2-1 data from ground Lat_____ Long_____ GETI_____ ΔV_____		This data defines landing site and thrusting parameters for a first orbit, deorbit, and entry.
	3.2.2	SCS Attitude Reference Comparison Check, 8.4.7		Check must be performed as near to orbit injection as possible to prevent additional drift in attitude reference systems.
	3.2.3	SCT/SXT Dust Cover Jett Procedure WARNING Until optics are to be used, the OPT ZERO (pnl 122), should be kept at ZERO to prevent inadvertent jett of optics covers.		

NORMAL/BACKUP

STA/T	STEP	PROCEDURE	PANEL	REMARKS
CP	1	G/N OPT PWR - on (up)	100	
		OPT ZERO - OFF	122	OPT ZERO - OFF enables function of OPT MODE and OPT SPEED switches.
		OPT MODE - MAN		
		OPT COUPLING - DIR		
		OPT SPEED - HI		
	2	OHC - max right		Shaft angles for dust cover jettison are SCT = 150° and SXT = 40°. The optics shaft should be driven and maintained at full rate through these angles until covers are jettisoned.
		Observe ejection thru optics		
		3.2.4 ECS Postinsertion Configuration		
		Sec rad leak check		
		ECS IND sel - SEC	2	
		Monitor SEC ACCUM QTY ind		
		GLY TO RAD SEC vlv - NORM for 30 sec, then BYP	377	Provides rapid post-insertion pressure integrity check of secondary radiator circuit - verification system has not opened during boost phase. This does not verify coolant loop heat rejection capability as defined in 5.4.2, step 7.
		ECS IND sel - PRIM	2	
AC		cb PL VENT FLT/PL - open	8	Prevents inadvertent opening of postlanding vent valves.
DP		cb ECS PRESS XDUCR 2 MNA - close	5	
ALL		MASTER ALARM pb/lt (3) - on, push	1,3,122	CO2 PP HI light will activate momentarily when circuit breaker is closed.
AC		CAB PRESS RELF vlv (2) - NORM (safety latch on)	325	

ECS POSTINSERTION CONFIGURATION

STA/T	STEP	PROCEDURE	PANEL	REMARKS
DP		PRIM GLY EVAP STM PRESS ind - 0.09-0.14 psia PRIM GLY EVAP OUT TEMP ind - 38°-43°F Initiate rad flow	2	Water-glycol flow through primary loop radiators to commence no sooner than T +20:00 or later than T +55:00. After 2-1/2 minutes of flow, radiator outlet temperature should be less than inlet temperature.
AC		GLY RSVR BYP vlv - OPEN GLY RSVR OUT vlv - CLOSE GLY RSVR IN vlv - CLOSE	326	
DP		PRIM ACCUM QTY ind - 30-65%	2	
CP,DP		PRIM ACCUM FILL vlv - ON, until 40-55% is reached	379,2	Primary accumulator quantity reading must be increased by at least 5% to provide ullage in glycol reservoir for temperature excursion.
DP		RAD FLOW CONT PWR - PWR	2	
AC		PRIM GLY TO RAD - NORM	325	
DP		RAD PRIM OUT TEMP ind - below RAD PRIM IN TEMP ind	2	
		xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx		
		Outlet temp > than inlet after 5 min		
AC		PRIM GLY TO RAD - BYP (pull), recheck in 10 min	325	ECS primary loop radiators again isolated. In 10 minutes, flow through radiators is attempted once more by repeating procedure.
		xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx		
CP		DRINK H20 SUP vlv - ON (CCW)	304	
DP		ECS RAD tb - gray	2	Gray indicates No. 1 flow proportioning valve controlling flow.

NORMAL/BACKUP

STA/T	STEP	PROCEDURE	PANEL	REMARKS
DP		POT H2O HTR - MNA	2	
		GLY EVAP IN TEMP - AUTO		
		cb WASTE DUMP HTRS (2) - close	5	
AC		REPRESS PKG vlv - FILL for 10 sec, then OFF	326	
CP		REPRESS O2 PRESS ind - >865 psia	602	
	3.2.5	Systems Verification and Monitoring		
AC	1	Mount ORDEAL BOX Perform ORDEAL Initialization, 8.4.8	13	
	2	Perform C&WS Oper Check, 5.5.1		
	3	Perform SM RCS Mon Check, 5.2.2		
	4	Perform CM RCS Mon Check, 5.2.3		
CP, DP	5	Perform EPS Checks, 5.3.1 thru 5.3.4		
	6	Perform ECS Mon Check, 5.4.1		
DP	7	Perform SPS Mon Check, 5.2.1		
	8	cb COAS/TUNL LTG MNB - close	226	Provides power for right COAS, six tunnel lights, and docking spotlight door initiator.

STA/T	STEP	PROCEDURE	PANEL	REMARKS
	3.2.6	Cabin Atmosphere Verification		
DP	1	CAB PRESS ind - 5.6-6.2 psia & decr	2	Cabin pressure will be 5.6-6.2 psia after launch and continuously decrease until cabin pressure regulator activates and controls pressure to 4.7-5.3 psia.
AC	2	DIRECT 02 vlv - close (CW)	7	Direct 02 should remain open for at least 3 hours for 02 purge. 02 flow will be 0.7±0.1 lbs/hr during purge.
DP	3	02 FLOW ind - 0.2 lb/hr	2	
CP	4	EMER CAB PRESS sel - BOTH	351	
	5	SUIT RETURN vlv - open (pull)	380	
ALL	6	Gloves & helmet removed		
CP	7	When CAB PRESS ind <5.3 psia 02 FLOW ind - 1.0 lb/hr 02 FLOW HI lt - on	2	
ALL		MASTER ALARM pb/lt - on, push	1,3,122	After 16-second time delay.
		CAUTION Opening cb ECS PRESS XDUCER 2 MNB to extinguish 02 FLOW HI lt is a crew option. If exercised, redundancy for the following functions will be lost. CAB PRESS ind 02 reg out press (PCM only) GLY EVAP STM PRESS ind 02 FLOW ind		

STA/T	STEP	PROCEDURE	PANEL	REMARKS
DP	8	cb ECS PRESS XDUCER 2 MNB - open	5	Optional.
	9	60/40 cab purge complete at 8 hrs		
CP		WASTE STOW VENT vlv - CLOSE	252	
DP		cb ECS PRESS XDUCER 2 MNB - close	5	If opened in step 8.
		O2 FLOW HI lt - out	2	

CABIN ATMOSPHERE VERIFICATION

STA/T STEP	PROCEDURE	PANEL	REMARKS
	4.0 DM INTERFACE		
	4.1 CSM/SLA SEPARATION, TRANSPOSITION AND DOCKING		
	1 The following are req CMC - on, 8.1.3 COAS - installed & calib, 13.1.8 CM Docking Sys Probe Extension & Status Check, 5.7.6 SCS - on, 8.4.2 ISS - on & orient known, 8.1.3 & sec 13 UDAP load & activate, 8.2.1 R1 - 111XX R2 - X1111 } Noun 46 Disp		Provides G&N control capability. Provides SCS control capability.
	SIVB mnvrs to sep att xxxxxxxxxxxxxxxxxxxxxxxxxxxxxx If LV GUID sw - CMC Do not reload UDAP Mnvr to sep att R____° P____° Y____° xxxxxxxxxxxxxxxxxxxxxxxxxxxxxx		Establishes G&N control capability as follows: CSM configuration, 4 quad translation (quads A, B, C, D - on). CSM maneuver should be performed in the following attitude and rate deadbands in either the CMC or SCS control modes to simplify control task during separation.
CP	Key V16N20E (N20) R____° P____° Y____° (N22) R____° P____° Y____° Load N22 (docking att) Pnl configuration per 3.2.1		Postorbital insertion status checklist.

	CMC	SCS
ATT DBD	±0.5° (R03)	±0.2° (MIN)
RATE DBD	+0.2°/sec (fixed)	±0.2°/sec (LO)
RATE CMD (RHC)	+0.5°/sec (R03)	±0.65°/sec

NORMAL/BACKUP

STA/T	STEP	PROCEDURE	PANEL	REMARKS
	2	Pnl reconfiguration & sep prep		
CP		Key V60E	2	Nulls FDAI 1 error needles, N17 = N20.
		Key V63E		Permits display of error between present and astronaut loaded gimbal angles on FDAI 1, N20 and N17.
		Verify SM RCS activation SM RCS PRPLNT tb (8) - gray		
		Set pnl 1 SCS att controls		
AC		THC PWR - on (up)	1	
		RHC PWR DIR (both) - MNA/MNB		Enables direct RCS coils for contingency takeover.
		RHC PWR NORM (both) - AC/DC		
		BMAG MODE (3) - RATE 2		Cages the BMAGs and prevents attitude maneuver signals from causing them to hit their stops.
		SC CONT - SCS		
		DBD/RATE - MIN/LO		
		ATT DBD - MIN		
		RATE - LO		
		CMC MODE - FREE		
		LIM CYCLE - OFF		
		LV IND/GPI sw - SIVB (verify)		
		AUTO RCS (16) - MNA or MNB	8	Jets enabled on MN bus A & B should be selected so that command will be maintained for the most critical maneuvers in case of either dc bus failure.
		MAN ATT (3) - RATE CMD	1	Establishes proportional manual control with rate damping for SCS backup
		FDAI SCALE - 5/1		
		TVC SERVO PWR 1 - AC1/MNA	7	
		Establish sep performance cues		
		Perform EMS ΔV Test & Null Bias check, 7.6.1, & EMS ΔV Setup, 7.6.2, except set ΔV ind at -100 to avoid operation around the 0.0 fps settings		

STA/T	STEP	PROCEDURE	PANEL	REMARKS
AC		GDC - align, 8.4.6	7	
		Establish displays		
		FDAI SEL - 1/2	1	Enables G&N on FDAI 1, SCS on FDAI 2.
AC,CP		Key V37E 00E	2	Integrates state vector forward.
AC		EVNT TMR RSET - RSET	1	RSET position is momentary.
		EVNT TMR ind - 00:00		
		cb RCS LOGIC (2) - open	8	Opening these circuit breakers prevents inadvertent direct ullage via THC CCW switches when SECS LOGIC switches on.
	3	Enbl sequencer logic		Provides power to sequencer and pyro circuits for separation.
		cb SECS ARM (2) - close		
		After STDN AOS		
		SECS LOGIC (both) - on (up)		Lever lock.
		Report logic arm		
		After GO from STDN		
		SECS PYRO ARM (2) - on (up)		Lever lock.
		Perform final presep functions		
CP		V66E	2	Transfer CSM state vector to Soyuz (LM) storage.
		Key V37E 47E (thrust monitor)		Permits display of velocity change during thrusting on DSKY. Perform -60 seconds prior to separation to minimize effect on PIPA bias.
		FL V16 N83		
		ΔVX, Y, Z (cont) XXXX.X FPS		
AC		RHC 2 - ARMED		
CP		RCS CMD - ON		ON position is momentary. Enables RCS latching relay in SECS. This function also accomplished automatically by SECS.
AC		SC CONT - CMC	1	

NORMAL/BACKUP

STA/T	STEP	PROCEDURE	PANEL	REMARKS
	4	Separation		
DP		FC REAC VLVS - LATCH	3	
AC		EMS MODE - NORM	1	Perform 30 seconds prior to separation to minimize effective EMS drift.
		CMC MODE - HOLD or AUTO		
		THC - ARMED		
-00:03		THC - +X & hold 3 sec prior to sep		Initiates preseparation tension.
00:00		CSM/LV SEP pb - push & hold		Guarded.
		Start Evnt Tmr		
		LV TK PRESS ind (4) - 0		Indicates physical separation.
		LV ENG 1 lt - out		
		CSM/LV SEP pb - rel		
		xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx		
		No sep		
		cb RCS LOGIC (2) - close	8	
		THC - CCW (leave in detent)		Activates automatic SECS separation and direct RCS
00:00		Evnt Tmr rset & counting up (auto)	1	ullage.
		RCS direct ullage (auto)		SECS delays separation for 3 seconds.
00:03		LV TK PRESS ind (4) - 0		Indicates physical separation.
		LV ENG 1 lt - out		
00:07 max		THC - neut		Terminates automatic direct RCS ullage.
		RCS direct ullage terminated (auto)		
		Confirm ΔV =__ fps		Separation velocity is a function of burn time, ≈2.5 seconds of burn per fps.
		xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx		
00:04 max		THC - neut		
		ΔV ≈-10X.X fps		Separation velocity is a function of burn time, ≈2.5 seconds of burn per fps.

STA/T	STEP	PROCEDURE	PANEL	REMARKS
	5	Postsep pnl configuration		During coast to transposition. Provides normal, safe, formation flight configuration.
		Verify SM RCS tb position		
CP		SM RCS QUAD He tb (4) - gray	2	
		SM RCS PRPLNT tb (8) - gray		
		SM RCS PSM PRPLNT tb (4) - bp		
		SM RCS PSM He tb - bp		
		SM RCS PSM MANF ISOL tb - gray		
		SM RCS SEC FUEL PRESS (4) - OPEN		
DP		FC REAC VLVS - NORM	3	
DP	6	Transposition		
		xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx		
		If propulsive venting not inhibited		If propulsive venting not inhibited, minimum separation distance at completion of pitch maneuver will be ≈65 feet.
		Do NOT perform -X trans at 00:35		
		xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx		
AC				
00:35		THC -X to ΔV = -100.3 fps		
		MAN ATT PITCH - ACCEL CMD	1	
		RHC - pitch up ≈2°/sec		Positive pitch at 2°/second followed by a negative pitch command to null rates at a total pitch maneuver of 180°. At completion of pitch maneuver, minimum separation distance will be ≈55 feet.
		Visually acq SIVB & null pitch rate		
CP		V62E	2	Permits display of error between present and docking attitude on FDAI 1, N20 and N22.

STA/T	STEP	PROCEDURE	PANEL	REMARKS
AC		MAN ATT PITCH - RATE CMD RHC, THC - Null trans errors & rates Key V49E, 8.3.4 Perform auto mnvr to docking att	1	
	or	Perform man mnvr to docking att CMC MODE - FREE RHC - null error needles		
	7	Set pnl 1 SCS att controls CMC MODE - FREE (verify) BMAG MODE (3) - ATT 1/RATE 2 SC CONT - SCS		
	8	Verify control status for docking COAS PWR - on (up)	15	
CP		EXT RNDZ LTS - SPOT	274	
	9	PROBE EXTD/REL - RETR (verify) PROBE EXTD/REL tb (2) - gray (verify)	2	Guarded. Verifies capture latches not locked.
	10	Initiate capture latch		
AC		THC - translate to close at 0.25 to 0.5 fps maintain min lateral velocity RHC - maintain min relative align angles with SIVB At contact, apply +X thrust as req		Rate established visually. Use COAS and docking target for alignment cues. Contact will be indicated by audio cues, a slight disturbance in motion, and/or COAS observation.

STA/T	STEP	PROCEDURE	PANEL	REMARKS
CP AC		PROBE EXTD/REL tb (2) - bp SC CONT - CMC	1	Talkbacks barber pole indicate capture. Only one talkback required for indication. Failure to capture will also be indicated by no noticeable rebound tension load (deceleration) and separation from SIVB. If retraction initiated, it will not occur until capture.
		Positive indication of no capture (Backup 1) SC CONT - SCS (verify) THC - X withdraw to formation flight distance PROBE EXTD/REL - EXTD/REL for 5 sec PROBE EXTD/REL - RETR PROBE EXTD/REL tb - gray (verify) ATTEMPT redocking as before or perform redocking with backup 2 procedure	2	Guarded. EXTD/REL position is momentary. Guarded.
		Positive indication of no capture (Backup 2) SC CONT - SCS (verify) THC - X withdraw to formation flight distance	1	

NORMAL BACKUP

STA/T	STEP	PROCEDURE	PANEL	REMARKS
AC		ATTEMPT redocking as before and place PROBE EXTD/REL - EXTD/REL (HOLD) during final phase prior to contact. After contact with +X applied and probe in drogue, place PROBE EXTD/REL - RETR	2	
		xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx		
		xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx		
		Probe auxiliary retract method		The probe auxiliary retract method bypasses the normal retract circuit.
		SECS PYRO ARM (2) - SAFE	8	Lever lock.
		SECS LOGIC (2) - OFF		Lever lock.
		cb SECS ARM (2) - OPEN		
		THC - LOCKED		
		RHC - LOCKED		
		UTIL PWR - OFF (verify)	15	
		Remove UTIL pwr receptacle cap		Cap tethered.
		Remove LDEC access pnl (aft of pnl 276)		E tool. LDEC (Lunar Docking Event Controller).
		Remove LDEC receptacle J5 cap (fwd LDEC)		Cap tethered.
		Remove aux dump nozzle htr cable from stowage		For stowage, reference NASA-S-74-517. Cable length 108 inches.
		Remove docking probe aux harness cable		Cable length 12 inches.
		Connect cables together		
		Connect cable between UTIL pwr receptacle and J5 receptacle of fwd LDEC		

STA/T	STEP	PROCEDURE	PANEL	REMARKS
AC		THC - UNLOCKED RHC - UNLOCKED Repeat docking approach at ≈0.10 fps RHC - maintain min relative align angles with SIVB At contact, apply +X until hard dock or 10 sec max UTIL PWR - on (up) while thrusting UTIL PWR - OFF, after hard dock	15	Probe retracts.
		xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx		
		Allow probe to damp SC motions (≈10 sec) THC - null pitch & yaw align error to within ±3° (min poss rates & misalign)		Alignment determined using COAS and docking target. Retraction loads may cause docking ring damage. Loads are minimum at zero misalignment during retraction.
		RHC - null roll align error to within ±10°		Docking with roll angles >±10° may prohibit CM/DM umbilical connection.
	11	Initiate retraction & docking latch closure PROBE RETR PRIM - 1 Observe retraction movement between the two vehicles PROBE EXTD/REL tb (2) - gray	2	When capture latch alignment satisfactory. 10-inch retraction stroke should take ≈10 seconds. Talkback A will indicate only if docking latches 1, 5, and 9 close. Talkback B will indicate only if latches 3, 7, and 11 close. Audio and tactile cues will also indicate docking latch closure.

NORMAL/BACKUP

STA/T	STEP	PROCEDURE	PANEL	REMARKS
		xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx		
CP		PROBE EXTD/REL tb (2) - remain bp after 30 sec & docking latch closure cues (auditory & tactile) unsatisfactory PROBE RETR PRIM - 2 If docking still unsuccessful PROBE RETR SEC - 1	2	
		xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx		
	12	Safe docking sys		
AC		SECS PYRO ARM (2) - SAFE	8	Lever lock.
		SECS LOGIC (both) - OFF		Lever lock.
		cb SECS ARM (2) - open		
		EDS PWR - OFF	7	
		cb EDS (all) - open	8	
CP		PROBE EXTD/REL - OFF	2	Guarded.
		PROBE RETR (2) - OFF		
AC		cb DOCK PROBE (2) - open	8	
	13	Postdocking pnl configuration		
		RATE - HI	1	
		ATT DBD - MAX		
		cb RCS LOGIC (2) - open (verify)	8	If backup method separation is used (THC - CCW), RCS LOGIC circuit breakers will still be closed so that direct ullage will be activated. In this case it is not desirable to open these circuit breakers until after maneuvering is completed.
AC		TVC SERVO PWR (2) - OFF	7	
CP		EXT RNDZ LTS - off (ctr)	274	

STA/T	STEP	PROCEDURE	PANEL	REMARKS
CP		PRO	2	
		FL V37		
		Key 00E		
AC		COAS PWR - OFF	15	
		EMS MODE - STBY	1	
		EMS FUNC - OFF		
		BMAG MODE (3) - RATE 2		
		Key V83E	2	Checks state vector.
		Key V47E		Moves Soyuz (LM) state vector into CSM state vector.
	4.2	PREPARATION FOR DM EJECTION		
ALL	1	Configure PGAs, 5.4.6b		
CP		Retrieve & don helmet protective shield		
	2	Configure couches as req		
	3	Configure control pnl		
DP		cb DM PWR (2) - open (verify)	274	
		cb DM FURNACE/CRYSTAL GROWTH (3) - open (verify)		
		TUNL LTS - on (up)		
	4	Perform docking tunl operations		
		CM/DM tunl press equalization & integrity check		
		TUNL VENT vlv - DM/CM ΔP	12	
		DM/CM ΔP ind - (-)4.0 psid (pegged)		
		PRESS EQUAL vlv - OPEN	Fwd hatch	
		DM/CM ΔP ind - 0.0 psid		

STA/T	STEP	PROCEDURE	PANEL	REMARKS
		xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx		
DP		TUNL VENT vlv - DM PRESS, for ≈15 min.	12	
		xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx		
		PRESS EQUAL VLV - CLOSE	Fwd hatch	
		Monitor DM/CM ΔP ind for 2 min & verify ΔP stable	12	
		PRESS EQUAL VLV - OPEN	Fwd hatch	
		Remove fwd hatch, 5.7.1	tunl	
		Verify docking latches		A minimum of nine good docking ring latches required for any CSM/DM SPS burns.
		Pull latch handle of each latch to ensure hook is engaged		Latch indicator button (red) may protrude through hole in latch handle if latch is not engaged.
		Pwr bungee parallel to +X axis (verify)		
		xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx		
CP		If hook(s) not engaged		
		Attempt to engage latch handle prior to recocking latch		
		If pwr bungee not parallel to +X axis		
		Push on top of bungee fairing to obtain final preload		
		If hook(s) cannot be engaged or pwr bungee parallel to +X axis not attained		

STA/T	STEP	PROCEDURE	PANEL	REMARKS
CP		Recock latch(es) & man trigger, 5.7.10 steps 2 & 4	tunl	
		xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx		
		Verify probe extend latch engaged - indicator (RED) not visible		
		Depress GN2 bleed button (red) at aft end of probe body & hold for 10 sec		Required to bleed probe retract gas system for subsequent operation.
		Disconnect both docking probe connectors (yellow) and install in probe stowage receptacles		
		Connect DM umb conn (4) as follows & per following chart P23 to J23 (orange to orange) P24 to J24 (orange to orange) P27 to J27 (yellow to yellow) P28 to J28 (yellow to yellow)		
		Disengage conn from stowage receptacle in DM tunl		One at a time.
		Pull umb across docking interface		
		Align index marks		
		Push DM umb conn into receptacle in CM docking ring & rot CW to lock		
		Route DM umb thru slot in back of receptacle assy & close fairing (orange)		Fairing must be closed to install hatch.
		Repeat according to chart for remaining 3 umbs		
		Reinstall fwd hatch, 5.7.2		
DP		TUNL LTS - OFF	274	
ALL	5	Reconfigure couches as req		

STA/T	STEP	PROCEDURE	PANEL	REMARKS
		4.3 DM EJECTION FROM SLA		
	1	The following are req		
		CMC - on, 8.1.3		
		SCS - on, 8.4.2		
		ISS - on & orientation known, 8.1.3 & sec 13		
		RCS DAP load & activated, 8.2.1		
		R1 - 61102 R2 - X1111 Noun 46 disp		
		R1 - XXXXX R2 - 00000 Noun 47 disp		N47 R1 = combined CSM + DM weight.
		Load desired GET I (N33) & ΔVX (N81), 11.1.1		P30. Recommended value of ΔVX is 3.0 ft/sec.
		Call P41, RCS Thrusting Program, 12.2.2		
		Bypass auto mnvr.		
	2	Pre-DM ejection		
AC		Set Evnt Tmr 00:00	1	
		cb SECS ARM (2) - close	8	
		After STDN AOS		
		SECS LOGIC (both) - on (up)		Lever lock.
		Report logic arm		
		After GO from STDN		
		SECS PYRO ARM (2) - on (up)		Lever lock.
		STDN verify pyro buses armed		
	3	Perform ejection		
		TVC SERVO PWR 1 - AC1/MNA	7	
		EMS FUNC - ΔV SET	1	
		SLEW ΔV ind - +100.0		
		EMS FUNC - ΔV		
		EMS MODE - NORM		Perform ~30 seconds prior to ejection to minimize EMS drift error.
DP		cb SIVB/DM SEP (2) - close (verify)	278	

STA/T	STEP	PROCEDURE	PANEL	REMARKS
		CAUTION		
		cb SIVB/DM SEP (2) are to be closed before operating SIVB/DM SEP switches to on (up) position. If not, SIVB/DM SEP will not occur.	278	
	00:00	SIVB/DM SEP - on (up)	2	Guarded. On (up) position is momentary.
		Start Evnt Tmr CMC MODE - AUTO	1	Spring system will provide a minimum separation velocity of TBD fps (assumes four actuators operated).
AC				
	00:05	THC -X & hold		
	00:10	THC - neut		Provides ≈2.0 fps separation velocity.
		When clear of SIVB THC - null N85 components		Results in a total separation velocity of ≈3.0 fps in the posigrade direction. Refer to the Operational Data Book, paragraph 4.8.1.2 for data relative to recontact with SIVB.
	4	Postejection		
		SECS PYRO ARM (2) - SAFE	8	Lever lock.
		SECS LOGIC (both) - OFF		Lever lock.
		cb SECS ARM (2) - open		
DP		cb SIVB/DM SEP (2) - open	278	
AC		LV IND/GPI sw - GPI	1	
		CMC MODE - FREE		When clear of SIVB.
		MAN ATT (3) - MIN IMP		
		SC CONT - SCS		
CP		Reload DAP	2	
		N46, R1 = 61111		

STA/T	STEP	PROCEDURE	PANEL	REMARKS
AC		EMS MODE - STBY	1	
		EMS FUNC - OFF		
		THC PWR - OFF		
		RHC PWR DIR (both) - OFF		
		RHC, THC - LOCKED		
		TVC SERVO PWR (2) - OFF	7	
	5	Verify DM passive mode		Docking mechanism was configured to passive mode during prelaunch. This check verified passive mode prior to predocking operations and verified integrity of umbilical connections. Convention for passive mode configuration dictates that structural latches are open as well as docking mechanism being in passive mode. Refer to Figure 18-1 for docking system status light logic.
		System A		
DP		cb DS A IND LOGIC MNA - close	274	
		cb DS A IND PWR AC1 - close		
		cb DM POWER (2) - close		DM wall heaters, fan, lights and instrumentation.
CP		STRUCT LATCH OPEN lt - on	2	Structure latches should be fully open.
		PASSIVE lt - on		PASSIVE lt on (passive mode) requires BACKUP (passive) Hooks at RESET (closed), Body Latches closed, and Guide Ring fully retracted.
DP		cb DS A IND LOGIC MNA - open	274	
		cb DS A IND PWR AC1 - open		
		System B		Conditions same as for System A.
		cb DS B IND LOGIC MNB - close		
		cb DS B IND PWR AC2 - close		

STA/T STEP	PROCEDURE	PANEL	REMARKS
CP	STRUCT LATCH OPEN lt - on	2	
	PASSIVE lt - on		
	cb DS B IND LOGIC MNB - open	274	
DP	cb DS B IND PWR AC2 - open		
	xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx		
	One or both lts not on NOTIFY STDN		State of all (6) docking system status lights communicated to STDN via TLM.
	If STDN verifies lts on condition, continue nominal operations (STDN confirms configuration state in lieu of on-board status lts)		
	If STDN confirms lts not on Recycle system		Recycling system may correct an intermittant condition, caused by launch dynamics, that prevents positive status light verification of passive mode.
	cb DS IND LOGIC (2) - close cb DS IND PWR (2) - close cb DS CONTROL BAT (2) - close cb DS MOTORS AC1 (3) - close cb DS MOTORS AC2 (3) - close		
	No STRUCT LATCH OPEN lt		
	CAUTION STRUCT LATCH - CLOSE must be oper by sys A or B only (single mtr). Stalled gear box load using two mtrs could exceed sys cable breaking strength.		

STA/T STEP	PROCEDURE	PANEL	REMARKS
CP	STRUCT LATCH (A) - CLOSE	2	System A only.
	STRUCT LATCH CLOSE lt - on		
	STRUCT LATCH (A) - OPEN		Guarded.
	STRUCT LATCH CLOSE lt - out		
	STRUCT LATCH OPEN lt - on		
	STRUCT LATCH (A) - off (ctr)		Guarded.
	If still no lt exercise sys B		
DP	MN BUS TIE BAT B/C - on (up)	5	Battery on line during system B structure latch motor operation to prevent main bus undervoltage.
CP	STRUCT LATCH B - CLOSE	2	System B only.
	STRUCT LATCH CLOSE lt - on		
	STRUCT LATCH B - OPEN		Guarded.
	STRUCT LATCH CLOSE lt - out		
	STRUCT LATCH OPEN lt - on		
	STRUCT LATCH B - off (ctr)		Guarded.
	If still no lt		
	(Deleted)		
	Exercise both sys (A & B) simultaneously using above sequence, except use only one system (A or B) when closing structure latches.		
	MN BUS TIE BAT B/C - OFF	5	
	No PASSIVE lt		
	Perform dock sys passive test (sys A & B), 18.4.7		This operation may necessitate access to DM earlier than planned. This test helps isolate cause of passive light failure before actually exercising backup passive system.
	Remove Fwd hatch, 5.7.1 (stow)		
	Remove docking probe & drogue, 5.7.4 & 5.7.7 (stow)		

STA/T STEP	PROCEDURE	PANEL	REMARKS
	Perform Dock Mod Press Integ ck, 18.3.1		
	Perform DM Press, 18.3.2 (steps 1 thru 3)		
DP	LIGHTING 1 - ON	815	Located in DM.
	LIGHTING 2 - OFF		
CP	BACKUP PASSIVE (2) - RELEASE	2	
	BACKUP PASSIVE (2) - RESET		
	BACKUP PASSIVE (2) - off (ctr)		Guarded.
	PASSIVE lt still not on		
	CAUTION GUIDE RING - EXTD/RETR must be oper on sys A or B only (single mtr). Dynamic forces using two mtrs could create loads in struct beyond design limit.		
	GUIDE RING (A) - EXTD		
	GUIDE RING EXTEND lt - on (8 sec min), then		System A only. GUIDE RING A or B must be at EXTD until GUIDE RING EXTEND lt - on, plus 8 sec (minimum) after light on. This will ensure full deployment of guide ring. GUIDE RING EXTEND lt sense switches actuate 1.5 inches from full deployment.
	GUIDE RING (A) - RETR		
	GUIDE RING EXTEND lt - out		
	GUIDE RING (A) - off (ctr)		
	PASSIVE lt still not on		
DP	MN BUS TIE BAT B/C - on (up)	5	Battery on line during system B guide ring motor operation to prevent main bus undervoltage.
CP	GUIDE RING B - EXTD	2	System B only.
	GUIDE RING EXTEND lt - on (8 sec min), then		
	GUIDE RING B - RETR		
	GUIDE RING EXTEND lt - out		
	GUIDE RING B - off (ctr)		

NORMAL BACKUP

STA/T	STEP	PROCEDURE	PANEL	REMARKS
DP		MN BUS TIE BAT B/C - OFF If still no lt, bypass GUIDE RING limit sw's, or go to Docking Sys malf	5	Docking system malfunctions are located in Docking module checklist.
DP		(Deleted) Remove CM O2 hoses from DM (stow in CM) Close DM hatch 2, 18.6.1d	815	Timeline may determine that DM should not be closed out.
		Install fwd hatch, 5.7.2 cb DS IND LOGIC (2) - open cb DS IND PWR (2) - open cb DS CONTROL BAT (2) - open cb DS MOTORS AC1 (3) - open cb DS MOTORS AC2 (3) - open	274	
		xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx		
		xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx		
		Guide ring limit sw bypass		Bypass switches are located in DM. Opening of hatches 1 and 2 and entry into DM earlier than planned may be required.
		If GUIDE RING sw will not operate guide ring on sys A or B		
		(Deleted)		

STA/T	STEP	PROCEDURE	PANEL	REMARKS
		Remove Fwd hatch, 5.7.1 (stow) Remove docking probe & drogue, 5.7.4 & 5.7.7 (stow) Perform Dock Mod Press Integ ck, 18.3.1 Perform DM Press, 18.3.2 (steps 1 thru 3)		
DP		LIGHTING 2 - ON	815	Located in DM.
		GUIDE RING EXTD LIMIT SW - BYPASS	862	Guarded. Located in DM.
		cb DS IND LOGIC (2) - close (verify)	274	
		cb DS IND PWR (2) - close (verify)		
		cb DS CONTROL BAT (2) - close (verify)		
		cb DS MOTORS AC1 (3) - close (verify)		
		cb DS MOTORS AC2 (3) - close (verify)		
		CAUTION GUIDE RING - EXTD/RETR must be oper on sys A or B only (single mtr). Dynamic forces using two mtrs could create loads in struct beyond design limit.		
		To Extend		
		If System B required		
DP		MN BUS TIE BAT B/C - on (up)	5	Battery on line during system B guide ring motor operation to prevent main bus undervoltage.
CP		GUIDE RING A(B) - EXTD	2	
		PASSIVE lt - out		
		GUIDE RING EXTEND lt - on (8 sec min), then		
		GUIDE RING - off (ctr)		
		STUCT LATCH OPEN lt - on		

STA/T	STEP	PROCEDURE	PANEL	REMARKS
		If System B used		
DP		MN BUS TIE BAT B/C - OFF	5	
		To Retract		
		Monitor applicable F/C for stalled motor current increase during retraction		Applicable fuel cell current monitored for overload resulting from stalled motor condition. Thermal switches in the motor circuit provide overload protection.
		GUIDE RING RETR LIMIT SW - BYPASS	862	Guarded.
		If System B required		
		MN BUS TIE BAT B/C - on (up)	5	Battery on line during system B guide ring motor operation to prevent main bus undervoltage.
CP		GUIDE RING A(B) - RETR	2	
		GUIDE RING EXTEND lt - out		
		STRUCT LATCH OPEN lt - on		
		When full retract		
		PASSIVE lt - on		
		GUIDE RING A(B) - off (ctr)		
DP		If System B used		
		MN BUS TIE BAT B/C - OFF	5	
		GUIDE RING LIMIT SW (2) - NORMAL	862	Guarded. May be left in BYPASS to preclude need for reentering DM if defective motor limit switches are indicated by docking system tests.
		Remove CM O2 hoses from DM (stow in CM)	815	
		Close DM hatch 2, 18.6.1 (step 3)		Timeline may determine that DM should not be closed out.
		Install fwd hatch, 5.7.2		
		cb DS IND LOGIC (2) - open	274	
		cb DS IND PWR (2) - open		
		cb DS CONTROL BAT (2) - open		
		cb DS MOTORS AC1 (3) - open		
		cb DS MOTORS AC2 (3) - open		

STA/T STEP	PROCEDURE	PANEL	REMARKS
	4.4 DM JETTISON AND SEPARATION		Contingency jettison and separation only. Nominal jettison and separation performed during Doppler experiment (MA-089), 17.7.
	1 If hatch 2 closed, go to 2		
	or Hatch 2 open Terminate DM atmosphere mixing		

STA/T	STEP	PROCEDURE	PANEL	REMARKS
DM		Remove CM 02 hoses		
		Terminate DM experiments		
DP		cb UV/DOPPLER MN A - open	274	
		EXPERIMENT COVERS ARM - SAFE	230	
		Disconn drag thru from J1, pnl 230. Pass cable thru tunnel for stowage in DM		
DM		DM Jett Config, 18.4.4 (if time permits).		
		Transfer drogue & probe to DM (if time permits)		
		DM crewman transfer to CM		
		Close hatch 2, 18.6.1d		
		HATCH 2 PRESS EQUAL VALVE - CLOSE	Hatch 2	
	2	Fwd hatch seal integrity ck, 5.7.3	Fwd Hatch	Closes forward hatch and verifies hatch integrity.
All	3	Don PGAs, check suit circuit, 5.4.9a		
AC	4	Mnvr to jett att		
		Key V49E, 8.3.4 (auto mnvr)		R62
	or	Perform SCS att mnvr, 8.4.5		
		At jett att		
		RMAG MODE (3) - ATT 1/RATE 2	1	
		SC CONT - SCS		
		RCS DAP - load & activate, 8.2.1		
		R1 - 11102 | N46 display	2	
		R2 - X1111 |		

STA/T	STEP	PROCEDURE	PANEL	REMARKS
	5	DM jett prep		
DP		Verify DM umbilical power off cb DM PWR (2) - open cb DM FURNACE/CRYS GROWTH (3) - open cb DS A (6) - open cb DS B (6) - open	274	
AC	6	Pyro check cb SECS ARM (2) - close	8	
		After STDN AOS SECS LOGIC (both) - on (up) Report logic arm		Lever lock.
		After GO from STDN SECS PYRO ARM (2) - on (up)		Lever lock.
	7	DM jett		
CP		Key V37E 47E (thrust monitor)	2	P47 should be called just prior to DM jettison to keep IMU compensation and average G computation errors to a minimum.
DP		cb CSM/DM FNL SEP (2) - close	277	
CP		CSM/DM FNL SEP (both) - on (up)	2	Guarded and momentary. Provides jettison of DM, with docking ring and probe attached, from CSM. Separation velocity of 0.33 ft/sec will be obtained with the use of the docking ring pyrotechnic separation device only (CM/DM tunnel depressurized). Refer to Operational Data Book, para. 4.8.14, for additional ΔV, imparted due to pressure in CM/DM tunnel.
	8	Postjett pnl configuration SECS PYRO ARM (2) - SAFE SECS LOGIC (both) - OFF cb SECS ARM (2) - open	8	
	9	Separation SCS att mnvr to sep att, 8.4.5		
or		Auto mnvr to sep att, 8.34 Monitor G&N Thrusting, 8.1.6 EMS MODE - NORM THC - +Z (2jet) for 1.0 fps ΔV (5 sec min after pyro sep)		

DM JETTISON AND SEPARATION

STA/T STEP	PROCEDURE	PANEL	REMARKS
	4.5 PRE-DOCKING DM CHECKOUT		
	1 Tunnel 1 Press Integ ck & Equalization		
	TUNL VENT - DM/CM ΔP (verify) DM/CM ΔP ind - ≤ (±) 1 psid (verify)	12	
	xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx		
	If ΔP > (-1) psid (tunl leaked), or if ΔP > (+1) psid (DM leaked into tunl)		
	PRESS EQUAL vlv - OPEN (until DM/CM ΔP ind = 0 psid)	Fwd Hatch	
	PRESS EQUAL vlv - close DM/CM ΔP ind - monitor (2 min) for stability If not stable Report to STDN	12	
	xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx		
	PRESS EQUAL vlv - OPEN (CCW)/lock	Fwd Hatch	
	2 Remove Stow Fwd Hatch/Probe/Drogue		
	Remove Fwd Hatch, 5.7.1 (stow) Remove Probe, 5.7.6 (stow) Remove Drogue, 5.7.7 (stow) TUNL PRESS RELIEF vlv - capped		
	3 Perform DM Press Integ ck, 18.3.1		

STA/T	STEP	PROCEDURE	PANEL	REMARKS
	4	Perform DM Press, 18.3.2, steps 1 thru 9		
	5	Perform C/W ck, 18.4.2		
	6	Config Telecom, 18.5		
	7	Perform following		
DP		HHAG - Unstow & mount in HIGH PRESS RELIEF vlv recess	821	
CP		Initiate CM DRR TAPE RCDR - RCD, FWD, CMD RESET	3	
DP		Check DM systems (voice rcd ind's) N2 TANK QTY (both) - >71% O2 TANK QTY (both) - >80% CABIN PRESS ind - 243-274 mmHg Verify HHAG calib with pnl ind CABIN TEMP ind - 13-27°C O2 PART PRESS ind (2) - ≥165 mmHg CO2 PART PRESS ind - <7.6 mmHg	815	
	8	Transfer equip		Equipment to be transferred from DM into CM.
CP/ DP	9	Perform TV Install and ckout, 18.5.2		
	10	Perform Furnace (MA-010) prep, 17.9		
	11	Perform struct latch load cell test, 18.4.5 (8 recordings, VDC), and report to STDN		

STA/T	STEP	PROCEDURE	PANEL	REMARKS
		4.6 CSM UNDOCKING FROM DM		Provides procedure for CSM/DM separation in lieu of DM Jettison. Nominal jettison and separation performed during Doppler experiment (MA-089), 17.7. Contingency jettison and Separation is found in 4.4.
	1	Verify CSM/DM pwr interface deactivated		
		UVA drag-thru cable removed, 17.6.7		
DP		cb DM FURNACE/CRYSTAL GROWTH (3) - open	274	
		cb DM PWR (2) - open		
		cb DS A (6) - open		
		cb DS B (6) - open		
		cb DOCK PROBE (2) - open	8	
ALL	2	All crewmen transfer to CSM		
	3	Perform prep for CSM/DM sep		
DP		TUNL LTS - on (up)	274	
		Disconnect & stow DM umb conn (4)		
		Install docking drogue & probe, 5.7.8 & 5.7.5		
		Preload probe & disengage docking latches, 5.7.9 & 5.7.10		
		Perform fwd hatch seal integrity ck, 5.7.3		
		TUNL LTS - OFF (verify)		
	4	Perform sys prep		
		SCS - on, 8.4.2		
		UDAP - load & activate, 8.2.1		
AC		cb A/C ROLL, B/D ROLL, P, Y (8) - close (verify)	8	
		Select desired displays, 7.2		

STA/T STEP	PROCEDURE	PANEL	REMARKS
	Select Att control, 7.1		
AC	MAN ATT (3) - RATE CMD	1	
	DBD/RATE - MIN/HI		
	ATT DBD - MIN		
	RATE - HI		
	THC PWR - on (up)		
	RHC PWR NORM (both) - AC/DC		
	RHC PWR DIR (both) - MNA/MNB		
	AUTO RCS (16) - MNA/MNB		
	SC cont - CMC/AUTO		
	SC CONT - CMC		
	CMC MODE - AUTO		
	BMAG MODE (3) - RATE 2		
	ΔV Setup, 7.6.2		
	Set ΔV ind +100.0 fps		
	cb DOCK PROBE (2) - close	8	
CP	PROBE EXTD/REL - RETR	2	Guarded.
	PROBE EXTD/REL tb (2) - bp (verify)		Verifies redundant probe retract capability.
	PROBE EXTD/REL - OFF		Guarded.
	SPOT LIGHT - ON		
5	Perform fnl prep pnl oper		
AC	Set Evnt Tmrs		Timer will be set up to read 00:00 at separation.
	EVNT TMR RSET - DOWN	1	
-XX:XX	EVNT TMR START - START (on signal from AC)		START position is momentary. Timer started by CP.
	EMS MODE - NORM		

STA/T	STEP	PROCEDURE	PANEL	REMARKS
	6	SM RCS thrusting prep		
CP		SM RCS PRPLNT (4) - OPEN	2	
		SM RCS PRIM PRPLNT tb (4) - gray gray		
		SM RCS SEC PRPLNT tb (4) - gray ray		
		SM RCS PSM PRPLNT (4) - CLOSE		
		SM RCS PSM PRPLNT tb (4) - bp		
		SM RCS PSM He - CLOSE		
		SM RCS PSM He tb - bp		
		SM RCS PSM MANF ISOL - CLOSE		
		SM RCS PSM MANF ISOL tb - bp		
		RCS IND sel - SM D (verify)		
		SM RCS IND sw - TK PRESS/QTY (verify)		
	7	Undocking/Separation		AC will count down to separation time.
00:00		PROBE EXTD/REL - EXTD/REL & hold for DM sep +5 sec	2	Guarded. EXTD/REL position is momentary. Probe extended by a compression spring and attenuator airhead forces.
		PROBE EXTD/REL tb (2) - gray to bp to gray		Barber pole indicates power to talkback through probe circuitry. Return to gray indicates full extension of probe.
		Monitor DM sep		AC will monitor DM separation.
		SPOT LIGHT - OFF		

5.0 SYSTEMS MANAGEMENT

Systems management is a compilation of data and procedures that are common to more than one mission phase. The procedures involve system monitoring, periodic checks, and unique functions of the following systems only: SPS, RCS, EPS, ECS, C&WS, T/C and Mechanical. Systems integrated procedures for prelaunch through postlanding phases will repeatedly reference material contained in systems management.

5.1 GENERAL DATA

This paragraph contains information of a general nature that closely relates with Systems Management procedures.

5.1.1 Systems Test Indicator Readouts

A SYS TEST indicator and two selector switches (panel 101) provide the crew with the capability of monitoring some systems measurements telemetered to STDN. A chart (figure 5-1) for converting the SYS TEST indicator readings to measurement parameters is included in this paragraph. Measurements consist of the following:

- Fuel cells 1, 2, and 3 regulated 02 and H2 pressures
- 02 tank 1 & 2 heater temperatures
- Fuel cells 1, 2, and 3 radiator outlet temperatures
- DM 02 tank 1 and 2 quantity
- DM N2 tank 1 and 2 quantity
- DM 02 partial pressure
- DM cabin press
- He press pnl temp
- UV exp pointing error
- Battery compartment manifold pressure
- Battery relay bus voltage
- SPS oxidizer line temperature
- CM/RCS engine injector temperature

The systems test indicator conversion chart (figure 5-1) lists positions of the SYS TEST switches (2), and pertinent data available for each indicator readout.

SYS TEST Sel Sw (2) Position	SYS TEST Ind				
	System			Nominal Range	
	Function	Measurement No.	Sensor Range	System	Display (volts)
1A	02 TK 1 HTR TEMP	SC 0070 T	-300/+600°F	<350°F	<3.6
1B	DM 02 PP B	DF 9616 P	0 - 500 mm Hg	>150 mm Hg	>1.5V
1C	02 TK 2 HTR TEMP	SC 0071 T	-300/+600°F	<350°F	>3.6
1D	FC 1 02 REG PRESS	SC 2066 P	Zero/75 psia	58 - 69 psia	3.9 - 4.6
2A	FC 2 02 REG PRESS	SC 2067 P	Zero/75 psia	58 - 69 psia	3.9 - 4.6
2B	FC 3 02 REG PRESS	SC 2068 P	Zero/75 psia	58 - 69 psia	3.9 - 4.6
2C	FC 1 H2 REG PRESS	SC 2069 P	Zero/75 psia	57 - 67 psia	3.8 - 4.5
2D	FC 2 H2 REG PRESS	SC 2070 P	Zero/75 psia	57 - 67 psia	3.8 - 4.5
3A	FC 3 H2 REG PRESS	SC 2071 P	Zero/75 psia	57 - 67 psia	3.8 - 4.5
3B	FC 1 RAD OUT TEMP	SC 2087 T	-50/+300°F	-10 - +90°F	0.6 - 2.0
3C	FC 2 RAD OUT TEMP	SC 2088 T	-50/+300°F	-10 - +90°F	0.6 - 2.0
3D	FC 3 RAD OUT TEMP	SC 2089 T	-50/+300°F	-10 - +90°F	0.6 - 2.0
4A	DM 02 TK 1 QTY	DF 9632 Q	0 - 100%	0 - 100%	0.0 - 5.0V
4B	DM 02 TK 2 QTY	DF 9637 Q	0 - 100%	0 - 100%	0.0 - 5.0V
4C	DM N2 TK 1 QTY	DF 9652 Q	0 - 100%	0 - 100%	0.0 - 5.0V
4D	DM N2 TK 2 QTY	DF 9657 Q	0 - 100%	0 - 100%	0.0 - 5.0V

Figure 5-1. Systems Test Indicator Conversion Chart (Sheet 1 of 4)

SYSTEMS TEST INDICATOR READOUTS

SYS TEST Sel Sw (2) Position	SYS TEST Ind				
	System			Nominal Range	
	Function	Measurement No.	Sensor Range	System	Display (volts)
5A	SPS OXID LINE TEMP	SP 0049 T	Zero/+200°F	+45 - +75°F	1.1 - 1.9
5B	BAT RLY BUS VOLT	CC 0232 V	Zero/+45 vdc	30.5-37 vdc	3.4 - 4.1
5C	CM RCS 24 INJ TEMP	CR 2110 T	-50/+50°F	>28°F	>3.9
5D	CM RCS 25 INJ TEMP	CR 2116 T	-50/+50°F	>28°F	>3.9
6A	CM RCS 12 INJ TEMP	CR 2114 T	-50/+50°F	>28°F	>3.9
6B	CM RCS 14 INJ TEMP	CR 2100 T	-50/+50°F	>28°F	>3.9
6C	CM RCS 16 INJ TEMP	CR 2103 T	-50/+50°F	>28°F	>3.9
6D	CM RCS 21 INJ TEMP	CR 2119 T	-50/+50°F	>28°F	>3.9
7A	BAT COMPT PRESS	CC 0188 P	Zero/20 psia	6.4 - 9.6 psia	1.6 - 2.4V
7D	He PRESS PNL TEMP	SP 9017 T	Zero/+200°F	0 - +100°F	0.0 - 2.5V
8A	DM 02 PP A	DF 9615 P	0 - 500 mm Hg	>150 mm Hg	>1.5V
8B	DM CABIN PRESS	DF 9605 P	0 - 880 mm Hg	250 - 550 mm Hg	1.4 - 3.1V
8C	UV EXP POINTING ERROR	DL 9666 H	-1.5 - +1.5 deg	-0.30 - +0.30	2.0 - 3.0V
8D	DOPPLER TRACKING RECEIVER LOCK	SL 9658 X	N/A	Discrete	0.0 or 5.0V

Figure 5-1. Systems Test Indicator Conversion Chart (Sheet 2 of 4)

5.1.1 SYSTEMS TEST INDICATOR READOUTS

NORMAL BACKUP

SYS TEST Ind Display	FC O2, H2 Reg Press. (psia)		EPS Rad Out Temp (°F)	CM-RCS Oxid Vlv Temp (°F)	SPS He Press. Pnl Temp (°F)	SPS Oxid Line Temp (°F)	Bat Compt Manf Press. (psia)	Bat Rly Bus (vdc)	O2 Tk Htr Temp (°F)
0.0	0	0	-50	-50	[0]	0	0.00	0	[-300]
0.2	3	3	-36	-46	[8]	8	0.80	1.8	[-264]
0.4	6	6	-22	-42	[16]	16	1.60	3.6	[-228]
0.6	9	9	[-8]	-38	[24]	24	2.40	5.4	[-192]
0.8	12	12	[+6]	-34	[32]	32	3.20	7.2	[-156]
1.0	15	15	[+20]	-30	[40]	40	4.00	9.0	[-120]
1.2	18	18	[+34]	-26	[48]	[48]	4.80	10.8	[-84]
1.4	21	21	[+48]	-22	[56]	[56]	[5.60]	12.6	[-48]
1.6	24	24	[+62]	-18	[64]	[64]	[6.40]	14.4	[-12]
1.8	27	27	[+76]	-14	[72]	[72]	[7.20]	16.2	[+24]
2.0	30	30	[+90]	-10	[80]	80	[8.00]	18.0	[+60]
2.2	33	33	+104	-6	[88]	88	[8.80]	19.8	[+96]
2.4	36	36	+118	-2	[96]	96	[9.60]	21.6	[+132]
2.6	39	39	+132	+2	104	104	10.40	23.4	[+168]
2.8	42	42	+146	+6	112	112	11.20	25.2	[+204]
3.0	45	45	+160	+10	120	120	12.00	27.0	[+240]
3.2	48	48	+176	+14	128	128	12.80	[28.8]	[+276]
3.4	51	51	+188	+18	136	136	13.60	[30.6]	[+312]
3.6	54	54	+202	+22	144	144	14.40	[32.4]	[+348]
3.8	[57]	[57]	+216	+26	152	152	15.20	[34.2]	[+384]
4.0	[60]	[60]	+230	[+30]	160	160	16.00	[36.0]	[+420]
4.2	[63]	[63]	+244	[+34]	168	168	16.80	37.8	[+456]
4.4	[66]	[66]	+258	[+38]	176	176	17.60	39.6	[+492]
4.6	[69]	[69]	+272	[+42]	184	184	18.40	41.4	[+528]
4.8	[72]	[72]	+286	[+46]	192	192	19.20	43.2	[+564]
5.0	[75]	[75]	+300	[+50]	200	200	20.00	45.0	[+600]

Bracketed values indicate normal range.

Figure 5-1. Systems Test Indicator Conversion Chart (Sheet 3 of 4)

SYS TEST Ind Display	DM 02 Tk 1/2 Qty (%)	DM N2 Tk 1/2 Qty (%)	DM 02 PP A (mm Hg)	DM 02 PP B (mm Hg)	DM Cabin Press. (mm Hg)	UV Exp Pointing (Fly to ind-degrees)
0.0	0	0	0	0	0.0	-1.50
0.2	4	4	20	20	35.2	-1.38
0.4	8	8	40	40	70.4	-1.26
0.6	12	12	60	60	105.6	-1.14
0.8	16	16	80	80	140.8	-1.02
1.0	20	20	100	100	176.0	-0.90
1.2	24	24	120	120	211.2	-0.78
1.4	28	28	140	140	246.4	-0.66
1.6	32	32	160	160	281.6 250.0	-0.54
1.8	36	36	180	180	316.8	-0.42
2.0	40	40	200	200	352.0	-0.30
2.2	44	44	220	220	387.2	-0.18
2.4	48	48	240	240	422.4	-0.06
2.6	52	52	260	260	457.6	+0.06
2.8	56	56	280	280	492.8	+0.18
3.0	60	60	300	300	528.0 550.0	+0.30
3.2	64	64	320	320	563.2	+0.42
3.4	68	68	340	340	598.4	+0.54
3.6	72	72	360	360	633.6	+0.66
3.8	76	76	380	380	668.8	+0.78
4.0	80	80	400	400	704.0	+0.90
4.2	84	84	420	420	739.2	+1.02
4.4	88	88	440	440	774.4	+1.14
4.6	92	92	460	460	809.6	+1.26
4.8	96	96	480	480	844.8	+1.38
5.0	100	100	500	500	880.0	+1.50

Figure 5-1. System Test Indicator Conversion Chart (Sheet 4 of 4)

5.1.2 Limited Use Circuit Breakers

The following list defines circuit breakers which will be open during major portions of flight time. Primary considerations are to maintain maximum crew safety, reduce consumable usage, and increase equipment reliability.

Circuit Breakers	Panel Location	When Opened	When Closed	Remarks
NONESS INST	5	Prelaunch	When required	No requirements are defined for use of this circuit breaker at the present time.
RAD HTRS OVLD (2)	5	Prelaunch	Not used	The cb RAD HTRS OVLD (2) are opened at prelaunch and throughout the mission. GSE opens the motor switches at prelaunch to prevent energizing primary and secondary ECS radiator heaters in flight.
FLOAT BAG (all)	8	Prelaunch	After splashdown	Opened to ensure against inadvertent activation of float bag compressors and sea dye marker.
CM RCS HTRS (both)	8	Prelaunch	Prior to deorbit and entry if heating required	Opened to ensure against inadvertent CM RCS jet activation. Heating probably not required.
ELS/CM SM SEP (2)	8	Postorbital insertion check	Prior to deorbit and entry	Opened to isolate ELS and CM SM SEP function until needed.
PL VENT FLT/PL	8	Postorbital insertion check	After splashdown	Opened to ensure against inadvertent activation of postlanding vents.

LIMITED USE CIRCUIT BREAKERS

Circuit Breakers	Panel Location	When Opened	When Closed	Remarks
SECS ARM (2)	8	Postorbital insertion check	During prelaunch, launch, docking, deorbit and entry procedures	Opened to ensure against inadvertent activation of SECS functions.
RCS LOGIC (2)	8	Post S-IVB separation check	During prelaunch, launch, deorbit, and entry procedures	Opened to ensure against inadvertent CM/SM RCS transfer and/or CM RCS activation.
EDS (all)	8	Post separation panel configuration (CSM/SLA separation)	Prelaunch	No further use after CSM/SLA separation.
SPS PITCH 1 BAT A	8	When SCS powered down after first SPS thrust	From launch through first SPS thrust and during subsequent SPS thrusts	Opened to prevent power drain through SCS TVC fail sensor.
SPS YAW 1 BAT A	8	When SCS powered down after first SPS thrust	From launch through first SPS thrust and during subsequent SPS thrusts	Opened to prevent power drain through SCS TVC fail sensor.
MN REL (2)	229	Prelaunch	Only after splashdown	Opened to prevent premature main parachute release.
O2 VAC ION PUMPS (2)	229	Prelaunch	When required	No requirements are defined for use of these circuit breakers at the present time. Closing will be dictated by STDN.
PYRO A&B BAT BUS A&B (2)	250	Prelaunch	Only when required, if pyro bats indicate <35 vdc during bat check	Connects battery buses to pyro buses in event of pyro battery(s) failure.

5.1.2 LIMITED USE CIRCUIT BREAKERS

NORMAL/BACKUP

Circuit Breakers	Panel Location	When Opened	When Closed	Remarks
BAT C TO BAT BUS A&B (2)	250	Prelaunch	When required to connect bat C to bat bus A or B	Connected when battery C is used to back up failed battery A or B.
MN A&B BAT C (2)	275	Prelaunch	Prior to deorbit and as required for bat A or B backup	Opened to isolate battery C from main buses.
FLT/PL BAT BUS A&B & BAT C (3)	275	Prelaunch	Prior to splashdown	Opened to isolate battery bus A & B and battery C from flight and post-landing bus.
CSM/DM FNL SEP (2)	277	Prelaunch	Prior to DM jettison	No further use after DM jettison.
UPR SYS COMPR (both)	278	Prelaunch	After splashdown	Opened to ensure against inadvertent activation of float bag compressors.
SIVB/DM SEP (2)	278	Following DM extraction	Prelaunch	No further use after DM is extracted from SIVB.

LIMITED USE CIRCUIT BREAKERS

5.1.3 Non-Dioded/Non-Switchable Loads

MAIN BUS A

EPS/CRYO
- Tk 1 H2 Htr
- Tk 1 02 100W Htr
- Tk 2 02 50W Htr
- Inv 1 Pwr
- Util Outlets (pnl 15 & 16)
- Tk 1 02 Vac-Ion Pump

ECS
- CO2 PP ind C/W lt & PCM (Deleted)
- Rad Flow Contr 1 & Auto Sel
- Rad Isol vlv Man Sel
- H20 Accum 1 Auto & Man Cont
- Urine & Waste H20 Dump Htr A
- Steam Duct Htr A (Deleted)
- Sec Rad In & Out Temp ind & PCM

RCS
- CM Sys 1 Htrs
- CM Sys 1 Fuel & Oxid Purge
- CM Oxid Interconnect
- CM Fuel/He Interconnect
- CM Sys 1 Prplnt Dump 42 Sec TD
- CM Sys 1 Prplnt Isol vlv & tb
- SM B & D Htrs
- SM B & D He 1 & 2 Isol vlv & tb
- SM B & D Prim/Sec Prplnt Isol vlv & tb
- SM B & D Sec Fuel Press Isol vlv
- Trnfr Mot sw 1

SPS
- P & Y (Prim) Gmbl Mots
- Enbl Pwr Sol Driver 1
- He 1 vlv & tb
- Pilot 1 & 2 vlv
- Prim Pilot Pre vlv
- Line Htrs A
- PUGS Test (deactivated)

SCS
- FDAI 1 Total Att
- GDC (except RSI)
- BMAG 1 Htr & C/W Temp lt (eventually lose BMAG 1 as temp decr)
- Auto coils CM RCS 1 (if prior to CM/SM sep)
- Dir Ull Pitch C3 & A4
- Auto ΔV
- Auto Att Hold
- Rate 1 MTVC
- Rot Contr Pwr Dir 1
  - a. MNA/MNB to half of jets
  - b. MNA to all jets
- Rot Contr Pwr Dir 2, MNA/MNB to half of jets

LIGHTING
- RH Girth Shelf Flood (Fixed Mode)
- RH Couch Flood (Fixed Mode)
- LH Girth Shelf Flood (Var Mode)
- LH Couch Flood (Var Mode)
- LH & RH Strut Flood (Var Mode)
- LH Opt Align Sight
- Rndz lt
- Sys A Tunl lts (6 elements)

DISPLAYS & CONTROLS
- Msn Elapsed Tmr (pnl 2)

DOCKING
- Sys A Probe conn (however A & B conn may be switched)

MAIN BUS B

EPS/CRYO
- Tk 2 H2 Htr
- Tk 2 02 100W Htr
- Tk 1 02 50W Htr
- Inv 2 Pwr
- Util Outlet (pnl 100)
- Tk 2 02 Vac-Ion Pump

ECS
- 02 High Flow C/W lt (Deleted)
- Rad Flow Contr 2

MAIN BUS B (CONT)		BAT BUS A
ECS (cont) Prim Rad In Temp ind & PCM H2O Accum 2 Auto & Man Cont Urine & Waste Dump Htr B Steam Duct Htr B RCS CM Sys 2 Htrs CM Sys 2 Fuel & Oxid Purge CM Fuel Interconnect CM Oxid/He Interconnect CM Sys 2 Prplnt Dump 42 Sec TD CM Sys 2 Prplnt Isol vlv & tb SM A & C Htrs SM A & C He 1 & 2 Isol vlv & tb SM A & C Prim/Sec Prplnt Isol vlv & tb SM A & C Sec Fuel Press Isol Trnfr Mot sw 2 SPS P & Y (Sec) Gmbl Mots Enbl Pwr Sol Driver 2 He 2 vlv & tb Pilot 3 & 4 vlv Sec Pilot Pre vlv Line Htrs B SCS FDAI 2 Total Att GDC	BMAG 2 Htr & C/W Temp lt (eventually lose BMAG 2 as temp decr) Auto Coils CM RCS 2 (if prior to CM/SM sep) Dir Ull Yaw D3 & B4 Auto ΔV (may be degraded) Min Imp Incr to *42 MS RSI ORDEAL Rot Contr Pwr Dir 1, MNA/MNB to half of jets Rot Contr Pwr Dir 2 a. MNA/MNB to half of jets b. MNB to all jets LIGHTING LH Girth Shelf Flood (Fixed Mode) LH Couch Flood (Fixed Mode) LH & RH Strut Flood (Fixed Mode) RH Couch Flood (Var Mode) RH Girth Shelf Flood (Var Mode) RH Opt Align Sight Sys B Tunl lts (6 elements) Spotlight Door Initiator DISPLAYS & CONTROLS Msn Elapsed Tmr (pnl 306) DOCKING Sys B Probe conn (however A & B conn may be switched)	EPS/CRYO Mn Bus Tie A/C Mot sw (Deleted) RCS Mot sw 1 SPS P & Y 1 (Prim) Gmbl Mot Cont SCS Auto RCS Sel MNA (if not previously enabled) SECS SECS & ELS Sys A Float Bag Compr 1 Float Bag 1 Mot sw & Cont vlv EDS Voting Logic
		BAT BUS B
		EPS/CRYO Mn Bus Tie B/C Mot sw ECS (Deleted) SECS Auto RCS Trnfr to Trnfr Mot sw 2

NON-DIODED/NON-SWITCHABLE LOADS

BAT BUS B (CONT)	AC BUS 1	LIGHTING FDAI 1 EMS Num & Grid Msn Tmr Num (pnl 2) DSKY Num (pnl 2) EL for pnls 1-9, 15, 16, 229, 275 Sys 1 SM Run lts (6 elements) & EVA lt (1 element)
SPS P & Y (Sec) Gmbl Mot Cont SCS Auto RCS Sel MNB (if not previously enabled) SECS SECS & ELS Sys B Float Bag Compr 2 Float Bag 2 Mot sw & Cont vlv EDS Voting Logic 3 BATTERY C ECS Voting Logic 2 BAT RELAY BUS EPS/CRYO FC 1, 2, 3, Reacs vlvs, Latch Ckt & tbs FC 1, 2, 3 Rad Byp vlvs & tbs FC 1, 2, 3 to Mn Bus A & B Switching & tbs Mn Bus A&B UV Sensing & UV lt Inv 1, 2, 3 to AC Bus 1 & 2 & DC Bus Switching AC Over/UV Sensing & C/W lt AC Ovld C/W lt (if C/W NORM sw in ACK)	EPS/CRYO Tk 1 H2 Fans Tk 1 H2 & 02 Qty & Temp Sig Condr (ØC) ECS **Cab Fans** (2) Man Cont Prim Evap Stm vlv (ØC) Auto Cont Prim Gly Cont vlv (ØA) Sec Loop Evap Cool (ØA) Elect Cont Suit Ht Exch Gly Byp vlv (ØB) Rad Flow Contr 1 & Rad Isol vlvs (ØC) SCS GDC (all modes except RSI) FDAI 1 BMAG 1 (ATT HOLD, RATE CMD) Min Imp (ØA) RHC 1 MTVC (ØA) Rate Cmd Prplnt Att Cont (ØA) Auto ΔV (ØA) No. 1 Pitch & Yaw Needles on GPI (ØA) SIVB Fuel & Oxid Press for ind No. 1 (ØA)	AC BUS 2 EPS/CRYO Tk 2 H2 Fans Tk 2 H2 & 02 Qty & Temp Sig Condr (ØC) ECS Prim Evap Temp Cont Unit (ØA) Auto Cab Temp Cont Unit (ØC) Rad Flow Contr 2 & Rad Isol vlvs (ØC) SCS MTVC (RATE CMD, ACCEL CMD) Proportional RATE CMD (TVC, ATT CONT) FDAI 2 BMAG 2 RSI (ØA) GDC (ØA) Auto ΔV (TVC) (ØA)

5.1.3 NON-DIODED/NON-SWITCHABLE LOADS

NORMAL BACKUP

AC BUS 2 (CONT)		
SCS (cont) ORDEAL No. 2 Pitch & Yaw Needles on GPI (ØA) SIVB Fuel & Oxid Press for ind No. 2 (ØA) LIGHTING EMS Roll Att & Scroll lts Msn Tmr Num (pnl 306)	DSKY Num (pnl 140) EL for pnls 10, 100, 101, 122, 225, 226, 306 Sys 2 SM Run lts (8 elements) & EVA lt (1 element) Dock Trgt & Spot lt **PYRO BUS A** Fuel/He Interconnect Ox Interconnect	CM RCS 1 Purge vlvs Seq Sys A Func (pyros) **PYRO BUS B** Ox/He Interconnect Fuel Interconnect CM RCS 2 Purge vlv Seq Sys B Func (pyros)

NON-DIODED/NON-SWITCHABLE LOADS

5.1.4 Powerdown Electrical Loads

The following electrical loads list may be utilized to effect a powerdown if main buses should indicate less than 26 vdc with no short circuit verification. Three types of loads are provided to permit most rapid and effective selection for a given mission phase. A return to normal configuration should be established when main buses reach 26.5 vdc.

Use of list assumes that entry batteries A and B (battery C when applicable) have been tied to main buses before powerdown selections are made.

Load Control	LAUNCH Liftoff to Orbit Insertion	FLIGHT Orbit Insertion to Entry Preparation	ENTRY Entry Preparation to 50K'	SPS Burns	Remarks
CONTINUOUS LOADS					
cb G/N (10) - open			9.50 amp		After 0.05 G
FC PUMPS (all) - OFF	8.73 amp	8.73 amp	8.73 amp	8.73 amp	Until CM/SM sep
IMU to stby	6.33 amp				
cb ESS INST (2) - open	4.85 amp	4.80 amp	1.10 amp	4.80 amp	MNA & B
S BD PWR AMPL HI - off (ctr)	4.00 amp	4.00 amp	4.00 amp	4.00 amp	
SUIT COMPR 1 (or 2) - OFF		4.00 amp/compr	4.00 amp/compr	4.00 amp/compr	Unsuited only
TELCOM (both) - OFF	1.76 amp	3.71 amp	1.80 amp	3.71 amp	Group 1 & 2
G/N OPT PWR (2) - OFF			3.10 amp		
GLY PUMPS - OFF	2.57 amp	2.57 amp	2.57 amp	2.57 amp	OFF no longer than 15 min
CMC to stby	1.96 amp				
G/N PWR - OFF	1.50 amp	1.50 amp	1.50 amp	1.50 amp	
cb RAD CONT/HTRS (2) - open	1.05 amp	1.05 amp	1.05 amp	1.05 amp	Until CM/SM sep
SCE PWR - off (ctr)	0.65 amp	0.65 amp	0.65 amp	0.65 amp	

5.1.4. POWERDOWN ELECTRICAL LOADS

NORMAL/BACKUP

Load Control	LAUNCH Liftoff to Orbit Insertion	FLIGHT Orbit Insertion to Entry Preparation	ENTRY Entry Preparation to 50K'	SPS Burns	Remarks
MANUALLY CYCLED LOADS					
GMBL MOT PITCH & YAW 2 - OFF	10.0 amp				At crew discretion
SPS LINE HTRS - off (ctr)		3.09 amp/bus		3.09 amp/bus	
SPS GAUGING - OFF				2.96 amp	
Min CM lighting	1.57 amp	1.57 amp	1.57 amp	1.57 amp	
TAPE RCDR FWD - off (ctr)	1.57 amp	1.57 amp	1.57 amp	1.57 amp	
NONESS BUS - OFF	4.4 amp	4.4 amp		4.4 amp	
AUTOMATICALLY CYCLED LOADS					
02 HTRS (both) - OFF	17.0 amp	17.0 amp	17.0 amp	17.0 amp	Until CM/SM sep
SM RCS HTRS (4) - OFF		2.90 amp/quad	2.90 amp/quad	2.90 amp/quad	Until CM/SM sep
POT H20 HTR - OFF		1.62 amp		1.62 amp	
H2 HTRS (both) - OFF	1.43 amp	1.43 amp	1.43 amp	1.43 amp	Until CM/SM sep
H2 FANS (both) - OFF		1.08 amp	1.08 amp	1.08 amp	Until CM/SM sep

POWERDOWN ELECTRICAL LOADS

STA/T STEP	PROCEDURE	PANEL	REMARKS
	5.2 PROPULSION SYSTEMS Specific functions of the SPS and RCS must be monitored to assure operational readiness and capability. SPS and SM RCS monitoring checks are performed during post-orbital insertion check and at 4-hour intervals and after each SPS burn. In addition, the SM RCS monitoring check is performed prior to each SPS burn. The CM RCS monitoring check is performed during post-orbital insertion check and at 12-hour intervals and prior to entry.		
	5.2.1 SPS Monitoring Check		
DP	SPS PRPLNT TEMP ind - +45° to +75°F If <45°F, SPS LINE HTRS - A If >75°F, SPS LINE HTRS - off (ctr) SPS PRESS IND sw - He, N2A, & N2B SPS He/N2 PRESS ind SPS He PRESS - 3750 psia max SPS N2 A PRESS - 2900 psia max SPS N2 B PRESS - 2900 psia max SPS PRESS IND sw - He SPS FUEL PRESS ind - 170-195 psia SPS OXID PRESS ind - 170-195 psia	3	Use A/B position if double heater operation required for temperature control. 3600±50 psia at launch, decreases with each burn. 2900 psia at 130°F, decreases with each burn. 2900 psia at 130°F, decreases with each burn. Fuel and oxidizer tanks pressurized with helium prior to launch.
	CAUTION **If ΔP between fuel and oxid >20 psi prior to critical SPS burn, repressurize prplnt tanks manually by placing SPS He VLV (both) - ON. ΔP between tanks >20 psi during burn may result in degraded performance, rough combustion, and/or engine failure.**		

STA/T	STEP	PROCEDURE	PANEL	REMARKS
DP		SPS INJ VLV ind (4) - CLOSE	3	Each CLOSE indicates two propellant ball valves closed.
		SPS OXID QTY ind - N/A		PUGS deactivated.
		SPS FUEL QTY ind - N/A		PUGS deactivated.
		SPS OXID UNBAL ind - N/A		PUGS deactivated.
		OXID FLOW VLV PRIM - PRIM		PUGS deactivated.
		SPS He VLV (both) - AUTO		
		SPS He VLV tb (both) - bp		Barber pole indicates each helium isolation valve is closed.
		SYS TEST (2) - 5A	101	
		SYS TEST ind - 1.1-1.9 vdc		Equivalent to +45 - +75°F SPS OXID LINE TEMP indication.
		SYS TEST (2) - 7D		
		SYS TEST ind - 0.0-2.5 vdc		Equivalent to 0 - +100°F SPS He PRESS PNL TEMP.
		SYS TEST (2) - 5B		
	5.2.2	SM RCS Monitoring Check		In addition to normal monitoring checks, all helium and propellant talkbacks for valves in use should be verified gray after any mechanical shock to CSM.
		NOTE		
		Data in [ ] applies when PSM is active.		
CP		SM RCS QUAD He tb (4) - gray [bp]	2	Gray indicates both helium main isolation valves open in each quad.
		SM RCS PRIM PRPLNT tb (4) - gray [bp]		Gray indicates fuel and oxidizer isolation valves open.
		SM RCS SEC PRPLNT tb (4) - gray [bp]		Gray indicates fuel and oxidizer isolation valves open.
		SM RCS PSM PRPLNT tb (4) - bp [gray]		Barber pole indicates at least one PSM manifold to quad propellant (fuel or oxidizer) isolation valve closed.

SM RCS MONITORING CHECK

STA/T	STEP	PROCEDURE	PANEL	REMARKS
CP		SM RCS PSM He tb - bp [gray]	2	Barber pole indicates at least one of two redundant helium isolation valves closed.
		SM RCS PSM MANF ISOL tb - gray		Gray indicates both fuel and both oxidizer isolation valves open.
		RCS IND sel - SM A, B, C, D		Check each quad in turn.
		SM RCS PKG TEMP ind - 115°-175°F (C/W 75°-205°F)		Temperature maintained by two redundant and separately selected package heater circuits, each thermostatically controlled between 115°F and 134°F. Above nominal temperature may occur during and after long jet firings. Prolonged cold soak may produce lower than nominal temperatures.
		SM RCS He TK PRESS ind - record (quad)		Nominally 4150 psia before quad used.
		SM RCS He TK TEMP ind - record (quad)		
		SM RCS IND sw - PRPLNT QTY		
		SM RCS SEC FUEL TK PRESS ind - 178-192 psia (quad)		192-207 psia until quad used, after orbit insertion. Fuel line readout of primary fuel tank only, until secondary tank pressurized - then primary and secondary common manifold if quad isolation valves open.
		SM RCS PRPLNT QTY ind - record % (quad)		
		When SM RCS SEC FUEL PRESS ind - 150 psia (quad)		Indicates quad primary fuel quantity low. SM RCS status lights on at 145 psia.
		SM RCS SEC FUEL PRESS A(B, C, D) - OPEN		OPEN position is momentary. No talkbacks. Opens helium isolation valve at quad secondary fuel tank.
		RCS IND sel - PSM		
		SM RCS PKG TEMP ind - zero		Operational only when RCS IND selector at SM A, B, C, or D.
		SM RCS He PRESS ind - record (PSM)		Temperature variations cause excursions from nominal.

STA/T	STEP	PROCEDURE	PANEL	REMARKS
CP		SM RCS SEC FUEL PRESS ind - 130-150 psia (before PSM activation)	2	Nominal pressures for fully loaded PSM. Partial loads result in higher pressures.
		SM RCS SEC FUEL PRESS ind - 178-192 psia (after PSM activation)		Regulated helium pressure common manifold.
		SM RCS PRPLNT QTY ind - record % (PSM)		
		SM RCS IND sw - He TK TEMP		
		SM RCS He TK TEMP - record (PSM)		
		RCS IND sel - SMD		
		SM RCS QUAD HTRS (4) - PRIM (verify)	274	
	5.2.3	CM RCS Monitoring Check		
		CM RCS PRPLNT tb (both) - gray	2	Gray indicates fuel and oxidizer isolation valves open. Check both CM RCS system 1 and 2 in turn.
		RCS IND sel - CM 1, 2		
		CM RCS He TEMP ind - 45°-80°F		
		Prior to CM RCS activation		
		CM RCS He PRESS ind - 3900-4300 psia		Temperature variations cause pressure excursions from nominal.
		CM RCS MANF PRESS ind - 80-105 psia		GSE servicing pressure monitored until system activated. Pressure varies with temperature and ullage. If manifold pressure drops suddenly, indicating a ruptured burst diaphragm, close CM RCS propellant isolation valves and then perform procedure for preheating jets (14.1.4) for 20 minutes. Procedure vents any propellant trapped between propellant isolation valves and jets by energizing jet valve direct coils.
		After CM RCS activation		
		CM RCS He PRESS ind - 3600-3800 psia (after ≈15 min)		
		CM RCS MANF PRESS ind - 287-302 psia		

CM RCS MONITORING CHECK

STA/T STEP	PROCEDURE	PANEL	REMARKS
CP	SM RCS QTY ind - zero	2	Operational only when RCS IND selector at SM A, B, C, D or at PSM.
	SYS TEST (2) - 5C, 5D, 6A, 6B, 6C, 6D SYS TEST ind - ambient (vdc) SYS TEST (2) - 5B	101	CM RCS engine injector valve temperatures of jets 24 (-P), 25 (+Y), 12 (-R), 14 (-P), 16 (-Y) and 21 (+R), respectively.

5.2.3 CM RCS MONITORING CHECK

NORMAL/BACKUP

5.3 ELECTRICAL POWER SYSTEM

EPS Management

The normal EPS configuration will be with two fuel cells on main bus A and one on main bus B, e.g., FC 1 and 2 on MNA and FC 3 on MNB. If one fuel cell is to be removed from buses, one of two configurations may be assumed. The prime configuration is one fuel cell per bus; for example, fuel cell 1 to main bus A and fuel cell 3 to main bus B. This configuration requires a dual inverter configuration and subsequent load balancing after fuel cell configuration has been established. The second configuration is to have two fuel cells paralleled to buses. This configuration should not be assumed unless equipment malfunction does not permit load balancing or one of the remaining fuel cells performance is degraded.

Standby operation (in-line heaters, reactants and pumps remain on) may be used when powering down spacecraft, as a corrective action for fuel cell malfunctions, or in the event it is desired to hold a fuel cell in reserve for future use. Batteries and remaining fuel cells should be normal when a fuel cell is placed on standby operation (open circuit). Inline heaters and pumps should not be turned off unless fuel cell is to be shut down. If, during the mission, it becomes necessary to conserve cryogenics, electrical loads should be reduced which will in turn decrease flow of cryogenics to fuel cells. In an emergency situation, consideration may be given to deactivate a fuel cell (inline heaters, pumps, and loads off) to conserve cryogenics. During deactive period, continuous monitoring of the fuel cell system will not necessarily assure a reactivation capability and there exists a possibility of complete loss of the fuel cell.

The prime inverter configuration is to have inverter 1 powering ac bus 1 and inverter 2 powering ac bus 2, with inverter 3 as backup. This configuration permits optimum bus isolation; however, reliability of the inverter permits single inverter operation to both ac buses if cryogenics are to be conserved. When a single inverter is used to power both ac buses, there will be a transient when it is tied to the second ac bus. This could cause spurious RCS jet firings and momentary loss of telemetry.

Entry batteries A and B will normally supply main bus A and main bus B respectively with battery C as backup. The batteries (2) should be on during countdown, lift-off, and all delta V maneuvers. Battery C will supply the buses prior to deorbit burn and as required throughout the mission.

Battery C will be connected to buses as required to provide two-battery configuration for delta V maneuvers. All three batteries are to be used during final deorbit burn.

The battery charging cycle should be terminated when either the battery bus voltage indicated on PCM exceeds 39.5 vdc or when 100 percent of the expended energy has been replaced. This presumes charger current PCM data availability, and integration of charge current on the ground with STDN advice to crew when 100 percent of charge is returned. If PCM link is lost, voice readouts of the onboard charger DC AMPS indicator will be required at intervals of 20 to 30 minutes for integration on the ground. Charging may be resumed if interrupted before achieving terminal conditions previously listed. Normal practice is to continue any charge to completion.

Batteries will be checked prior to each GO/NO-GO flight decision, prior to deorbit burn, and in routine periodic checks as required.

The onboard readout will be prime readout throughout EPS checks.

Application of control voltage less than 22 vdc to any motor switch should be terminated after 10 seconds with repeated applications no more often than once each five minutes. (Under normal bus conditions, motor switches are limited to six transfers in any six-minute period.)

Fuel cell periodic verification consists of updating onboard data and comparing respective fuel cell performance for a particular phase, with established history of the powerplant.

Normal fuel cell purge requirements will be established in flight on the basis of prelaunch purity tests and elapsed amp-hours since previous purge. Purging is accomplished by sequentially purging O2 (for 120 seconds) then H2 (for 80 seconds).

The time required for the H2 vent line heater activation prior to H2 purge has been set at 20 minutes. This time is flexible in that a purge may be attempted with less heater time (for example, a contingency corrective action) with no immediate adverse effect on the powerplant.

STA/T	STEP	PROCEDURE	PANEL	REMARKS
		5.3.1 Cryogenic Pressure-Quantity Check		
CP		CRYO H2 PRESS ind (both) - 225-260 psia	2	Indicates H2 tank 1 and 2 pressure.
		CRYO PRESS IND sw - SRG		
		CRYO 02 PRESS 1/SRG ind - 865-935 psia		Indicates surge tank 02 pressure
		CRYO PRESS IND sw - 1		
		CRYO 02 PRESS ind (both) - 865-935 psia		Indicates 02 tank 1 and 2 pressure.
		CRYO H2 QTY ind (both) - record		Nominal per mission profile curve, 100% maximum indicates full tank (28 lbs each tank).
		CRYO 02 QTY ind (both) - record		Nominal per mission profile curve, 100% maximum indicates full tank (320 lbs each tank).
		5.3.2 FC Power Plant Check		
DP		FC HTRS (all) - on (up)	3	Enables electronic switches which automatically apply or remove power to fuel cell heaters.
		FC RAD tb (all) - gray		Gray indicates fuel cell radiator panel not bypassing flow.
		FC REACS tb (all) - gray		Gray indicates fuel cell reactant valves open.
		FC IND sel - 1, 2, 3		
		FC H2 FLOW ind - 0.03-0.15 lb/hr		Flow limits are proportional to individual fuel cell currents and can be approximated by fuel cell 02 flow ≈(amps x 2.0)/100, and fuel cell H2 flow ≈(amps x 2.5)/1000.
		FC 02 FLOW ind - 0.25-1.2 lb/hr		
		FC SKIN TEMP ind - 390°-440°F		
		FC COND EXH TEMP ind - 150°-175°F		
		FC pH HI tb - gray		Gray indicates pH factor normal.
		FC RAD TEMP LO tb - gray		Gray indicates fuel cell radiator temperatures normal.

FC POWER PLANT CHECK

STA/T	STEP	PROCEDURE	PANEL	REMARKS
		5.3.3 D-C Voltage-Amperage Check		
DP		MN BUS TIE (2) - OFF (verify)	5	
		FC 1 & 2 MNA tb (2) - gray FC 3 MNA tb - bp	3	Gray indicates fuel cells 1 and 2 connected to main bus A. Barber pole indicates fuel cell 3 disconnected from main bus A.
		FC 1 & 2 MNB tb (2) - bp FC 3 MNB tb - gray		Barber pole indicates fuel cells 1 and 2 disconnected from main bus B. Gray indicates fuel cell 3 connected to main bus B.
		DC IND sel - FC 1, 2, 3 DC AMPS ind - record amps		Record dc amps for each fuel cell.
		DC IND sel - MNA, B DC VOLTS ind - 26.5-31 vdc (record)		Record dc volts for main buses A and B.
		DC IND sel - BAT BUS A, B, & BAT C DC VOLTS ind - 31.5-38.0 vdc DC AMPS ind - <3.0 amps		Voltage indication may be different than shown when charging battery.
CP		SYS TEST (2) - 5B SYS TEST ind - 3.4-4.1 vdc	101	Verifies battery relay bus voltage 30.5 to 37.0 vdc and verifies system test indicator. Perform if convenient.
		CAUTION Do not leave DC IND sel at PYRO BAT A (B) position any longer than req to read DC VOLTS ind, or pyro bat charge will be depleted.		
DP		DC IND sel - PYRO BAT A, B DC VOLTS ind - 36.5-37.5 vdc DC IND sel - MNA	3	Check pyro batteries A and B once every 24 hours.

STA/T	STEP	PROCEDURE	PANEL	REMARKS
	5.3.4	A-C Voltage Check		
		AC IND sel - BUS 1, 2, ØA, B, C	3	
		AC VOLTS ind - 113-117 vac		
	5.3.5	Battery A (B, C) Charging		If battery charge started immediately after discharge, charger current may be high and/or voltage may be low.
DP		MN BUS TIE (2) - OFF	5	Placing MN BUS TIE switches OFF disconnects battery from main buses.
		cb BAT RLY BUS BAT A(B) - open		
		cb BAT BUS A&B TO PYRO BUS (2) - open (verify)	250	
		cb BAT C TO BAT BUS A&B (2) - open (verify)		
		DC IND sel - BAT CHGR	3	
		BAT CHG - A, B or C		
		DC VOLTS ind - 37.5-39.5 vdc		
		BAT CHG - OFF (at STDN request or when DC VOLTS ind reads 39.5 vdc)		
		cb BAT RLY BUS BAT A(B) - close	5	
		DC IND sel - MNA	3	
CP		SYS TEST (2) - 7A	101	
		SYS TEST ind - <2.3 vdc (after sea level ambient press 14 psia has been vented)		
		If >2.3 vdc, notify STDN		
		If ≈0.0 vdc, BAT VENT vlv - CLOSED, notify STDN		
		SYS TEST (2) - 5B		

BATTERY A (B, C) CHARGING

STA/T	STEP	PROCEDURE	PANEL	REMARKS
		5.3.6 FC Power Plant Purging		
DP	1	02 purging		Refer to purge information at beginning of 5.3. Purging is performed as determined by real time decision.
		FC IND sel - 1, 2, or 3	3	
		FC 1, 2, or 3 PURG - 02 (2 min)		
		FC 02 FLOW ind - flow incr ≈0.6 lb/hr		02 flow rate will increase ≈0.6 lb/hr. This may cause FC 02 FLOW indicator to exceed its normal limits and activate MASTER ALARM pb/lt (3) and FC 1 (2 or 3) light. Alarm limits may be checked by monitoring FC 02 FLOW indicator at the moment C/W light comes on.
				o If normal 02 flow is at lowest limits, purging 02 side of fuel cell will not cause MASTER ALARM pb/lt to come on.
		FC 1, 2, or 3 PURG - OFF		
	2	H2 purging		Refer to purge information at beginning of 5.3. Purging is performed as determined by real time decision.
		H2 PURG LINE HTR - on (up), 20 min prior to purge		
		FC IND sel - 1, 2, or 3		
		FC 1, 2, or 3 PURG - H2 (1 min, 20 sec)		
		FC H2 FLOW ind - flow incr & peg meter at upper limit of 0.2 lb/hr		H2 flow rate will increase ≈0.7 lb/hr. This will cause FC H2 FLOW indicator to exceed its normal limits, and activate MASTER ALARM pb/lt (3) and FC 1 (2 or 3) light.
ALL		MASTER ALARM pb/lt (3) - on	1,3,122	
		MASTER ALARM pb/lt - push		
		MASTER ALARM pb/lt (3) - out		
CP		FC 1, 2, or 3 lt - on (until norm flow restored)	2	
DP		FC 1, 2, or 3 PURG - OFF	3	
		After ≈10 min		
		H2 PURG LINE HTR - OFF		

STA/T	STEP	PROCEDURE	PANEL	REMARKS
		5.3.7 Fuel Cell Load Disconnect (Example using FC 2)		This procedure is presented with the following assumptions:
CP	a.	Prior to Disconnect Ensure that at least one FC is powering each main bus	3	Fuel cells 1 and 2 powering dc main bus A. Fuel cell 3 powering dc main bus B.
		FC disconnect		
		(1) Prime configuration		Requires load balancing.
DP		FC 2 MNA - OFF FC 2 MNB - OFF (verify)		Fuel cell 2 is now disconnected from both dc main buses.
		FC 2 MNA & B tb (2) - bp		Barber poles indicate fuel cell 2 is disconnected from main bus A and main bus B.
		FC 1 MNA tb - gray		Gray indicates fuel cell 1 is connected to main bus A.
		FC 1 MNB tb - bp		Barber pole indicates fuel cell 1 is disconnected from main bus B.
		FC 3 MNA tb - bp		Barber pole indicates fuel cell 3 is disconnected from main bus A.
		FC 3 MNB tb - gray		Gray indicates fuel cell 3 is connected to main bus B.
		(2) Secondary configuration		This configuration is assumed if load balancing cannot be obtained.
		FC 1 MNB - on (up) FC 3 MNA - on (up)		On position is momentary. On position is momentary.

FUEL CELL LOAD DISCONNECT

STA/T STEP	PROCEDURE	PANEL	REMARKS
ALL	MASTER ALARM pb/lt (3) - on	1,3,122	MASTER ALARM and FC BUS DISC lights are energized when fuel cell main bus switches pass through center position when placing fuel cells on main buses.
CP	FC BUS DISC lt - on (momentary)	2	
ALL	MASTER ALARM pb/lt - push, out	1,3,122	
CP	C/W lts (all) - out	2	
DP	FC 2 MNA - OFF	3	Fuel cell 2 disconnected from both dc main buses. Fuel cells 1 and 3 paralleled to both dc main buses.
	FC 2 MNB - OFF (verify)		
	FC 1 MNA & B tb (2) - gray		Gray indicates fuel cell 1 connected to main bus A and B.
	FC 3 MNA & B tb (2) - gray		Gray indicates fuel cell 3 connected to main bus A and B.
	FC 2 MNA & B tb (2) - bp		Barber poles indicate fuel cell 2 disconnected from main bus A and B.
	b. Return FC to Normal Configuration		
	FC to bus connection		
	FC 2 MNA - on (up)		On position is momentary.
ALL	MASTER ALARM pb/lt (3) - on	1,3,122	MASTER ALARM and FC BUS DISC lights are energized when fuel cell main bus switches pass through center position when placing fuel cells on main buses.
CP	FC BUS DISC lt - on (momentary)	2	
ALL	MASTER ALARM pb/lt - push, out	1,3,122	
CP	C/W lts (all) - out	2	

STA/T STEP	PROCEDURE	PANEL	REMARKS
DP	FC 1 MNB - OFF FC 3 MNA - OFF	3	Fuel cells returned to normal configuration (fuel cell 1 and 2 powering dc main bus A and fuel cell 3 powering dc main bus B).
	FC 2 MNA tb - gray FC 2 MNB tb - bp		Gray indicates fuel cell 2 connected to main bus A, barber pole indicates fuel cell 2 disconnected from main bus B.
	FC 1 MNA tb - gray		Gray indicates fuel cell 1 connected to main bus A.
	FC 1 MNB tb - bp		Barber pole indicates fuel cell 1 disconnected from main bus B.
	FC 3 MNA tb - bp		Barber pole indicates fuel cell 3 disconnected from main bus A.
	FC 3 MNB tb - gray		Gray indicates fuel cell 3 connected to main bus B.
	5.3.8 Inverter Changeover		Normal operation throughout mission will be with 2 inverters operating. During drifting flight, a single inverter is adequate to power both ac buses; however, two-inverter operation is assumed, providing maximum bus isolation.
	WARNING Ensure at least one inv on each ac bus at all times (if available).		If 3 inverters are switched onto one ac bus, loss of ac power to that bus will result.
DP	a. Dual Inv (No. 1 & 2) Oper AC2 RSET - OFF		This procedure is presented with the assumption that inverter 1 is powering ac bus 1 and 2.

STA/T	STEP	PROCEDURE	PANEL	REMARKS
DP		INV 2 - MNB	3	During dual inverter operation, inverter connected to dc main bus A should always power ac bus 1 and inverter connected to dc main bus B should always power ac bus 2, to preclude loss of all ac and dc power to SCS in event of single dc main bus failure.
		INV 1 AC2 - OFF		S-band phaselock will be lost upon switching inverters.
		INV 2 AC2 - on (up)		Inverter 1 now powering ac bus 1 and inverter 2 powering ac bus 2. Rapid performance of inverter switching sequence may initiate MASTER ALARM pb/lt when inverter is connected to bus.
		AC2 RSET - RSET		RSET position is momentary.
ALL		MASTER ALARM pb/lt (3) - on MASTER ALARM pb/lt - push MASTER ALARM pb/lt (3) - out	1,3,122	Placing AC1 or 2 RSET switch to RSET and releasing ensures a MASTER ALARM pb/lt - on. Placing AC1 or 2 RSET to center will cause random activation of MASTER ALARM pb/lt.
CP		C/W lts (all) - out	2	
DP		Perform AC Voltage Check, 5.3.4		
	b.	Single Inv Oper		This procedure is presented with the assumption that inverter 1 is powering ac bus 1 and inverter 2 is powering ac bus 2.
		AC2 RSET - OFF	3	
		INV 2 - OFF		
		INV 2 AC2 - OFF		S-band phaselock will be lost upon switching inverters.
		INV 1 AC2 - on (up)		Inverter 1 now powering ac bus 1 and ac bus 2. Rapid performance of inverter switching sequence may initiate MASTER ALARM pb/lt when inverter is connected to bus.

NORMAL/BACKUP

STA/T	STEP	PROCEDURE	PANEL	REMARKS
DP		AC2 RSET - RSET	3	RSET position is momentary.
ALL		MASTER ALARM pb/lt (3) - on MASTER ALARM pb/lt - push MASTER ALARM pb/lt (3) - out	1,3,122	Placing AC1 or 2 RSET switch to RSET and releasing ensures a MASTER ALARM pb/lt - on. Placing AC1 or 2 RSET to center will cause random activation of MASTER ALARM pb/lt.
CP		C/W lts (all) - out	2	
DP		Perform AC Voltage Check, 5.3.4		
	c.	Stby Inv (No. 3) Check or Oper		This procedure is presented with the assumption that inverter 1 is powering ac bus 1 and inverter 2 is powering ac bus 2.
		AC2 RSET - OFF INV 2 - OFF INV 3 - MNB	3	When switching inverter 3 from one main dc bus to the other, pause momentarily in OFF position.
		INV 2 AC2 - OFF		S-band phaselock will be lost upon switching inverters.
		INV 3 AC2 - on (up)		Rapid performance of inverter switching sequence may initiate MASTER ALARM pb/lt when inverter is connected to bus.
		AC2 RSET - RSET		RSET position is momentary.
ALL		MASTER ALARM pb/lt (3) - on MASTER ALARM pb/lt - push MASTER ALARM pb/lt (3) - out	1,3,122	Placing AC1 or 2 RSET switch to RSET and releasing ensures a MASTER ALARM pb/lt - on. Placing AC1 or 2 RSET to center will cause random activation of MASTER ALARM pb/lt.
CP		C/W lts (all) - out	2	

INVERTER CHANGEOVER

STA/T STEP	PROCEDURE	PANEL	REMARKS
DP	Perform AC Voltage Check, 5.3.4 If stby inv check Go to dual inv (No. 1 & 2) oper, 5.3.8a, & set INV 3 - OFF	3	Standby inverter (No. 3) check should be performed every 24 hours.
	5.3.9 H2 Manual Fan Operation CAUTION In the following step, if CRYO PRESS lt illuminates, do not set H2 FANS - OFF or proceed to next step until lt extinguishes. H2 FANS (all) - ON, then OFF sequentially for 1 min prior to and subsequent to crew rest periods.		Manual H2 fan operation should be used during flight to prevent possible cryo pressure control motor switch arcing, which may cause a-c inverter a-c bus disconnect.

NORMAL/BACKUP

5.4 ENVIRONMENTAL CONTROL SYSTEM

ECS systems management procedures are divided into two categories. The first category consists of five procedures, described in steps 1 through 5, that are conducted at specific time intervals.

1. An ECS monitoring check is recommended every hour from time the SC attains orbit until CSM separation. This check provides crew with latest status of the ECS.

2. A redundant component check is accomplished at 24-hour intervals to determine operational status of certain ECS redundant components and secondary water-glycol loop. The test will reveal any inoperative or malfunctioning components that might have been selected for use later in the mission. Several redundant components are not checked, however, because of excessive use of oxygen, a means of selection not incorporated, or lack of direct indication.

3. Replacement of one CO2-odor absorber filter is required on an alternate basis, at 12-hour intervals, for the ECS to remain within prescribed metabolic limit. Filters are also changed if CO2 partial pressure exceeds 7.6 mm Hg.

4. It is recommended that at 24-hour intervals the debris screen on suit circuit return valve be checked and cleaned as necessary.

5. It is recommended that chlorine and a buffer chemical be individually injected into potable water supply every 24 hours to maintain potability. There is a 10-ampoule supply of each chemical on the CM. Should a condition exist where either glycol evaporator is in use and waste water tank is empty, chlorine and buffer injections should be postponed.

The second category consists of procedures, described in steps 1 through 13, that are accomplished at random intervals or only as required.

1. PGA/shirtsleeve mode changes require certain precautions to be taken regarding suit power switch settings, communication functions and ECS adjustments. This applies whether the mode change is from PGA-to-shirtsleeve, shirtsleeve-to-PGA, or full PGA to partially suited mode.

STA/T STEP	PROCEDURE	PANEL	REMARKS
	10. Procedural data is provided for donning and doffing the emergency oxygen masks.		
	11. Data for servicing the gas separator cartridges is provided. Separator cartridges are used as a backup for normal system $H2/H2O$ separator.		
	12. The steps required to activate or deactivate the primary glycol evaporator are provided. Such action may be necessary to prevent navigation perturbations due to steam venting or for any other reason.		
	13. Procedures are provided for checking CM, cabin for leaks prior to rest periods and following completion of eating and overboard dumps.		
	5.4.1 <u>ECS Monitoring Check</u>		
CP	SUIT CAB ΔP ind - -1.0 to -3.5 in. H2O	2	
	O2 FLOW ind - 0.2-0.45 lb/hr		O2 flow may be as high as 1.0 lb/hr (pegged) prior to completion of cabin purge.
	CRYO PRESS IND sw - SRG		
	CRYO O2 PRESS 1/SRG ind - 865-935 psia		
	CRYO PRESS IND sw - 1		
	REPRESS O2 PRESS ind - >865 psia	602	
	ECS RAD tb - gray	2	Gray indicates No. 1 flow proportioning valve is controlling flow.
	xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx		
	If ECS RAD tb - 2 RAD FLOW CONT AUTO - 1 until tb gray (≈20 sec), then AUTO		Attempt resetting talkback before assuming radiator proportioning malfunction.
	If tb cannot be reset RAD FLOW CONT AUTO - 1		

STA/T STEP	PROCEDURE	PANEL	REMARKS
CP	RAD PRIM OUT TEMP ind - within correct range	2	Correct range indicates talkback malfunction only, with both proportioning systems and failure detection circuit operable.
	RAD FLOW CONT AUTO - AUTO RAD PRIM OUT TEMP ind - outside correct range		
	Refer to ECS Malfunction Procedure PRIM ECS RAD OUT TEMP HIGH, in the Flight Data File		
	xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx		
	ECS IND sel - PRIM RAD PRIM IN TEMP ind - 60°-90°F RAD PRIM OUT TEMP ind - -12° to +65°F PRIM GLY EVAP OUT TEMP ind - 38°-50.5°F (EVAP AUTO); 42°-67°F (EVAP OFF) PRIM GLY EVAP STM PRESS ind When boiling - 0.09-0.14 psia Not boiling - >0.14 psia PRIM GLY DISCH PRESS ind - 39-52 psig SUIT TEMP ind Without evap - 45°-70°F With evap - 45°-55°F CAB TEMP ind - 70°-80°F SUIT PRESS ind - =CAB PRESS ind CAB PRESS ind - 4.7-5.3 psia		Cabin pressure will be 5.6 to 6.2 psia after launch and continuously decrease until cabin pressure regulator activates and controls to 4.7 to 5.3 psia.

STA/T	STEP	PROCEDURE	PANEL	REMARKS
CP		CO2 PP ind - <7.6 mm Hg	2	
		SUIT COMPR ΔP ind - 0.3-0.4 psid		
		PRIM ACCUM QTY ind - 30-65%		
		If quantity <30%		
CP,DP		PRIM ACCUM FILL vlv - ON until 40-55% is reached	379,2	
CP		H2O QTY IND sw - POT	2	
		POT H2O QTY ind - 10-100%		
		H2O QTY IND sw - WASTE		
		WASTE H2O QTY ind - 15-90%		
	5.4.2	ECS Redundant Component Check		
	1	Suit compressor		
DP		SUIT COMPR (both) - redundant compr	4	
CP		SUIT COMPR ΔP ind - 0.3-0.4 psid	2	
	2	Suit demand regulators		
AC		DEMAND REG sel - 1	380	
		Close demand reg cabin bleed port with finger		Obstruct bleed flow only long enough to obtain momentary high flow.
CP		O2 FLOW ind - momentary incr	2	
AC		DEMAND REG sel - 2	380	
		Close demand reg cabin bleed port with finger		Obstruct bleed flow only long enough to obtain momentary high flow.
CP		O2 FLOW ind - momentary incr	2	
AC		DEMAND REG sel - BOTH	380	
	3	Main O2 regulators		
CP		MN REG B - close	351	
		EMER CAB PRESS sel - 1		
		EMER CAB PRESS TEST pb - push		Press-to-test pushbutton held only long enough to obtain momentary high flow.

STA/T	STEP	PROCEDURE	PANEL	REMARKS
CP		02 FLOW ind - pegged high MN REG B - OPEN MN REG A - close EMER CAB PRESS sel - 2 EMER CAB PRESS TEST pb - push	2 351	Press-to-test pushbutton held only long enough to obtain momentary high flow.
		02 FLOW ind - pegged high MN REG A - OPEN EMER CAB PRESS sel - BOTH (OFF if all crewmen suited)	2 351	
	4	H2O accumulators SUIT H2O ACCUM AUTO - redundant accum 02 FLOW ind - monitor for momentary (10 sec) incr	2	Allow up to 10 minutes for accumulator stroking.
	5	Urine dump nozzle heaters WASTE H2O DUMP - redundant heater URINE DUMP - redundant heater STDN reports no significant change in urine & water dump nozzle temperatures	101	Nozzle temperatures are telemetered only. Temperature decrease indicates heater failure; however, if nozzles are facing sun, decrease may not be immediate.
	6	Open coolant control atten panel		Covers panel 382. Opened to perform part of secondary glycol loop check.
		WARNING SUIT FLOW RELF vlv must remain OFF throughout mission or swelling of CO2 odor absorber filters may result.	382	

STA/T	STEP	PROCEDURE	PANEL	REMARKS
	7	Secondary glycol loop		Coldplates are not provided in secondary glycol loop for DRR and G&N. Usage time for noncoldplated items is as follows: DRR: 2 hours ON, 1 hour OFF. G&N: 1.9 hours ON, 9.2 hours OFF.
CP		GLY TO RAD SEC vlv - BYP	377	
		SEC EVAP H2O CONT - AUTO	382	
		ECS IND sel - SEC	2	
		SEC COOL PUMP - AC1		
		SEC GLY DISCH PRESS ind - 39-52 psig		
		SEC ACCUM QTY ind - 30-60%		
		SEC COOL EVAP - EVAP		
		SEC GLY EVAP STM PRESS ind		
		When boiling - 0.09-0.14 psia		
		Not boiling - 0.14 psia		
		After 5 min		
		SEC GLY EVAP OUT TEMP ind - 38°-50.5°F		
		SEC COOL PUMP - AC2		
		SEC GLY DISCH PRESS ind - 39-52 psig		
		SEC COOL EVAP - RSET for 58 sec min, then off (ctr)		RSET closes steam pressure control valve. Steam pressure valve requires 58 seconds from full open to full close.
		ECS IND sel - PRIM		
		SEC COOL PUMP - off (ctr)		
	8	Secondary radiator leak check		
		Monitor SEC ACCUM QTY ind		
		GLY TO RAD SEC vlv - NORM for 30 sec, then BYP	377	
		SEC ACCUM QTY ind - no change	2	

STA/T	STEP	PROCEDURE	PANEL	REMARKS
CP	9	Close coolant control atten panel		Covers panel 382.
	10	Primary glycol pumps		
DP		GLY PUMPS - redundant pump	4	Switch to pump opposite that on at beginning of test. This verifies primary loop pump operation.
CP		PRIM GLY DISCH PRESS ind - 39-52 psig PRIM ACCUM QTY ind - 30-65%	2	
	5.4.3	CO2 Absorber Filter Replacement		
		CAUTION Connect ground wire when removing or replacing filter from canister or stowage.		
		Obtain unused filter		

Filter No.	Stowage Container	Filter No.	Stowage Container
1	Canister A	11	D4 (DM)
2	Canister B	12	D4 (DM)
3	A4 (CM)	13	D4 (DM)
4	A4 (CM)	14	D4 (DM)
5	A4 (CM)	15	D4 (DM)
6	A4 (CM)	16	D4 (DM)
7	B6 (CM)	17	D4 (DM)
8	B6 (CM)	18	D4 (DM)
9	B6 (CM)	19	D4 (DM)
10	B6 (CM)	20	D4 (DM)
		21	D4 (DM)
		22	D4 (DM)

CO2 ABSORBER FILTER REPLACEMENT

STA/T	STEP	PROCEDURE	PANEL	REMARKS
CP		Open CO2 canister atten panel CO2 CSTR DIVERT vlv - up (or dn)	350	Handle placed up for canister B filter change, down for canister A filter change.
		CAUTION Apply pressure to latching handle to allow pressure interlock pin to withdraw, otherwise latching handle may not disengage.		
		Canister manual bleed vlv - press Cover latching handle - unlock Replace used filter Cover latching handle - lock CO2 CSTR DIVERT vlv - ctr Close CO2 canister atten panel Stow used filter Stow excess shims		For stowage, reference NASA-S-74-517.
	5.4.4	Debris Screen Check		Lint or other debris on screens may reduce flow substantially.
AC	a.	SUIT RETURN vlv screen Open coolant control atten panel	380	Covers panel 382 and SUIT RETURN valve screen.
		WARNING		
CP		SUIT FLOW RELF vlv must remain OFF throughout mission or swelling of CO2 odor absorber filters may result.	382	

NORMAL/BACKUP

STA/T	STEP	PROCEDURE	PANEL	REMARKS
		If debris is present		
AC		SUIT RETURN vlv - CLOSE PUSH	380	
CP		Clean screens		
AC		SUIT RETURN vlv - OPEN PULL		
CP		Close coolant control atten panel		
		b. Cabin ht exch inlet screen		
		CAB FAN (both) - OFF (verify)	2	
		Check cabin ht exch inlet screen		
		If debris present - clean screen		
		5.4.5 Potable Water Chlorination		Chlorine concentration must not exceed 6 ppm.
		CAUTION		
		If waste water quantity is approaching empty (read ≤15%) and either glycol evaporator is in operation, chlorination procedure will not be performed, as impairment of evaporator efficiency may result.		
	1	Check POT H2O QTY ind - if >90%, withdraw 8 oz of water		It is necessary to withdraw water to allow space for water flow into tank after chlorine and buffer injection.
ALL	2	Retrieve chlorination unit		For stowage, reference NASA-S-74-517.
	3	Remove chlorination port cap		

STA/T	STEP	PROCEDURE	PANEL	REMARKS
		xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx		
ALL		Chlor port leaking Use tools W & 3 Insert tool 3 only 1/4 inch into insert socket Tighten (CW) 1/4 turn with tools W & 3		Prevents torque set driver puncturing grommet.
		xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx		
CP	4	Attach needle assy to inject port	352	
	5	Insert chlorine ampoule into casing		Chlorine ampoules color-coded red.
	6	Connect knob assy & rotate (CW) until piston contacts ampoule firmly	352	
ALL	7	Install ampoule assy on needle assy (push and turn CW) CAUTION If potable water quantity is <50%, inject half the contents of each ampoule (chlorine and buffer) by rotating knob three turns (CW).		
	8	Rotate knob ≈3-1/2 turns (CW) until ampoule is empty (piston bottoms out)		Two turns for half empty if H20 quantity <50%.
	9	Disconnect ampoule assy from needle assy (push & turn CCW)		

STA/T	STEP	PROCEDURE	PANEL	REMARKS
ALL	10	Rotate knob (CCW), remove & stow used ampoule	352	Place used ampoule in chlorination unit stowage bag.
	11	Repeat steps 5 through 8 using buffer ampoule		Buffer ampoules color-coded brown.
	12	Wait 10 min, remove ampoule of H20 by slowly rotating injector barrel (CCW) three turns while holding bayonet section in locked position (CW).		
	13	Rotate knob (CCW), remove & stow used ampoule		
	14	Stow chlorination unit		
	15	Replace chlorination port cap		
		CAUTION Wait 30 min before withdrawing water for drinking or food preparation.		
	5.4.6	PGA Mode Changes		
		a. PGA to Shirtsleeve		Two flow paths exist for returning cabin atmosphere to suit circuit for scrubbing.
CP		CAB PRESS ind - >4.7 psia (verify)	2	
		EMER CAB PRESS sel - BOTH	351	
ALL		Doff and stow gloves & helmet		

STA/T	STEP	PROCEDURE	PANEL	REMARKS
		If suit return vlv is used		
AC		SUIT RETURN vlv - OPEN PULL	380	
ALL		Retrieve inflight coveralls		
		SUIT PWR - OFF	9,10,6	
		PWR - OFF		
		AUDIO CONT - NORM		
		WARNING		
		If comm umbilical is to be disconnected at bulkhead or control head, VHF AM sw on associated panel must be placed OFF & S BD MODE PCM sw must be in PCM or ctr.		
		Disconnect O2 & comm umbilicals at PGA & insert interconnect in O2 return hose		
		If suit return vlv is <u>not</u> used		
		Retrieve inflight coveralls		
		SUIT PWR - OFF		
		PWR - OFF		
		AUDIO CONT - NORM		
AC		DEMAND REG sel - OFF	380	Screens plus hose causes increased pressure drop in suit circuit causing O2 demand flow.
		WARNING		
		If comm umbilical is to be disconnected at bulkhead or control head, VHF AM sw on associated panel must be placed OFF & S BD MODE PCM sw must be in PCM or ctr.		

STA/T	STEP	PROCEDURE	PANEL	REMARKS
ALL		Disconnect O2 & comm umbilicals at PGA & install suit return hose screen cap		Suit donning and suit loop isolation requires additional time for repositioning suit flow valves (inaccessible from couches) in addition to normal suiting time.
CP		SUIT FLOW vlv - CAB FLOW (for unsuited crewmen)	300,301,302	Adjust suit flow valve between CAB FLOW and FULL FLOW to maintain adequate flow for suited crewman.
ALL		Disconnect UTCA, comm & biomed connectors Doff & stow UTCA & PGA Don inflight coveralls Retrieve & connect CWG adapter to comm & biomed connectors Audio panel sw (all) - as desired	9,10,6	Comm and biomed integrity should be verified.
	b.	Shirtsleeve to PGA SUIT PWR - OFF PWR - OFF AUDIO CONT - NORM WARNING If comm umbilical is to be disconnected at bulkhead or control head, VHF AM sw on associated panel must be placed OFF & S BD MODE PCM sw must be in PCM or ctr.		Two flow paths exist for returning cabin atmosphere to suit circuit for scrubbing.

STA/T	STEP	PROCEDURE	PANEL	REMARKS
ALL		Disconnect & stow CWG adapter Doff & stow inflight coveralls Retrieve & don UTCA & PGA, connecting UTCA, comm & biomed connectors		
		If suit return vlv is used Remove O2 umbilical interconnect & connect O2 & comm umbilicals to PGA		Connect blue to blue and red to red.
AC		SUIT RETURN vlv - CLOSE PUSH (if all suited)	380	
		If suit return vlv is not used Remove suit circuit return hose screen cap & connect O2 & comm umbilicals		Connect blue to blue and red to red. Suit donning and suit loop isolation requires additional time for repositioning suit flow valves (inaccessible from couches) in addition to normal suiting time.
		DEMAND REG sel - BOTH	380	
ALL		SUIT FLOW vlv - FULL FLOW (for suited crewman)	300,301,302	
		Audio panel sw (all) - as desired	9,10,6	Comm and biomed integrity should be verified.
		Retrieve & don helmet & gloves		
CP		EMER CAB PRESS sel - OFF (if all suited)	351	
	c.	PGA to Partial PGA		Two flow paths exist for returning cabin atmosphere to suit circuit for scrubbing.
		CAB PRESS ind - >4.7 psia (verify)	2	
		EMER CAB PRESS sel - BOTH		
ALL		Doff & stow gloves & helmet		

NORMAL BACKUP

STA/T	STEP	PROCEDURE	PANEL	REMARKS
		If suit return vlv is used		
AC		SUIT RETURN vlv - OPEN PULL	380	
ALL		Reverse 02 umbilical connections at PGA		02 umbilicals reversed for optimum flow distribution within PGA.
		Supply hose to outlet connector		
		Return hose to inlet connector		
		If suit return vlv is not used		
AC		DEMAND REG sel - OFF		Screens plus hose cause increased pressure drop in suit circuit causing 02 demand flow.
ALL		Disconnect return hose from PGA & install suit return hose screen cap		
		Connect supply hose to outlet connector		

5.4.7 Waste Management Procedures

WARNING

If germicide pouch is accidently ruptured, proceed as follows:

- Germicide on CM surface or hardware; wipe up with tissue.
- Germicide on crewman's skin; blot with tissue and flush with water.
- Germicide in crewman's eyes; irrigate with water from water gun or soaked tissue.

STA/T STEP	PROCEDURE	PANEL	REMARKS
	• Germicide ingested; take magnesium compound and/or high protein food - do not induce vomiting.		
	a. Urine Dump Modes		
ALL	(1) PGA urine collection (UCTA) bag		
	Connect urine line filter to urine trnfr hose		For stowage, reference NASA-S-74-517.
	Connect urine trnfr hose/ filter to urine/overboard QD		
	Remove cap from PGA thigh QD and stow		Temporary stowage.
	Connect urine trnfr hose T QD to thigh QD		
	OVBD DRAIN vlv - DUMP	251	
	When PGA bag (UCTA) empty, disconnect urine trnfr hose T QD at PGA thigh QD		
	Replace cap on PGA thigh QD		
	Connect adapter to urine trnfr hose (tethered to hose)		
	Connect UTS to urine trnfr hose/filter QD		
	UTS vlv - open		
	Purge until particles cease exhausting vent line (2 to 5 min), then OVBD DRAIN vlv - OFF		View urine expulsion from dump nozzle through left window No. 1.

STA/T STEP	PROCEDURE	PANEL	REMARKS
ALL	UTS vlv - close Disconnect UTS from urine trnfr hose and stow Disconnect urine trnfr hose from urine/overboard QD and stow	251	For stowage, reference NASA-S-74-517.
	(2) UTS (collection)		Used when inconvenient for simultaneous urination and overboard dumping.
	Obtain UTS and verify vlv closed Roll cuff - affixed UTS vlv - open Perform task		Six spare roll-on cuffs stowed in medical accessory kit, and one spare receiver assembly provided.
	UTS vlv - close Roll cuff - removed Free urine in cuff absorbed with tissue UTS - stow (temporary) When convenient, dump urine by UTS (dump) procedure		
	(3) UTS (dump) Connect urine line filter to urine trnfr hose (verify) Connect urine trnfr hose/ filter to urine/overboard QD Connect adapter to urine trnfr hose (tethered to hose)		

STA/T STEP	PROCEDURE	PANEL	REMARKS
ALL	Obtain UTS and verify vlv closed		For stowage, reference NASA-S-74-517.
	Attach UTS to urine trnfr hose/adapter QD		
	Perform UTS (collection) (if req), 5.4.7a (2)		
	OVBD DRAIN vlv - DUMP	251	
	When UTS bag empty, UTS vlv - open		
	Purge 2-5 min, then OVBD DRAIN vlv - OFF		
	UTS vlv - close		
	Disconnect UTS from urine trnfr hose/adapter and stow		
	Disconnect urine trnfr hose from urine/overboard QD and stow		
(4)	Urine Receptacle Assy (URA)		GFE assembly.
	Connect urine line filter to urine trnfr hose		
	Connect urine trnfr hose/filter to urine/overboard QD		
	Connect urine receptacle to urine trnfr hose		
	URA vlv - VENT		
	Remove receptacle cover		
	OVBD DRAIN vlv - DUMP		
	Perform task		Direct urine stream parallel to honeycomb to prevent splashback. Avoid accelerations to URA during use. Remove last drop by touching screen at top of URA.

NORMAL/BACKUP

STA/T STEP	PROCEDURE	PANEL	REMARKS
ALL	Flush screen & honeycomb with water gun (10 sec max)	251	
	Replace receptacle cover after liquid has cleared from URA		
	URA vlv - VENT (verify) and purge URA for 2-5 min		
	URA vlv - CLOSE (CW)		
	Stow URA for next use with urine trnfr hose conn & OVBD DRAIN vlv - DUMP (verify)		Allows URA to vacuum dry between uses.
	For stowage prior to entry OVBD DRAIN vlv - OFF		
	Remove & stow URA, urine trnfr hose & urine filter		For stowage, reference NASA-S-74-517.
b.	Defecation		
	Remove fecal collection assy from stowage		Assemblies stowed in compartment R-10.
	Obtain defecation collection device from assy		
	Remove germicide pouch		
	Insert germicide pouch (protective cover removed) into inner fecal bag		
	Remove protective covering from lip of inner fecal bag & place into TSB.		Lip of inner fecal bag covered with adhesive. TSB (temporary stowage bag).
	Affix inner fecal bag		
	Perform task		
	Seal inner fecal bag		Remove air prior to sealing.
	Rupture germicide pouch		
	Knead contents for 4 min		
	Insert into outer fecal bag		
	Only subsequent to initial odor detection will waste stowage container be vented prior to each waste deposit		

STA/T STEP	PROCEDURE	PANEL	REMARKS
	Connect UT hose/filter to urine/ feces QD		For stowage, reference NASA-S-74-517.
	Connect UT hose to vent QD on stowage container		
	WASTE STOW VENT vlv - VENT for 30 sec, then CLOSE	252	
	Stow fecal bag		Fecal matter stowed in waste stowage container.
	c. Emesis		
	Obtain fecal/emesis (F/E) bag		
	Perform task		
	Insert germicide pouch (protective cover removed) into inner F/E bag		
	Seal inner F/E bag		
	Rupture germicide pouch		
	Insert inner F/E bag into outer F/E bag & seal		
	Only subsequent to initial odor detection will waste stowage container be vented prior to each waste deposit		
	Connect UT hose/filter to urine/ feces QD		
	Connect UT hose to vent QD on stowage container		
	WASTE STOW VENT vlv - VENT for 30 sec, then CLOSE		
	Stow outer F/E bag		
	d. Side Hatch Urine/Water Dump		
CP	Remove dump nozzle conn cover and withdraw wires, wire guard, and heater conn from cover	Side hatch	Use tool E. Rotate cover as necessary to permit removal of electrical heater connector. Connector lock pins must be aligned with slots (3) in threaded portion of cover.

NORMAL/BACKUP

STA/T STEP	PROCEDURE	PANEL	REMARKS
CP	Remove plug and stow	Side hatch	Use tool E. For stowage, reference NASA-S-74-517.
	Install cable tether retaining ring over aux dump nozzle QD threads		
	Install male QD on dump nozzle (finger tight)		
	Connect cable to htr conn (if req)		The side hatch dump nozzle heater need not be connected (crew option). CM orientation and previous cold soak should be considered when electing not to connect heater. If nozzle freezes, connect and use heater to thaw nozzle.
	UTIL PWR - OFF (verify)	16	
	Connect cable to utility outlet		
	UTIL PWR - ON (up)		
	If urine overboard dump req		
	Connect urine dump hose to dump nozzle QD	Side hatch	Cabin to ambient ΔP will provide for urine flow.
	If waste H2O overboard dump req		
	WASTE TK SERV vlv - CLOSE (verify)	352	
	Remove conn cap on waste tank servicing conn		Use tool L.
	Install female QD on waste tank servicing conn		
	Connect urine dump hose tee-adapter to waste tank servicing conn QD and to dump nozzle QD		
DP	H2O QTY IND sw - WASTE	2	
CP	WASTE TK SERV vlv - OPEN until WASTE H2O QTY ind ≈15%, then CLOSE	352	

WASTE MANAGEMENT PROCEDURES

STA/T	STEP	PROCEDURE	PANEL	REMARKS
CP		If req to dump to 0% POT TK IN vlv - OPEN WASTE TK IN vlv - AUTO (verify)	352	A dump to zero could expose the suit heat exchanger to adverse pressure conditions if the POT TK IN vlv and the WASTE TK IN vlv are not configured properly.
		Disconnect urine dump hose tee-adapter from waste tank servicing conn QD		
		Disconnect tee-adapter from urine dump hose and purge (30 sec min)		The tee-adapter is tethered to the urine dump hose. This will provide overboard vent to purge urine dump hose.
		Disconnect urine dump hose from dump nozzle QD and stow	Side hatch	
		Reconnect tee-adapter		
		UTIL PWR - OFF (verify)	16	
		Disconnect heater cable from dump nozzle heater conn and to utility outlet (verify)	Side hatch	
		Remove dump nozzle QD and stow		
		Stow heater cable (verify)		
		Install plug and dump nozzle conn cover		Use tool E.
	e.	Water Collection		
		Conn urine trnfr hose-filter to urine/overboard QD	251	
		Conn cab purge QD to urine trnfr hose		
		OVBD DRAIN vlv - DUMP		
		Collect water		
		After collection is complete Purge until particles cease exhausting vent line (1 to 2 min)		
		OVBD DRAIN vlv - OFF		

NORMAL/BACKUP

STA/T	STEP	PROCEDURE	PANEL	REMARKS
		f. Vac Oper Using O2 Umb		
		CAUTION Not to be used for H2O collection. Ingestion of H2O will cause swelling of CO2 cstr element.		
AC		DEMAND REG sel - OFF	380	Screens plus hose cause increased pressure drop in suit circuit causing O2 demand flow.
		SUIT RETURN vlv - close (push)		
ALL		Install one interconnect to two return hoses		
		Use third return hose		
		SUIT FLOW vlv (3) - FULL FLOW	300,301,302	
		At completion of vac		
AC		SUIT RETURN vlv - open (pull)	380	
		DEMAND REG sel - BOTH		
ALL		SUIT FLOW vlv (3) - CAB FLOW	300,301,302	
DP		Remove interconnect & install screen cap on return hose		
	5.4.8	CM Repressurization		
		a. Normal Mode (time ≈30 min)		
AC		CAB PRESS RELF vlv (2) - NORM (safety latch on)	325	
CP		CAB PRESS DUMP vlv - close (CW) (verify)	Side hatch	
		CRYO PRESS IND sw - SRG	2	

STA/T	STEP	PROCEDURE	PANEL	REMARKS
AC		REPRESS PKG vlv - FILL	326	
		REPRESS O2 - OPEN	601	Guarded.
CP		CRYO O2 PRESS 1/SRG ind - 150 psia min	2	Minimum surge tank pressure.
AC		REPRESS PKG vlv - OFF	326	
CP		CAB PRESS ind - 3.0 psia (in 1 min)	2	
		REPRESS O2 PRESS ind - 0.0 psig	602	
AC		REPRESS O2 - CLOSE	601	Guarded.
CP		CAB REPRESS vlv - open (CW)	351	Maintain 150 psia minimum in surge tank.
		CAB PRESS ind - 4.7-5.3 psia	2	
		CRYO PRESS IND sw - 1		
		CAB REPRESS vlv - OFF (CCW)	351	
	b.	**Alternate Mode (time ≈52 min)**		
AC		CAB PRESS RELF vlv (2) - NORM (safety latch on)	325	
CP		CAB PRESS DUMP vlv - close (CW) (verify)	Side hatch	
		EMER CAB PRESS sel - BOTH	351	
		CAB REPRESS vlv - OPEN (CW)		
		CRYO PRESS IND sw - SRG	2	
		CRYO O2 PRESS 1/SRG - 150 psia min		Minimum surge tank pressure.
		EMER CAB PRESS sel - OFF	351	
		CAB REPRESS vlv - adjust to 150 psia min		
		CAB PRESS ind - 4.7-5.3 psia	2	
		CRYO PRESS IND sw - 1		
		CAB REPRESS vlv - OFF (CCW)	351	

NORMAL/BACKUP

STA/T	STEP	PROCEDURE	PANEL	REMARKS
	5.4.9	Pressure Suit Circuit & PGA Check at 5.0 Psia		
		Configure Suit Loop Crew members suited & umbilical connected SUIT FLOW vlv not used by crewman - OFF, or PGA 02 umbilical couplings installed		PGA 02 umbilical couplings (3) are plugged.
		a. Gross Suit Circuit Verification		This procedure may be used in lieu of step b, PGA Check Only, to ascertain complete suit loop integrity.
AC		DIRECT 02 vlv - close (CW)	7	
CP		SUIT PRESS ind - 4.7-5.3 psia 02 FLOW ind - 0.2-0.4 lb/hr	2	
		CAUTION • SUIT TEST vlv should remain IN PRESS position until suit circuit pressure is stabilized to preclude seal scarring. • If repositioning of SUIT TEST vlv from PRESS is required prior to suit pressure stabilization, perform the following:		
AC		a. DEMAND REG sel - OFF b. Allow 15 sec (min) stabilization time c. Reposition SUIT TEST vlv - DEPRESS or OFF as applicable d. When suit pressure stabilized, DEMAND REG sel - BOTH	380	

PRESSURE SUIT CIRCUIT & PGA CHECK AT 5.0 PSIA

STA/T	STEP	PROCEDURE	PANEL	REMARKS
AC		SUIT TEST vlv - PRESS	380	All crewmen exercise PGA joints during pressurization period. DIRECT 02 valve may be slightly opened to reduce suit loop pressurization time, but must be fully closed (CW) at 4.0 psig suit pressure.
CP		02 FLOW ind - 1.0 lb/hr (pegged)	2	
		02 FLOW HI lt - on		After 16-second delay.
ALL		MASTER ALARM pb/lt (3) - on, push	1,3,122	
AC		Cycle SUIT RETURN vlv - OPEN	380	Continue suit circuit pressurization until 02 flow starts to decrease.
		PULL & CLOSE PUSH when SUIT PRESS ind - 1.5-2.0 psia >cabin press	2	
CP		SUIT PRESS ind - 8.8-9.8 psia		Crewmen remain inactive while monitoring suit circuit pressure and 02 flow indicator to preclude fluctuations in 02 flow. Monitoring should not be scheduled during H20 accumulator stroking (or 30 seconds thereafter), or accumulators should be temporarily disabled during test (SUIT H20 ACCUM AUTO - ctr, then back to previous position).
ALL		PGA press ind (3) - 4.1-4.5 psig	PGA	
CP		02 FLOW HI lt - out	2	
		02 FLOW ind - stabilize for 15 sec, & remain <0.8 lb/hr for 30 sec after stabilization		
AC		SUIT TEST vlv - DEPRESS	380	
CP		02 FLOW ind - 0.2-0.4 lb/hr	2	
		SUIT PRESS ind - slightly >CAB PRESS ind		In ≈75 seconds.
AC		SUIT TEST vlv - OFF	380	
		DEMAND REG sel - BOTH (verify)		

5.4.9 PRESSURE SUIT CIRCUIT & PGA CHECK AT 5.0 PSIA

NORMAL/BACKUP

STA/T	STEP	PROCEDURE	PANEL	REMARKS
		b. PGA Check Only		This procedure performed only if individual or collective PGA verification required.
AC CP		DIRECT O2 vlv - close (CW) SUIT PRESS ind - 4.7-5.3 psia O2 FLOW ind - 0.2-0.4 lb/hr	7 2	
		CAUTION SUIT TEST vlv should remain in PRESS position until suit circuit pressure is stabilized to preclude seal scarring.		
AC		SUIT TEST vlv - PRESS	380	All crewmen exercise PGA joints during pressurization period. DIRECT O2 valve may be slightly opened to reduce suit loop pressurization time, but must be fully closed (CW) at 4.0 psig suit pressure.
CP		O2 FLOW ind - 1.0 lb/hr (pegged) O2 FLOW HI lt - on	2	
ALL		MASTER ALARM pb/lt (3) - on, push	1,3,122	
CP		SUIT PRESS ind - 8.8-9.8 psia	2	After ≈75 seconds.
ALL		PGA press ind (3) - 4.1-4.5 psig	PGA	
		WARNING Suit flow vlv(s) may remain in OFF position for no longer than one min or asphyxiation may result.		

PRESSURE SUIT CIRCUIT & PGA CHECK AT 5.0 PSIA

STA/T	STEP	PROCEDURE	PANEL	REMARKS
		CAUTION If all suit flow vlvs are closed simultaneously, the suit compressors must be shut off to prevent compressor damage because of deadheading of suit loop.		
CP		SUIT FLOW vlv (suited crewmen) - OFF	300,301,302	
		PGA press ind (suited crewmen) - PGA <0.5 psi/min pressure decay		Crewmen hold breath and remain inactive while monitoring PGA pressure decay to preclude pressure drop or fluctuation on PGA pressure indicators.
		SUIT FLOW vlv (suited crewmen) - FULL FLOW	300,301,302	
		CAUTION If repositioning of SUIT TEST vlv from PRESS is required prior to suit pressure stabilization, perform the following:		
AC	a.	DEMAND REG sel - OFF	380	
	b.	Allow 15 sec (min) stabilization time		
	c.	Reposition SUIT TEST vlv - DEPRESS or OFF as applicable		
	d.	When suit pressure stabilized, DEMAND REG sel - BOTH		

NORMAL/BACKUP

STA/T	STEP	PROCEDURE	PANEL	REMARKS
AC		SUIT TEST vlv - DEPRESS	380	
CP		02 FLOW HI lt - out	2	
		02 FLOW ind - 0.2-0.4 lb/hr		
		SUIT PRESS ind - slightly >CAB PRESS ind		In ≈75 seconds.
AC		SUIT TEST vlv - OFF	380	
	5.4.10	CM 02 Supply Refill		
CP		CRYO PRESS IND sw - SRG	2	
		CRYO 02 PRESS 1/SRG ind - ≥400 psia		After cabin repressurization, 400 psia is minimum surge tank pressure that will assure an 02 system equilibrium pressure >150 psia at initiation of refill operation.
		CAB REPRESS vlv - OFF (CCW)	351	
AC		REPRESS 02 - CLOSE	601	Guarded.
		REPRESS PKG vlv - FILL	326	
CP		CRYO 02 PRESS 1/SRG ind - 865-935 psia	2	Monitor pressure to ensure no decrease below 150 psia.
		CRYO PRESS IND sw - 1		Upon completing refill operation.
AC		REPRESS PKG vlv - OFF	326	
	5.4.11	CM Pressure Dump		
	a.	Using Cab Press Relf Vlv		
CP		CAB FANS - OFF (verify)	2	
AC		DIRECT 02 vlv - close (CW)	7	
		rh CAB PRESS RELF vlv - DUMP (safety latch off)	325	Valve in DUMP position long enough for cabin pressure to decrease to ≈3.25 psia. 02 FLOW HI light may come on prior to cabin pressure regulator lockup.
CP		CAB PRESS ind - 3.0-3.25 psia	2	
AC		rh CAB PRESS RELF vlv - BOOST/ENTR	325	
CP		02 FLOW ind - ≈0.24 lb/hr	2	Verifies cabin pressure regulator lockout.

STA/T	STEP	PROCEDURE	PANEL	REMARKS
AC		SUIT PRESS ind - 3.5-4.0 psia	2	Verifies suit demand pressure regulator aneroid function.
AC		rh CAB PRESS RELF vlv - DUMP	325	
CP		CAB PRESS ind - 0.0 psia (within 6 min)	2	Cabin at 0.01 psia within 4.5 minutes.
AC		CAB PRESS RELF vlv (2) - NORM (safety latch on)	325	
	b.	Using Side Hatch Cab Press Dump Vlv		
DP		CAB FANS - OFF (verify)	2	
CP		EMER CAB PRESS sel - OFF	351	
AC		REPRESS PKG vlv - OFF	326	
		If lone crewman oper REPRESS PKG vlv - FILL		REPRESS PKG valve should be in FILL position for lone crewman activities, as leaving valve in OFF reduces immediate repressurization capability to ≈1.8 psia, less than amount required to sustain life if suit ruptures.
DP		REPRESS O2 vlv - CLOSE	601	
AC		CAB PRESS RELF vlv (2) - NORM (safety latch on)	325	
		DIRECT O2 vlv - close (CW) (verify)	7	
DP		CAB PRESS DUMP vlv - open (CCW - one turn)	Side hatch	Valve in open position long enough for cabin pressure to decrease to ≈3.25 psia. O2 FLOW HI light may come on prior to cabin pressure regulator lockup.
		CAB PRESS ind - 3.0-3.25 psia	2	
		CAB PRESS DUMP vlv - close (CW)	Side hatch	
		O2 FLOW ind - <0.5 lb/hr	2	Verifies cabin pressure regulator lockout and that EMER CAB PRESS selector is OFF.

STA/T	STEP	PROCEDURE	PANEL	REMARKS
DP		SUIT PRESS ind - 3.5-4.0 psia	2	Verifies suit demand pressure regulator aneroid function.
		CAB PRESS DUMP vlv - open (CCW)	Side hatch	Full open.
		CAB PRESS ind - ≈0 psia	2	
		CAB PRESS DUMP vlv - close (CW)	Side hatch	
	5.4.12	Suit Circuit Purge of H2		
AC		DIRECT O2 vlv - OPEN (CCW) for 1 min	7	Suit circuit pressure relief valve dumps hydrogen into cabin.
CP		O2 FLOW ind - 1.0 lb/hr (pegged)	2	
		O2 FLOW HI lt - on		After 16-second time delay.
ALL		MASTER ALARM pb/lt (3) - on, push	1,3,122	
AC		DIRECT O2 vlv - close (CW)	7	
CP		O2 FLOW HI lt - out	2	
		O2 FLOW ind - 0.2 lb/hr (pegged)		
	5.4.13	Cabin Cold-Soak Operation		Secondary glycol loop placed in evaporative cooling mode.
	a.	Activate Cold Soak		
CP		Open cool control atten pnl		Covers panel 382.
		WARNING		
		SUIT FLOW RELF vlv must remain OFF throughout mission or swelling of CO2 odor absorber filters may result.	382	

STA/T	STEP	PROCEDURE	PANEL	REMARKS
CP		SUIT HT EXCH SEC GLY - BYPASS	382	
		SEC EVAP H2O CONT vlv - AUTO		
		Close cool control atten pnl		
DP		CAB TEMP - MAN (verify)	2	
CP		PRIM CAB TEMP vlv - COLD (CW)	303	Maximum cold position.
		SEC CAB TEMP vlv - MAX COOL (CW)		
DP		ECS IND sel - SEC	2	
		SEC COOL PUMP - AC2		
		SEC GLY DISCH PRESS ind - 39-52 psig		After initiating cold-soak operation, periodic ECS monitoring check should include readings from the following secondary loop indicators: SEC GLY EVAP OUT TEMP, SEC GLY EVAP STM PRESS, SEC GLY DISCH PRESS, and SEC ACCUM QTY.
		SEC ACCUM QTY ind - 30-60%		
		SEC COOL EVAP - EVAP		
		SEC GLY EVAP OUT TEMP ind - 38°-50.5°F		
		SEC GLY EVAP STM PRESS ind		
		When boiling - 0.09-0.14 psia		
		Not boiling - >0.14 psia		
		ECS IND sel - PRIM		
		RAD PRIM OUT TEMP ind - >-20°F		
		If <-20°F		Cold soak operation is stopped until RAD PRIM OUT TEMP indicator - >0°F.
		SEC COOL EVAP - RSET for 58 sec min, then off (ctr)		
		SEC COOL PUMP - off (ctr)		
	b.	Deactivate Cold Soak		
CP		PRIM CAB TEMP vlv - COLD (CW)	303	
DP		(Deleted)	2	
		SEC COOL EVAP - RSET for 58 sec min, then off (ctr)		RSET closes steam pressure control valve. Steam pressure valve requires 58 seconds from full open to full close.

NORMAL/BACKUP

STA/T	STEP	PROCEDURE	PANEL	REMARKS
DP CP		SEC COOL PUMP - off (ctr) Open cool control atten pnl	2	
		WARNING		
		SUIT FLOW RELF vlv must remain OFF throughout mission or swelling of CO2 odor absorber filters may result.	382	
		SEC EVAP H2O CONT vlv - OFF Close cool control atten pnl		Valve should be left at AUTO for cold soak deactivation prior to entry.
	5.4.14	Operation of Emergency O2 Masks		
		EMER O2 - OPEN	600	Masks stowed on aft bulkhead aft of emergency O2 unit.
ALL		Don emer O2 masks	AESB	Push mask pushbutton for continuous flow, otherwise mask is demand flow.
		Doff emer O2 masks		
CP		EMER O2 - CLOSE	600	
	5.4.15	Waste Water Tank Drain		
		BAT VENT vlv - CLOSE	252	
		H2O QTY IND sw - WASTE	2	
		PRESS RELF sel - DUMP A	352	
		Monitor WASTE H2O QTY ind - decr (5% per min) WASTE H2O QTY ind - ≈15%	2	

WASTE WATER TANK DRAIN

STA/T	STEP	PROCEDURE	PANEL	REMARKS
CP		If req to dump to 0%	2	A dump to zero could expose the suit heat exchanger to adverse pressure conditions if the WASTE TK IN vlv is not configured properly.
		POT TK IN vlv - OPEN (verify) WASTE TK IN vlv - AUTO (verify)	352	
		PRESS RELF sel - 2 BAT VENT vlv - VENT	252	
	5.4.16	Gas Separator Cartridge Servicing		
	a.	Remove separator cartridges from stowage		
	b.	Attach separator to water pistol		Female port of separator will fit on water pistol probe.
	c.	Trigger water pistol in short pulses until water is observed at separator outlet port		
	d.	Wait 10 min		Allow 10 minutes for membrane wetting.
		CAUTION Membrane can be damaged by pencils, screwdrivers, & other pointed objects.		
	e.	Use separator on water pistol or food prep unit as req		

NORMAL/BACKUP

STA/T	STEP	PROCEDURE	PANEL	REMARKS
		5.4.17 Primary Glycol Evaporator Operation		
	1	Activate prim evap		
AC		GLY EVAP H2O FLOW - AUTO	2	
		GLY EVAP STM AUTO - AUTO		
	2	Deactivate prim evap		
		GLY EVAP H2O FLOW - off (ctr)		
		GLY EVAP STM AUTO - MAN		
		GLY EVAP STM INCR - INCR for 58 sec		INCR position is momentary. Steam pressure valve requires 58 seconds from full open to full close.
		5.4.18 Cabin Leak Check		Procedure to be performed just prior to each rest period following completion of eating and overboard dumps.
CP	1	OVBD DRAIN vlv - OFF	251	
		WASTE STOW VENT vlv - CLOSE (verify)	252	
AC		CAB PRESS RELF vlv (2) - NORM (verify)	325	
		PRESS EQUAL vlv - CLOSE (verify)	Fwd hatch	
		TUNL VENT vlv - DM/CM ΔP (verify)	12	
	2	DIRECT O2 vlv - OPEN (CCW) until CAB PRESS ind - 5.7 psia	7	
	3	DIRECT O2 vlv - CLOSE (CW)		Cabin pressure decay data will be monitored by ground crew.

CABIN LEAK CHECK

STA/T	STEP	PROCEDURE	PANEL	REMARKS
	5.4.19	USBE Suit Hose Utilization		
		Installation		
AC		rh SUIT FLOW - FULL FLOW (verify)	300	Use right hand crewmens suit hoses.
		Remove suit return hose screen cap and stow		For stowage, reference NASA-S-74-517.
		Install supply and return hoses to attach brackets	USBE	The bracket blocks return flow to the suit circuit. USBE has only one attach bracket.
		Fasten retention strap		
		Removal		
		Remove retention strap		
		Disconnect supply and return hoses from attach brackets		
		Install suit return hose screen cap		
	5.4.20	VTR Suit Hose Utilization		
		Installation		
		lh SUIT FLOW - FULL FLOW (verify)	301	Use LH crewmen umbilical and/or center crewmen's umbilical.

NORMAL/BACKUP

STA/T STEP	PROCEDURE	PANEL	REMARKS
	(Deleted)		
AC	Connect supply hose to ctr fitting on VTR with restraint strap		Center fitting is the normal use position. Use side fitting also when additional cooling is required. Suit return hose screens remain on return hoses. For stowage of restraint strap, reference NASA-S-74-517.
	Removal		
	Remove restraint strap and disconnect suit hose from VTR fitting		
	(Deleted)		

VTR SUIT HOSE UTILIZATION

STA/T STEP	PROCEDURE	PANEL	REMARKS

5.5 CAUTION AND WARNING SYSTEM

CAUTION

Any or all of the system status lights should not be left illuminated for more than 10 minutes or overheating of the matrix will occur.

System management procedures for the C&WS consist of the following:

1. A procedure is provided for an operational test of the detection unit, system status lights, and MASTER ALARM pb/lt and tone. The test may be conducted at any time during the mission at discretion of crew.

2. An adjustment may be made at each orbital sunset to facilitate dark adaptation during period of orbital darkness.

3. Acknowledgement of system status light illumination and resetting of master alarm circuit is required. The procedures apply during prelaunch or any flight phase of the mission.

4. A procedure is provided for inhibiting master alarm tone in each headset, at discretion of the crew.

5. If one or more of the C&WS status lights are illuminated for more than 10 minutes, the status light matrix will become hot to the touch. The Acknowledge Mode may be used to prevent excessive on-time of status lights.

6. During normal operations some C/W master alarms may illuminate. These alarms are listed, accompanied by information on what action should be taken to return C/W system to normal.

STA/T	STEP	PROCEDURE	PANEL	REMARKS
		5.5.1 C&WS Operational Check		
CP		C/W LAMP TEST - 1 (hold)	2	Position 1 is momentary. Lamp test of MASTER ALARM light on panel 122 accomplished when G&N condition lights on that panel tested. Master alarm tone not activated by this test.
AC		MASTER ALARM pb/lt - on	1	
CP		lh C/W lts (16) - on	2	
		C/W LAMP TEST - 2 (hold)		Position 2 is momentary.
AC		MASTER ALARM pb/lt - out	1	
CP		lh C/W lts (16) - out	2	
DP		MASTER ALARM pb/lt - on	3	
CP		rh C/W lts (20) - on	2	
		C/W LAMP TEST - rel		
DP		MASTER ALARM pb/lt - out	3	
CP		rh C/W lts (20) - out	2	
		C/W CSM - CM		Master alarm tone activated by this test.
		CM RCS lt (both) - on		Systems 1 and 2 status lights.
ALL		MASTER ALARM pb/lt (3) & tone - on	1,3,122	MASTER ALARM light on MDC-1 will not come on if C/W NORM switch is in BOOST position. Limit the ON time to 5 minutes continuous, with 5 minutes minimum OFF between ON periods.
		MASTER ALARM pb/lt - push		
		MASTER ALARM pb/lt (3) & tone - out		
CP		C/W CSM - CSM	2	
		CM RCS lt (both) - out		
		5.5.2 Dark Adaptation Adjustment		
		C/W NORM - ACK (at sunset)		
		C/W NORM - NORM (at sunrise)		

STA/T	STEP	PROCEDURE	PANEL	REMARKS
	5.5.3	Acknowledge/Reset Master Alarm Indication		
		a. Norm Mode		
ALL		MASTER ALARM pb/lt (3) & tone - on	1,3,122	
		MASTER ALARM pb/lt (3) - push		All MASTER ALARM lights have reset capability. Pushing any light will reset alarm circuit unless C/W NORM switch in BOOST position. In this case, there is no reset capability with MASTER ALARM light on MDC-1.
		MASTER ALARM pb/lt (3) & tone - out		
CP		Applicable C/W lt - remains on	2	C/W light remains on until malfunction corrected.
		b. Acknowledge Mode (C/W NORM in ACK)		
ALL		MASTER ALARM pb/lt (3) & tone - on	1,3,122	
AC,DP		MASTER ALARM pb/lt (2) - push & hold	1,3	MASTER ALARM light on panel 122 does not have acknowledge capability.
ALL		MASTER ALARM pb/lt (3) & tone - out	1,3,122	
CP		Applicable C/W lt - on, for malfunction indication	2	
AC,DP		MASTER ALARM pb/lt (2) - rel	1,3	
CP		Applicable C/W lt - out	2	Light may be recalled by again holding MASTER ALARM light on MDC-1 or MDC-3.
	5.5.4	Master Alarm Tone Headset Control		
		a. Inhibit Tone		
ALL		PWR (3) - AUDIO	9,10,6	Inhibit function may be selected individually or in any combination.
		b. Permit Tone		
		PWR (3) - AUDIO/TONE		

NORMAL/BACKUP

STA/T STEP	PROCEDURE	PANEL	REMARKS

5.5.5 Normal Operation C/W Master Alarms

The following list denotes those C/W lamps which may illuminate during normal operation. In all cases except SM C/W lights at CM/SM separation, push MASTER ALARM pb/lt to clear MASTER ALARM before proceeding to corrective action. For trigger limits refer to ASTP Operational Data Book (MSC-07765, Vol 1).

C/W Lamp (MDC-2)	Remarks	Corrective Action
FC BUS DISC	Occurs momentarily when connecting fuel cell to bus.	None
SM RCS A, B, C, & D SPS PRESS	Occurs at CM separation from SM because C/W CSM switch at CSM position.	C/W CSM - CM; MASTER ALARM pb/lt - push
SM RCS A, B, C, & D	High temperature may illuminate light during (1) boost heating, (2) ΔVs using SM RCS extensively with SIVB attached, or (3) transposition and docking using SM RCS extensively. During phase (1), MASTER ALARM on panel 1 inactive. During phases (2) or (3), normal operating ranges on indicators should be utilized.	None
O2 FLOW HI	Occurs (1) during cabin purge, and (2) if urine dump valve left open. May occur during urine dump.	Open cb ECS PRESS XDUCER 2 MNB (MDC-5).
CRYO PRESS	Limits may shift under flight conditions and cause low-limit warning during sleep periods.	Reference 5.3.1 & 5.3.9
FC 1, 2, & 3	Will occur during an H2 purge, may occur during an O2 purge.	None
BMAG 1 & 2	Occurs during power up.	BMAG PWR switch(es) should be left in WARMUP until light extinguished.

NORMAL OPERATION C/W MASTER ALARMS

STA/T STEP	PROCEDURE	PANEL	REMARKS

5.6 TELECOMMUNICATIONS

The T/C system will be in operation throughout entire mission. The information and procedures included here consist of normal and backup procedures that will be utilized to accomplish mission requirements and satisfy test objectives. Some of these procedures will only be required during tests or contingencies.

Most orbital paths will involve passage over several STDN ground stations within acceptable slant ranges for S-band voice and data communications. Equipment necessary for voice communications, PCM, and TLM transmission will be activated and operating at all times. The UDL will also remain activated and capable of receiving up-data when required.

Each orbital path will allow contact with the ATS-F relay satellite for approximately one half of the orbit time. CSM attitudes which do not allow high gain antenna acquisition of the satellite and use of the satellite for other purpose will not allow CSM data to be relayed through the satellite.

Action required of crew for voice communications and transmission of real-time PCM TLM will be to ensure optimum radiation and reception of RF signals, either by maintaining SC attitude such that selected antenna is directed toward STDN station or by changing antennas or antenna attitude with S-band antenna controls. Also, audio control panels (MDC-6, -9, and -10) must be set up in accordance with requirements of individual crewman for control of voice transmission and reception.

The reception of up-data for updating the CTE and receiving real-time commands (RTCs) will require no action on part of crew since the UDL will normally remain activated and will utilize the same antenna as that used for S-band voice and data operations. For updating command module computer, however, up-telemetry switches (panels 2 and 122) must be set to ACPT position.

The following procedures are presented with the assumption that appropriate electrical buses are powered and that proper circuit breakers are closed.

NORMAL/BACKUP

STA/T	STEP	PROCEDURE	PANEL	REMARKS
		5.6.1 Basic Switch Configuration		
DP	1	Apply A-C power		
		TELCOM GRP 1 - AC1	4	
		TELCOM GRP 2 - AC2		
ALL	2	Audio panel (3)		Each crewman's individual audio panel must be activated to enable him to receive or transmit voice signals. T/R position enables voice transmission and reception over selected audio channel. RCV position permits reception only.
		MODE (3) - INTERCOM/PTT	9,10,6	
		S BD (3) - T/R		
		S BD VOL tw (3) - as req		
		SUIT PWR (3) - OFF		
		AUDIO CONT (3) - NORM		
		PWR (3) - AUDIO/TONE		
		MASTER VOL tw (3) - as req		
		VHF AM (3) - T/R		
		VHF AM VOL tw (3) - as req		
		INTERCOM (2) - T/R	9,10	
		INTERCOM VOL tw - as req		
		CM/RMTE INTERCOM - T/R	6	Intercomm between CM, DM, and Soyuz.
		CM/RMTE INTERCOM VOL tw - as req		
		VHF FM/PAD COMM (3) - T/R	9,10,6	
		VHF FM/PAD COMM VOL tw (3) - as req		
AC		VHF RNG - NORM	9	
		PHONE/MIC CONNECT - OFF	10	
CP	3	Speaker/Icom Box		
		XMIT/ICOM - off (ctr)	98	XMIT and I'COM positions are momentary.
		POWER - ON		
		VOL tw - as req		
		SPKR/HEADSET - SPEAKER		

BASIC SWITCH CONFIGURATION

STA/T	STEP	PROCEDURE	PANEL	REMARKS
DP	4	S band norm		
		S BD XPNDR - PRIM	3	Whenever S BD XPNDR switch is positioned from PRIM to SEC or from SEC to PRIM, hesitate momentarily in OFF position to allow relay actuation to follow switch action. S-band phaselock will be lost upon switching to alternate transponder. Phaselock must be re-established.
		S BD PWR AMPL PRIM - PRIM		
		S BD PWR AMPL HI - HI		
		S BD MODE VOICE - VOICE		
		S BD MODE PCM - PCM		
		S BD MODE RNG - RNG		
	5	S band aux		
		S BD AUX TAPE - ctr		
		S BD AUX TV - ctr		
	6	Up TLM		
		UP TLM DATA - DATA		
		UP TLM CMD - NORM		
		PWR AMPL tb - gray		Gray indicates power applied to S-band power amplifier.
	7	S Band antenna		
		OMNI ANT - A		
		S BD ANT OMNI A - A		
		S BD ANT - A/C		
		OMNI SEL - UP TLM	230	Ground has command control over all four S-band omni-antennas.

NORMAL/BACKUP

STA/T	STEP	PROCEDURE	PANEL	REMARKS
DP	8	VHF AM		
		VHF AM A - SIMPLEX	3	
		VHF AM B - off (ctr)		
		VHF AM RCV - off (ctr)		
		VHF AM SQLCH tw (2) - noise +1		In event marginal VHF voice communications experienced and VHF voice communication required, VHF receiver squelch may be disabled by setting appropriate thumbwheel to 1. This will allow weak-signal reception, but will severely degrade DRR recorded voice.
	9	VHF BCN - OFF		
		VHF RNG - OFF		
	10	Tape recorder		
		TAPE RCDR PCM - PCM/ANLG		
		TAPE RCDR RCD - RCD		
		TAPE RCDR FWD - FWD		
		TAPE MOTION tb - gray		Gray indicates tape in motion.
		TRDC - ON	230	TRDC (tape recorder data conditioner).
	11	Power		
		SCE PWR - NORM	3	
		PMP PWR - NORM		
	12	TLM inputs		
		PCM BIT RATE - LO		
	13	VHF ANT - SM LEFT		
	14	S BD SQLCH - ENBL		

BASIC SWITCH CONFIGURATION

STA/T	STEP	PROCEDURE	PANEL	REMARKS
	15	CM TV Power up Prep		
CP		CM/DM CAMR POWER - OFF	181	
		TV AMPL - BYPASS		
		TV STATION SEL CM/REMOTE - UP TLM		
		TV STATION SEL CM1/CM2 - UP TLM		
		CM 1 TV STATION POWER - OFF		
		CM 2 TV STATION POWER - OFF		
		TV MONITOR POWER - OFF		
	16	ATS-F Power up		
DP		ATSF PWR AMPL - 1	230	
		ATSF XPNDR - PRIM		
		HGA SCAN - NORMAL (when undocked from Soyuz)		Guarded.
		HGA SCAN - INHIBIT (when docked with Soyuz)		Guarded.
		HGA POWER - on (up)		
		HGA SERVO ELECT - PRIM		
		HGA BEAM - NARROW		
		HGA TRACK - AUTO		
		HGA PITCH cont - as req		
		HGA YAW cont - as req		
		UP TLM - up tlm (ctr)		
		PCM RELAY - ON		
		RLY MODE CONT - UP TLM		
		RLY MODE TV CONT - UP TLM		
		RLY MODE DATA PCM CONT - UP TLM		
		RLY MODE DATA RT/PB CONT - UP TLM		
		PWR AMPL CONT - UP TLM		
		ATSP RELAY SQUELCH - ON		

STA/T	STEP	PROCEDURE	PANEL	REMARKS
	17	VTR Power up		
CP		TLM POWER - ON	400	
		INTRLVR POWER - ON		
		VTR POWER - ON		
		HD WHL DR MOT - ctr		
		MOTOR ON lt - out		
		TAPE MODE - ctr		
		RECORD lt - out		
		PLAYBACK lt - out		
		TAPE DRIVE - ctr		
		TAPE HD CLEAN - NORMAL		
		CLEAN HD lt - out		
		LAMP TEST - STATUS		
	18	DM & Soyuz TV Power up Prep		
		DM 1 TV STATION POWER - OFF	808	
		DM 2 TV STATION POWER - OFF		
		CAMR SYNC - CM/DM		
		TV STATION SEL DM/SOYUZ - UP TLM		
		TV STATION SEL DM1/DM2 - UP TLM		
		(Deleted)		
	5.6.2	VHF/AM Modes		Basic switch configuration provides CSM-STDN voice and CM-recovery voice.
		Simplex A		
		Select Basic, 5.6.1		
		Duplex A		Should not be used until after CSM/SIVB separation as STDN transmission on VHF AM B will interfere with booster TM.
		Select Basic, except		
		VHF AM A - DUPLEX		
		Simplex B		CM-recovery backup voice. Should not be used until after CSM/SIVB separation as STDN transmission on VHF AM B will interfere with booster TM.
		Select Basic, except		
		VHF AM B - SIMPLEX		
		VHF AM A - off (ctr)		

STA/T	STEP	PROCEDURE	PANEL	REMARKS
DP		**Duplex B**		
		Select Basic, 5.6.1, except	3	
		VHF AM B - DUPLEX		
		VHF AM A - off (ctr)		
		RCV ONLY A		
		Select Basic except		Provides capability to monitor recovery VHF voice transmissions.
		VHF AM RCV - A		
		VHF AM A - off (ctr)		
		5.6.3 VHF/FM Modes		
		VHF FM Simplex		
		Select Basic, 5.6.1		
		VHF FM/AM Duplex		
ALL		VHF AM (3) - RCV	6,9,10	
		VHF FM/PAD COMM VOL tw - full decr		
		5.6.4 VHF AM Ranging Mode		
		VHF AM A - off (ctr)		
		VHF AM B - DUPLEX		
		VHF RNG - on (up)		
		If P20 operating VHF AM rng option selected		
CP		TRACKER lt - on	2,140	CMC will activate TRACKER light and wait for a "data good" signal from digital ranging generator.

NORMAL/BACKUP

STA/T	STEP	PROCEDURE	PANEL	REMARKS
AC		EMS - VHF RNG EMS MODE - VHF RNG EMS FUNC - VHF RNG	1	
		CAUTION There must be no VHF AM voice transmission by CSM or STDN for ≈12 sec after VHF RNG - RSET.	9	Voice transmission at this time could interfere with the accuracy of ranging signal.
		VHF RNG - RSET (1 sec min) RNG ind - BBBBO 0 (read BBBBO.0)	1	RSET position is momentary, hold for 1 second minimum. When VHF RNG switch placed to RSET, RNG indicator will reset to zero, and operator will hear mid tone (3.95 kHz) and then low tone (247 Hz).
		If P20 operating VHF AM rng option selected		
CP		TRACKER lt - out	2,140	TRACKER light - out (no OCDU failure) and RNG indicator starts counting up 4 seconds after termination of low tone. RNG indicator interpreted as range in nautical miles to nearest .XX NM.
AC		RNG ind - BXXXX X (read BXXX.XX)	1	
	5.6.5	Pad Communications		
		Select Basic, 5.6.1 except		
DP		TAPE RCDR FWD - off (ctr)	3	
		Prior to launch		
ALL		VHF FM/PAD COMM (3) - T/R (or RCV)	9,10,6	VHF FM/PAD COMM switch can be used after launch for intercom backup with VHF FM/PAD COMM VOL thumbwheel decreased.
		VHF FM/PAD COMM VOL tw (3) - as req		
		Launch -10:00		
		VHF FM/PAD COMM (3) - OFF		

STA/T	STEP	PROCEDURE	PANEL	REMARKS
		5.6.6 S-Band Xponder Modes		
ALL		Voice, RT-HBR Data, Ranging Sel Basic, 5.6.1 except PCM BIT RATE - HI	3	
		Voice, RT-LBR Data, Ranging Sel Basic		
		Voice, RT-HBR Data Sel Basic, except S BD MODE RNG - OFF PCM BIT RATE - HI		
		Voice, RT-LBR Data Sel Basic, except S BD MODE RNG - OFF		
		Voice & Ranging Sel Basic, except S BD MODE PCM - ctr		
DP		Voice Sel Basic, except S BD MODE PCM - ctr S BD MODE RNG - OFF		
		Voice & LBR PCM with Apollo Range Instrumentation Aircraft (ARIA) Sel Basic, except S BD MODE RNG - OFF		

NORMAL/BACKUP

STA/T	STEP	PROCEDURE	PANEL	REMARKS
		5.6.7 FM Xmtr Mode		
DP		Dump PCM/Analog Sel Basic, 5.6.1 except TAPE RCDR FWD - REWIND S BD AUX TAPE - TAPE TAPE RCDR RCD - PLAY TAPE RCDR FWD - FWD (after rewind complete) TAPE MOTION tb - gray Rewind & return to Basic	3	Gray indicates tape in motion.
		5.6.8 DRR Record Modes		Under nominal conditions STDN will control tape recorder operation. If degraded data is experienced by STDN, then the DRR should be operated 4 seconds in fast forward mode prior to recording flight data on the initial footage of tape.
		Record HBR CM Data, CM/IC, DM/IC, EXP/PCM Data Sel Basic, 5.6.1 except PCM BIT RATE - HI		
		Record LBR CM Data, CM/IC, DM/IC, EXP/PCM Data Sel Basic		
		5.6.9 Relay Mode (VHF FM to MCC-H via SBD)		
CP		Select Basic, 5.6.1, except MODE - VOX VOX SENS tw - 8	10	

STA/T	STEP	PROCEDURE	PANEL	REMARKS
CP		VHF FM/PAD COMM - RCV	10	
		VHF FM/PAD COMM tw - 5		
		S BD VOL tw - full decr		
		PWR - AUDIO		
		MASTER VOL tw - 3		
		INTERCOMM VOL tw - full decr		
		VHF AM - OFF		
		AUDIO CONT - BU		
		PHONE/MIC CONNECT - ON		
	5.6.10	Sleep Configuration		
		Select Basic, 5.6.1, except		
DP		S BD - OFF	6	
		VHF FM/PAD COMM - RCV	9	
		INTERCOMM - RCV		
AC		VHF AM - OFF		
DP		AUDIO CONT - BU	10	
		Config to Relay Mode, 5.6.9		
	5.6.11	Backup Modes		
		Up Voice Backup		Requires coordination with STDN. Updata signal (noise) will be present in headsets until STDN reconfigures for this mode.
		Sel Basic, except		
		UP TLM DATA - UP VOICE BU	3	
		Down Voice Backup		
		Sel Basic, except		
		S BD MODE PCM - ctr		
		S BD AUX TAPE - DN VOICE BU		
		S BD MODE RNG - OFF		
		PCM BIT RATE - HI		

STA/T	STEP	PROCEDURE	PANEL	REMARKS
		Down Voice & LBR RT Data Backup		
DP		Sel Basic, 5.6.1, except		
		S BD AUX TAPE - DN VOICE BU	3	
		S BD MODE RNG - OFF		
		Key		
		Sel Basic, except		
		S BD MODE PCM - KEY		
		S BD MODE RNG - OFF		
		Down Data Backup		
		Sel Basic, except		
		PMP PWR - AUX		
		5.6.12 TV Oper - TD&E		TD&E (Transposition, docking, and DM ejection).
		Obtain camr mount from stowage.		For stowage, reference NASA-S-74-517.
		Remove TV camr 1 & launch bracket, & remount camr in launch position utilizing camr mount		
		Select Basic, 5.6.1		
		Verify TV camr connected to CM1 TV	181	
CP		STATION POWER receptacles		
		Obtain & assemble TV camr, monitor, cables, & camr mount (use bottom camr dove tail)		

STA/T	STEP	PROCEDURE	PANEL	REMARKS
CP		Connect TV camr to CM2 TV STATION POWER receptacles	181	
		ALC sw - AVG	TV Camr 2	
		GAMMA sw - LINEAR		
		SYNC sw - SLAVE		
		NOTE One camr must be selected MASTER, all operating camrs must be SLAVE.		
		Adjust lens - as req		
		Mount camr in RH rendezvous window (observe pin alignment mark)		
		TV MONITOR POWER - POWER	181	
		CM/DM CAMR POWER - POWER TV AMPL - ON CM 1 TV STATION POWER - on (up) CM 2 TV STATION POWER - on (up) Check monitors, adjust camr pointing & lens if req		

STA/T STEP	PROCEDURE	PANEL	REMARKS
	NOTE • Camr selection & VTR management will be accomplished by STDN commands. Cue light illuminates when camr is selected. • If VTR is recording, all intercom voice will be recorded on the VTR.		
	All crewmen done comm carriers assembly (CCA)		
ALL	MODE - VOX	6,9,10	
	VOX SENS tw - as req (≈7)		
	VOLUME tw - dcr (eliminate squeal)	98	
	When TV Complete		
CP	CM 1 TV STATION POWER - OFF	181	
	CM 2 TV STATION POWER - OFF		
	TV AMPL - BY PASS		
ALL	MODE - INTERCOM/PTT	6,9,10	

STA/T STEP	PROCEDURE	PANEL	REMARKS
	5.6.13 TV Oper - Rendezvous, Sta. Keeping, Docking, Undocking, Docking Test, Joint Experiments, & Sep		
	Select Basic, 5.6.1		
CP	Verify TV Camr mounted in launch position & connected to CM 1 TV STATION POWER receptacles (2)	181	
	Verify TV Camr mounted in RH Rendezvous window & connected to CM 2 TV STATION POWER receptacles (2)		
	CM/DM CAMR POWER - POWER TV AMPL - ON CM 1 TV STATION POWER - ON		
	CM 2 TV STATION POWER - ON		
	Check, monitors, adjust camera pointing & lens if req		
	NOTE • Camr selection & VTR management will be accomplished by STDN commands. Cue light illuminates when camr is selected.		

NORMAL/BACKUP

STA/T	STEP	PROCEDURE	PANEL	REMARKS
CP		• If VTR is recording, all intercom voice will be recorded on the VTR.	181	
		All crewmen don comm carriers assembly (CCA)		
ALL		MODE - VOX	6,9,10	
		VOX SENS tw - as req (≈7)		
		VOLUME tw - dcr (eliminate squeal)	98	
		When TV complete		
CP		CM 1 TV STATION POWER - OFF	181	
		CM 2 TV STATION POWER - OFF		
		TV AMPL - BYPASS		
ALL		MODE - INTERCOM/PTT	6,9,10	
	5.6.14	TV Modes		For DM TV checkout and TV crew transfers, refer to 18.5.2 and 18.5.3.
		a. STDN Realtime TV - Manual Select		
		Select TV Basic, 5.6.1, except		
DP		SBD AUX TV - TV	3	
		CM TV		
CP		TV STATION SEL CM/REMOTE - CM	181	
		TV STATION SEL CM 1/CM 2 - as req		

STA/T STEP	PROCEDURE	PANEL	REMARKS
	DM TV		
CP	TV STATION SEL CM/REMOTE - REMOTE	181	
	TV STATION SEL DM/SOYUZ - DM	808	
	TV STATION SEL DM1/DM2 - as req		
	Soyuz TV		
	TV STATION SEL CM/REMOTE - REMOTE	181	
	TV AMPL - ON	808	
	TV STATION SEL DM/SOYUZ - SOYUZ		
DP	RLY MODE TV CONT - PLAYBACK	230	
	RLY MODE CONT - TV		
	CAMR SYNC - as req	808	
	(SOYUZ if Soyuz camr operating)		
	MODE (3) - VOX	6,9,10	
	VOX SENS tw (3) - as req (≈7)		
	b. ATS-F Realtime TV - Manual Select		
	Select TV Basic, 5.6.1, except		
	CM TV		
CP	TV STATION SEL CM/REMOTE - CM	181	
	TV STATION SEL CM1/CM2 - as req		
	DM TV		
	TV STATION SEL CM/REMOTE - REMOTE		
	TV STATION SEL DM/SOYUZ - DM	808	
	TV STATION SEL DM1/DM2 - as req		

NORMAL/BACKUP

STA/T	STEP	PROCEDURE	PANEL	REMARKS
CP		Soyuz TV		
		TV STATION SEL CM/REMOTE - REMOTE	181	
		TV AMPL - ON		
		TV STATION SEL DM/SOYUZ - SOYUZ	808	
DP		RLY MODE TV CONT - REALTIME	230	
		RLY MODE CONT - TV		
		CAMR SYNC - as req (SOYUZ if Soyuz camr is operating)		
		MODE (3) - VOX	6,9,10	
		VOX SENS tw (3) - as req (≈7)		
	c.	STDN Playback TV - Manual Select		
		Select TV Basic, 5.6.1, except		
		SBD AUX TV - TV	3	
		RLY MODE TV CONT - REALTIME	230	
CP		HD WHL DR MDT - ON	400	ON is momentary.
		MOTOR ON lt - on		
		TAPE MODE - PLAYBACK		PLAYBACK is momentary.
		PLAYBACK lt - on		
		NOTE		
		Tape will stop automatically when end-of-tape is reached. MOTOR ON & PLAYBACK lts will go out.		

STA/T	STEP	PROCEDURE	PANEL	REMARKS
	d.	ATS-F Playback TV - Manual Select		
		Select TV Basic, 5.6.1, except		
DP		RELAY MODE CONT - TV	230	
		RELAY MODE TV CONT - PLAYBACK		
CP		HD WHL DR MOT - ON MOTOR ON lt - on	400	ON is momentary.
		TAPE MODE - PLAYBACK PLAYBACK lt - on		PLAYBACK is momentary.
		NOTE Tape will stop automatically when end-of-tape is reached. MOTOR ON & PLAYBACK lts will go out.		
	e.	Record TV - Manual Select		
		Select TV Basic, 5.6.1, except		
		SYNC sw - as req	Camr	

STA/T STEP	PROCEDURE	PANEL	REMARKS
	NOTE One camr must be selected MASTER all other operating camrs must be SLAVE. If Soyuz camr is operating, it must be MASTER		
	CM TV		
CP	TV STATION SEL CM/REMOTE - CM	181	
	TV STATION SEL CM1/CM2 - as req		
	DM TV		
	TV STATION SEL CM/REMOTE - REMOTE		
	TV STATION SEL DM/SOYUZ - DM	808	
	TV STATION SEL DM1/DM2 - as req		
	Soyuz TV		
	TV STATION SEL CM/REMOTE - REMOTE	181	
	TV AMPL - ON		
	TV STATION SEL DM/SOYUZ - SOYUZ	808	
	HD WHL DR MOT - ON	400	ON is momentary.
	MOTOR ON lt - on		RECORD is momentary.
	TAPE MODE - RECORD		
	RECORD lt - on		
	NOTE If lights go out during recording, VTR is at end-of-tape.		

TV MODES

STA/T STEP	PROCEDURE	PANEL	REMARKS
CP	CMR SYNC - as req (SOYUZ if Soyuz camr is operating)	400	
	MODE (3) - VOX VOX SENS (3) - as req (≈7)	6,9,10	
	f. VTR Standby - Manual Select		
	HD WHL DR MOT - OFF, RECORD, MOTOR ON lts - out	400	OFF is momentary.
	g. VTR Rewind - Manual Select		
	HD WHL DR MOT - ON MOTOR ON lt - on TAPE DRIVE - REWIND		ON is momentary. REWIND is momentary.
	NOTE Tape will stop automatically and MOTOR ON lt will go out when beginning of tape is reached. Full tape rewind requires 7-1/2 minutes.		
	h. VTR Fast Fwd - Manual Select HD WHL DR MOT - ON		
	MOTOR ON lt - on		
	TAPE DRIVE - FAST FORWARD		FAST FORWARD is momentary.

STA/T	STEP	PROCEDURE	PANEL	REMARKS
		NOTE Tape will stop automatically and MOTOR ON lt will go out when end-of-tape is reached. Full tape fast forward requires 7-1/2 min.		
	i.	VTR Lamp Test - Manual Select		
CP		LAMP - TEST (& hold) PLAY, MOTOR ON, RECORD, CLEAN HEADS lts - on LAMP - release 4 lts out	400	TEST is momentary.
	j.	VTR Tape Head Cleaning - Manual Select		
		At MCC-H direction		
		TAPE HEAD - CLEAN CLEAN HEADS lt - on		CLEAN is momentary.
		NOTE MCC-H will control VTR and will direct further action.		

STA/T STEP	PROCEDURE	PANEL	REMARKS
	k. VTR Activation - Manual Select		
CP	TLM POWER - ON	400	
	INTRLVR POWER - ON		
	VTR POWER - ON		
	l. VTR Deactivation - Manual Select		
	HD WHL DR MOT - OFF Record, MOTOR ON lts - out VTR POWER - OFF INTRLVR POWER - OFF TLM POWER - ON		OFF is momentary.
	5.6.15 High Gain Antenna Operation		
DP	cb ATSF SYSTEM (2) - close	225	
	HI GAIN ANT TRACK - MAN	230	
	HI GAIN ANT SERVO ELECT - PRIM		When switching HI GAIN ANT SERVO ELECT from PRIM to SEC or vice versa, HI GAIN ANT TRACK must be in MAN position, to prevent possible HGA anomalous operation. Guarded.
	HGA SCAN - NORMAL (when undocked from Soyuz)		Guarded.
	HGA SCAN - INHIBIT (when docked with Soyuz)		
	HI GAIN ANT BEAM - WIDE		
	HI GAIN ANT PWR - on (up)		HI GAIN ANT TRACK switch must be in MAN position before HI GAIN ANT PWR switch to on, to prevent HGA anomalous operation.

NORMAL/BACKUP

STA/T	STEP	PROCEDURE	PANEL	REMARKS
DP		Determine req ant coordinates If IMU aligned, 8.3.6 If G&N not available, trial & error method must be used		
		Verify that req coordinates are within full coverage region		Refer to CSM DATA BOOK, section 4.9, HGA Scan and Warning Limit, Yaw-Pitch Coordinates. Reliable acquisition can be accomplished with YAW-PITCH coordinates in full coverage region. In the CSM skin interference zone, RF reflections will cause no problems when operating in MANUAL, AUTO or REACQ mode, when in WIDE BEAM. After acquisition, the antenna will track through CSM skin interference zone and scan limit zone while in NARROW beam and in either AUTO or REACQ modes without incurring an interference problem. Should acquisition be attempted in the CSM skin interference zone in either NARROW or MEDIUM beam while in AUTO or REACQ mode, acquisition problems may be encountered. STDN and SC will experience (a) low signal strength indicating lockup on a side lobe or (b) varying signal strength caused by antenna alternately switching between wide and narrow beamwidth. SC antenna pitch and yaw indicator will also provide visual indication of condition (b). Other indicators of the interference condition include noise or loss of voice or track loss. Upon detection of this situation, attempt one of the following. a. Change CSM attitude to provide antenna coordinates in the full coverage region.

STA/T	STEP	PROCEDURE	PANEL	REMARKS
				b. Allow up to 60 seconds for the expected CSM attitude variation to alleviate the condition. c. In attitude hold condition, operate in wide beam mode. d. Transfer to narrow beam and acquire ATS-F manually.
DP		HI GAIN ANT PITCH & YAW cont (2) - set in req coordinates	230	
		HI GAIN ANT ind - >1/3 scale HI GAIN ANT TRACK - AUTO or REACQ		With TRACK switch in REACQ, antenna will reposition to position control settings when the antenna reaches the scan limit. To prevent acquisition problems, predicted ATSF position should be set in the full coverage region.
		HI GAIN ANT BEAM - NARROW HI GAIN ANT ind - >1/3 scale When omni ant operation is desired HI GAIN ANT TRACK - MAN HI GAIN ANT PITCH cont - 52° HI GAIN ANT YAW cont - 270°		

NORMAL/BACKUP

STA/T	STEP	PROCEDURE	PANEL	REMARKS
		5.7 MECHANICAL SYSTEMS		
		5.7.1 Forward Hatch Removal		
DP		Opening Fwd Hatch From CM Interior		
		Equalize CM/DM press		If required. Tunnel pressure integrity check is incorporated into these procedures.
		Actr handle rel - PULL & ROTATE	Tunl	To free actuator handle for operation, release is rotated to stop.
		Actr handle - pull to stop		Actuator handle should move ≈80°.
		Actr handle sel - U (unlatch)		
		Actr handle - push to stop		Actuator handle should move ≈60° to release latches.
		Gearbox disconnect socket - U (verify)		
		Actr handle sel - STOW		
		Actr handle - push to stowed position		Actuator handle release automatically locks handle in stowed position.
		Remove & stow fwd hatch		Hatch should be stowed in LHEB.
		5.7.2 Forward Hatch Installation		
DP or CP		Closing Fwd Hatch From CM Interior		Performed by DP or CP.
		Obtain fwd hatch from stowage	Fwd hatch	Forward hatch stowed in LHEB.
		Position hatch against sealing surface		Align equivalent colored arrows.
		Actr handle rel - PULL & ROTATE		To free actuator handle for operation, release rotated to stop.

FORWARD HATCH INSTALLATION

STA/T	STEP	PROCEDURE	PANEL	REMARKS
DP or CP		Actr handle - pull to stop	Fwd hatch	Actuator handle should move ≈80°.
		Actr handle sel - L (latch)		
		Actr handle - push to stop		Actuator handle should move ≈60° to engage latches.
		Verify gearbox disconnect socket is opposite L mark on hatch		
		Actr handle sel - STOW		
		Actr handle - push to stowed position		Actuator handle release automatically locks handle in stowed position.
		Push man gearbox lock (chrome tab)		Verifies that gear box lock is engaged.
AC		PRESS EQUAL vlv - CLOSE (CW)		Yellow indicator pin must be in green zone and valve handle must be in yellow-band area (indicates valve is fully closed).
		xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx		
		Cannot close PRESS EQUAL vlv Remove fwd hatch, 5.7.1 Insert Tool B in external tool interface for additional leverage, hold depressed & rot (CCW) Install fwd hatch		
		xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx		
	5.7.3	Forward Hatch Seal Integrity Check		
		Secure tunl hatches		
		Verify DM hatch is closed & PRESS EQUAL vlv is closed	Hatch 2	
CP		CAB PRESS ind - 4.7-5.3 psia (verify)	2	

NORMAL/BACKUP

STA/T	STEP	PROCEDURE	PANEL	REMARKS
CP		Install fwd hatch, 5.7.2		
		Read 02 FLOW ind	2	
		TUNL VENT vlv - TUNL VENT for 30 sec, then DM/CM ΔP & check ΔP incr	12	
		TUNL VENT vlv - TUNL VENT until ΔP >-3.5 psi		
		DM/CM ΔP ind - remains constant within ±0.2 psi at last value read for 2 min (verify)		
		02 FLOW ind - no incr (verify)	2	
		xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx		
		02 FLOW ind - incrs and/or		
		DM/CM ΔP ind - ΔP decr	12	
		02 FLOW ind remains stable, DM hatch is probably not integral		
		02 FLOW ind - incrs, CM fwd hatch is probably not integral		
		Pressurize tunl using PRESS EQUAL vlv	Fwd hatch	
		Open fwd hatch, 5.7.1		
		Check for foreign object(2) jammed in tunl/hatch seal interface or hatch seal damage		
		Close fwd hatch, 5.7.2		
		Reinitiate steps (secure tunl hatch & check integrity		
		xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx		

FORWARD HATCH INSTALLATION

STA/T	STEP	PROCEDURE	PANEL	REMARKS
CP		TUNL VENT vlv - TUNL VENT for >10 min DM/CM ΔP ind - >-4.0 (pegged) (verify) TUNL VENT vlv - OFF TUNL LT - OFF	12 274	
		5.7.4 Docking Probe Removal		
	1	Panel and tunnel configuration		
AC		PROBE (3) - OFF	2	PROBE EXTD/REL switch is guarded.
		cb DOCK PROBE (2) - open	8	
CP		Fwd hatch removed, 5.7.1	tunl	
	2	Verify extend latch engaged, ind (red) not visible		
		xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx If extend latch not engaged, indicator (red) not flush with latch housing Preload sel lever - rotate CW (away from orange stripe) Preload handle - torque CCW until extend latch engages, indicator (red) not visible xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx		
		GN2 bleed button (red) - press (10 sec)		GN2 bleed button (red) located under pyro components cover, depressurizes probe retract system when depressed.

NORMAL/BACKUP

STA/T	STEP	PROCEDURE	PANEL	REMARKS
CP		Preload sel lever - rotate CCW (parallel to orange stripe) Preload handle - torque CW until load removed from support beams	tunl	Support beams may become loose in docking ring sockets.
	3	Disconnect & stow probe umbilicals Pull first connector shell (yellow) & rotate CCW to unlock Pull connector to remove Align yellow mark with stowage connector (yellow) & push to engage Rotate connector shell CW to lock Repeat for second probe umbilical (yellow) Close probe umbilical connector covers (2) (yellow) Position preload handle against stowed probe umbilical Preload sel lever - place to mid-position		Stowage connector located on aft side of support beams.
	4	Fold probe Pull instal strut from clip on support beam, rotate foot 180° & position against tunl wall between yellow marks Depress ratchet handle rel button (gray) & pull ratchet handle aft to full extension		Ratchet handle rel button (gray) is on aft end of ratchet handle.

DOCKING PROBE REMOVAL

STA/T	STEP	PROCEDURE	PANEL	REMARKS
CP		Depress ratchet handle rel button (gray) & push ratchet handle to first detent (red band only visible) Push ratchet handle outboard 30° & hold allowing probe to fold	tunl	Probe fully folded when Teflon block on Z-support beam within 1/4 inch of ratchet housing.
		xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx x x Probe will not fold Using tool F, rotate jam nut & hex bolt (ratchet handle stop) CCW to remove bolt Push ratchet handle outboard until probe releases & hold until probe folds (Subs instal of probe must be done very carefully to avoid releasing ratchet & folding probe while attempting to install it) x x xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx		
		Depress ratchet handle rel button (gray) & pull ratchet handle aft to full extension Push ratchet handle outboard 25° for one stroke only Depress ratchet handle rel button (gray) & with ratchet handle held inboard, push fully fwd to stow position Rotate instal strut foot 180° to stow position & restow instal strut in clip on support beam		

5.7.4 DOCKING PROBE REMOVAL

NORMAL/BACKUP

STA/T	STEP	PROCEDURE	PANEL	REMARKS
CP	5	Release probe from drogue		
		Remove capture latch rel tool (tool 7) from stowage	tunl	For stowage, reference NASA-S-74-517.
		Insert tool into pyro cover guide bushing		
		Rotate tool 180° CW and hold to unlock		
		Grasp probe support handle & pull aft to rel probe from drogue		≈25 pounds pull required to release probe.
		xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx		
		If probe will not rel from drogue		
		Pull instal strut from clip on support beam, rotate foot 180° & position against tunl wall between yellow marks		
		Depress ratchet handle rel button (gray) & pull ratchet handle aft to full extension		
		Push ratchet handle outboard 25° to stop & repeat until support beams engage docking ring sockets		
		Rotate preload sel lever CCW (parallel to orange strip)		
		Rotate capture latch rel tool 180° CW & hold		
		Torque preload handle CW until capture latches release from drogue		
		Fold probe, step 4		
		xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx		

DOCKING PROBE REMOVAL

STA/T	STEP	PROCEDURE	PANEL	REMARKS
CP		Verify capture latch cocked (plunger recessed below probe head cap)	tunl	
		Remove and stow capture latch rel tool		For stowage, reference NASA-S-74-517.
		Remove probe from tunl & stow as req		
	5.7.5	Docking Probe Installation		
	1	Panel and tunnel configuration		
		PROBE (3) - OFF (verify)	2	PROBE EXTD/REL switch guarded.
AC		cb DOCK PROBE (2) - open	8	
CP		Drogue installed, 5.7.8		
	2	Remove probe from stowage		
	3	Engage capture latches		
		Push probe head into drogue until capture latches engage & lock		A slight pull in aft direction will disengage capture latches if not fully engaged.
	4	Engage probe in docking ring		
		Pull instal strut from clip on support beam, rotate foot 180° & position against tunl wall between yellow marks		Yellow marks located on -Z axis. Probe support beam and corresponding docking ring socket color-coded yellow.
		Depress ratchet handle rel button (gray) and pull ratchet handle aft to full extension (green & red bands visible)		Ratchet handle release button (gray) on aft end of ratchet handle.
		Push ratchet handle outboard 25° to stop & repeat until probe support beams (3) engage in docking ring sockets		From this point 19 strokes required to install probe. An orange hash mark on collar conduit becomes visible when fully installed. Care should be exercised to to ensure probe support beams (3) align with docking ring sockets and end of pitch arms do not interfere with docking latch fairings.

NORMAL/BACKUP

STA/T STEP	PROCEDURE	PANEL	REMARKS
	xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx		
	If pushing ratchet handle outboard does not advance support beams to engage docking ring sockets		
CP	Depress ratchet handle rel button (gray) & push ratchet handle fwd to first detent (red band only visible)	tunl	
	Slowly push ratchet handle outboard ≈25° until ratchet pawl engages (audible click) & repeat until 3 probe support beams engage in docking ring sockets		If ratchet pawl not audible, watch action of ratchet pawl indicator (red).
	(If ratchet handle pushed outboard past point of pawl engagement, probe will release)		
	xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx		
	Verify ratchet pawl ind (red) flush with ratchet housing		
	xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx		
	If ratchet pawl ind protruding above ratchet housing		
	Push ratchet handle outboard 25° to stop & hold		
	Press ratchet pawl ind (red) to seat pawl (ind flush)		
	Return ratchet handle to full inboard position		
	xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx		

DOCKING PROBE INSTALLATION

STA/T	STEP	PROCEDURE	PANEL	REMARKS
CP		Depress ratchet handle rel button (gray) & with ratchet handle held inboard, push fully fwd to stow position Rotate instal strut foot 180° to stow position & restow instal strut in clip on support beam	tunl	
	5	Adjust preload handle in direction req to maintain support beams in an unloaded condition		This step required only if probe installed in tunnel for stowage. Support beams may become loose in docking ring sockets. Rotate preload sel lever CCW (parallel to orange stripe) to move extend latch aft (compress probe) and CW (away from orange stripe) to move extend latch fwd (expand probe).
		Position preload handle at 45° angle to support beam (either side)		Position provides clearance with fwd hatch actuator handle.
	6	Push preload shaft fwd into detent		
	7	Connect probe umbilicals		This step not required when installing probe for stowage.
		Pull probe umbilicals covers (2) (yellow) inboard & rotate fwd to open		Probe umbilical covers located in docking ring.
		Pull first connector shell (yellow) aft & rotate CCW to unlock Pull connector to remove Align with docking ring connector (yellow) & push to engage Rotate connector shell CW to lock Repeat for sec probe umbilical (yellow)		Probe umbilical connectors are stowed on probe support beams.
		GN2 bleed button (red) - press (10 sec)		

NORMAL/BACKUP

STA/T	STEP	PROCEDURE	PANEL	REMARKS
		5.7.6 Docking System Probe Extension and Status Check		
AC		cb DOCK PROBE (2) - close (verify)	8	
		CAUTION PROBE EXTD/REL should not be held in EXTD/REL position longer than 20 sec if probe has not extended. Capability of capture latch release motors may be degraded.		
CP		PROBE EXTD/REL - EXTD/REL and hold until probe fully extended PROBE EXTD/REL tb (2) - gray to bp to gray PROBE RETR (2) - OFF (verify)	2	Guarded. EXTD/REL position is momentary. Probe extended by compression spring and attenuator airhead forces. Crew should readily sense by auditory cues that probe has extended when probe strikes stops. Crew may not see talkbacks go barber pole because of rapid probe motion. Barber pole indicates power to tb through probe circuitry. Return to gray indicates full extension of probe.
		PROBE EXTD/REL - RETR		Guarded.
		PROBE EXTD/REL tb (2) - gray (verify)		Verifies capture latches not locked and probe fully extended or capture latches not locked and probe has partially extended (3/4 inch).

DOCKING SYSTEM PROBE EXTENSION AND STATUS CHECK

STA/T STEP	PROCEDURE	PANEL	REMARKS
	PROBE POSITION / PROBE EXTD/REL sw POSITION: EXTD/REL / RETR FULL EXTD: gray / gray FULL RETR: bp / bp PARTIAL EXTD: bp / gray		Probe position indications.
	5.7.7 Docking Drogue Removal		
CP	Docking probe removal, 5.7.4	tunl	
	Pull & rotate (CCW) drogue lock lever until flush against tunl wall		
	Remove drogue		
	Drogue outer ring is grasped with both hands at opposite sides		
	Rotate (CW) & push until 3 drogue lugs clear support fittings		Care must be taken not to strike DM hatch.
	Rotate toward CM & grasp any 2 handles		
	Mnvr drogue past support fittings & stow in CM		Drogue must be canted and rotated to clear tunnel. For stowage, reference NASA-S-74-517.
	5.7.8 Docking Drogue Installation		
	Procure drogue from stowage		

NORMAL/BACKUP

STA/T	STEP	PROCEDURE	PANEL	REMARKS
CP		Install drogue Mnvr past support fitting DM tnl	tunl	Drogue must be canted and rotated to clear support fittings in tunnel. Limited clearance between DM hatch and support fittings requires care in maneuvering drogue if closed. Handles should be used for support.
		Align drogue lugs (3) with support fittings in DM tunnel		Drogue must be held along outer diameter at opposite sides adjacent to drogue lugs. At this point drogue handles are facing DM hatch.
		Pull drogue lugs into support fittings & rotate (CCW) until lugs hit stops in support fittings		Ramps on support fittings will guide drogue lugs into support fitting recesses.
		Push & rotate drogue latch lever 90° (CW)		Locks drogue latch mechanism.
	5.7.9	Probe Preload Operation		
		Rotate preload select lever CCW (parallel to orange stripe)		
		Torque preload handle CW until load limiter releases		Preload handle extension may be telescoped outboard to provide additional leverage if required.
		Push preload handle inboard to detent & position at 45° angle to support beam (either side)		Position provides clearance with fwd hatch handle.
		Rotate preload sel lever to mid-position		

PROBE PRELOAD OPERATION

STA/T	STEP	PROCEDURE	PANEL	REMARKS
		5.7.10 Tunnel Latch Operations		
CP	1	Verify probe is preloaded, 5.7.9	tunl	
	2	Cocking of latches		Any suitable tool may be used to trigger release lever if desired.
		WARNING To avoid possible injury to fingers or damage to PGA, care must be taken not to place fingers under or near a latch while cocking, nor under or near the latch hook of a cocked latch.		
		Depress rel button behind handle latch grip & pull latch handle down two complete strokes		This procedure disengages and cocks latch. It may take only one complete stroke to cock each latch.
		xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx If latch handle cannot be pulled While pulling handle, depress rh no-back pawl on bottom until it disengages from ratchet tooth If latch handle pulls free, remove pressure from rh no-back pawl & complete cocking procedures If latch handle still cannot be pulled While pulling handle, depress lh no-back pawl through fairing covering hole with tools E & R until ratchet tooth disengages & latch handle pulls free		

NORMAL/BACKUP

STA/T	STEP	PROCEDURE	PANEL	REMARKS
CP		Remove pressure from lh no-back pawl & complete cocking procedure If latch handle still cannot be pulled Remove fairing covering lh no-back pawl (using tools E & R) While pulling handle, depress both no-back pawls on bottom until ratchet teeth are disengaged & latch handle pulls free Remove pressure from both no-back pawls & complete cocking procedure	tunl	
		xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx		
		Verify hook rotates inboard to clear DM ring		
		xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx		
		If latch hook does not release from DM ring on first stroke Push top of AUX REL (yellow) button & proceed with sec stroke		
		xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx		
		Verify/push latch handle outboard against latch hook		Prevents latch handle sticking inboard which could prevent latch primary trigger from resetting after undocking.
	3	Repeat 2 until all 12 latches are disengaged & cocked		Latches reset for subsequent docking operations.

TUNNEL LATCH OPERATIONS

STA/T	STEP	PROCEDURE	PANEL	REMARKS
CP	4	Manual triggering of latches Push manual release lever at side of latches	tunl	This procedure engages latch. Manual release lever located at lower right side of latch handle. Use tool L to push manual release lever.

NORMAL/BACKUP

STA/T STEP	PROCEDURE	PANEL	REMARKS
	5.8 FLOODLIGHT OPERATING MODES		
	5.8.1 Prim Floodlight Mode		
ALL	FLOOD LTS - OFF (CCW) FLOOD DIM - 1 FLOOD LTS - full dim or full BRT	5,8,100	
	5.8.2 Sec Floodlight Mode		Operation in secondary mode is a backup only to be used in the event of DIM-1 circuitry in-flight failure. The DIM-2, dimmed floodlight predicted operating life is ≈100 hours.
	FLOOD LTS - OFF (CCW) FLOOD DIM - 2 FLOOD LTS - full BRT (CW)		

SEC FLOODLIGHT MODE

6.0 G&C REFERENCE DATA

This section provides data which generally apply to all G&C procedures in sections 7 through 21. The data do not include procedures but contain information which may be referenced in various procedures, may contain application of procedures, or may be helpful in applying the procedures.

6.1 G&C OPERATING NOTES

G&C operating notes are separated into three categories: G&C operations, SCS operations, and G&N operations. Notes for G&C operations provide data associated with guidance and control functions in general while notes for SCS and G&N operations are more specific to their systems.

6.1.1 G&C Operations

1. ULLAGE: For ullage switch setup with or without attitude control, see figure 6-1. Normally, the setup should include attitude control.

2. RCS JET, VENT, RADIATOR, AND ANTENNA LOCATIONS: SM and CM RCS jets, vent, and radiator locations are illustrated in figure 6-2.

3. SCS LOGIC BUS POWER DISTRIBUTION: SCS logic bus circuit breakers on panel 8 provide MNA and MNB power to four SCS logic buses. Figure 6-3 delineates power source and power distribution for SCS controls (pushbuttons, functions, and switches).

   Main bus power to SCS logic buses 1 and 4 is controlled only by the SCS logic bus circuit breakers on panel 8. Power to SCS logic buses 2 and 3 is controlled by SCS logic bus circuit breakers on panel 8 and the LOGIC 2/3 PWR switch on panel 7. Other than SCS TVC, equipment loads can only be removed from a specific logic bus by selecting acceptable control positions not powered by that bus. (See figure 6-3.)

   For SCS logic bus power loss and SCS logic bus power loss (special effects), see figures 6-4 and 6-5.

4. AC/DC BUS LOSS: Figure 6-6 relates ac and dc bus loss effects to G&C component functional capabilities. As shown, a functional capability may be only partially lost, or lost entirely.

NORMAL/BACKUP

Type of Ullage Desired		Required AUTO RCS Switch Positions (Jets Firing*)								RCS Jets* Providing Attitude Hold Capability	
		Pitch				Yaw					
		A3	C3	A4	C4	B3	D3	B4	D4	Pitch	Yaw
2 Jet-Quad A/C Pitch Jets C3 and A4	Without Attitude Control	OFF	MNA or MNB	MNA or MNB	OFF	MNA or MNB	OFF	OFF	MNA or MNB	None	B3 and D4
	With Attitude Control	MNA or MNB	MNA or MNB	MNA or MNB	MNA or MNB	MNA or MNB	OFF	OFF	MNA or MNB	A3 and C4	B3 and D4
2 Jet - Quad B/D Yaw Jets D3 and B4	Without Attitude Control	MNA or MNB	OFF	OFF	MNA or MNB	OFF	MNA or MNB	MNA or MNB	OFF	A3 and C4	None
	With Attitude Control	MNA or MNB	OFF	OFF	MNA or MNB	MNA or MNB	MNA or MNB	MNA or MNB	MNA or MNB	A3 and C4	B3 and D4
4 Jet - Quad ABCD Jets A4, B4, C3, D3	Without Attitude Control	OFF	MNA or MNB	MNA or MNB	OFF	OFF	MNA or MNB	MNA or MNB	OFF	None	None
	With Attitude Control	MNA or MNB	MNA or MNB	MNA or MNB	MNA or MNB	MNA or MNB	MNA or MNB	MNA or MNB	MNA or MNB	A3 and C4	B3 and D4

*See figure 6-2 for explanation of jet code.

Figure 6-1. SCS Ullage Setup

NORMAL/BACKUP

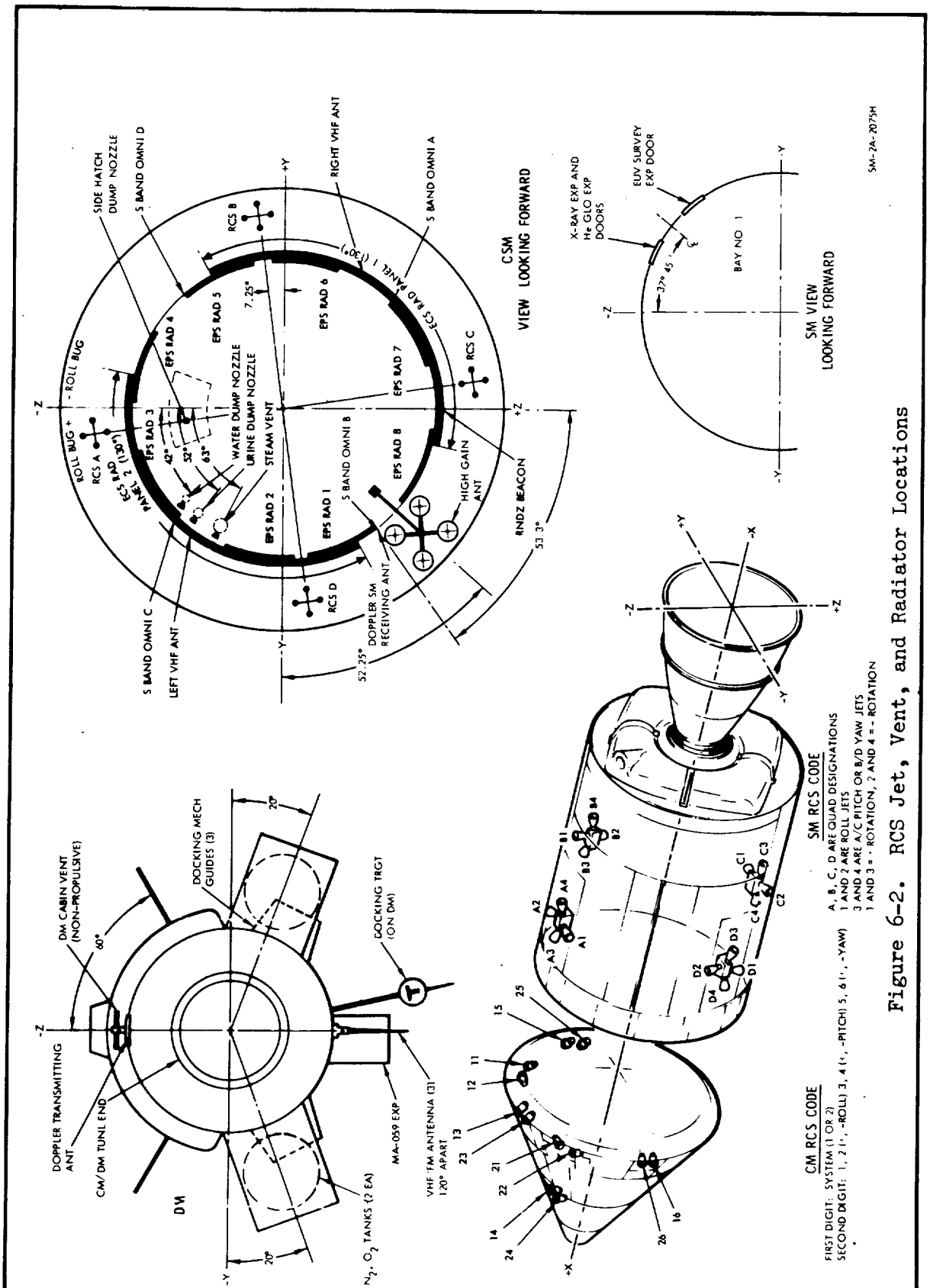


Figure 6-2. RCS Jet, Vent, and Radiator Locations

CONTROLS		POWER SOURCE				POWER OFF	
TITLE	POSITIONS	BUS 1 (cb direct)	BUS 2 (LOGIC 2/3 PWR sw)	BUS 3 (LOGIC 2/3 PWR sw)	BUS 4 (cb direct)	OPEN CIRCUIT	SWITCHED OFF BY
CMC ATT	IMU	X			X		cb SCS LOGIC 1/2, 1/4, & 3/4
	GDC					X	
FDAI SCALE	5/1					X	
	5/5		X				LOGIC 2/3 PWR
	50/15/50/10				X		cb SCS LOGIC 1/4 & 3/4
FDAI SEL	1/2				X		cb SCS LOGIC 1/4 & 3/4
	1			X			LOGIC 2/3 PWR
	2			X			LOGIC 2/3 PWR
FDAI SOURCE	CMC		X				LOGIC 2/3 PWR
	ATT SET			X			LOGIC 2/3 PWR
	GDC			X			LOGIC 2/3 PWR
ATT SET	IMU		X				LOGIC 2/3 PWR
	GDC				X		cb SCS LOGIC 1/4 & 3/4
MAN ATT (3)	ACCEL CMD	X					cb SCS LOGIC 1/2 & 1/4
	RATE CMD					X	
	MIN IMP	X					cb SCS LOGIC 1/2 & 1/4
LIM CYCLE	on (up)					X	
	OFF	X					cb SCS LOGIC 1/2 & 1/4
ATT DBD	MAX					X	
	MIN	X					cb SCS LOGIC 1/2 & 1/4
RATE	HI	X					cb SCS LOGIC 1/2 & 1/4
	LO					X	

Figure 6-3. SCS Logic Bus Power Distribution (Sheet 1 of 2)

CONTROLS		POWER SOURCE				POWER OFF	
TITLE	POSITIONS	BUS 1 (cb direct)	BUS 2 (LOGIC 2/3 PWR sw)	BUS 3 (LOGIC 2/3 PWR sw)	BUS 4 (cb direct)	OPEN CIRCUIT	SWITCHED OFF BY
SC CONT	CMC		X				LOGIC 2/3 PWR
	SCS			X			LOGIC 2/3 PWR
BMAG MODE	RATE 2		(R)	(P & Y)			LOGIC 2/3 PWR
	ATT 1/RATE 2		(R)	(P & Y)			LOGIC 2/3 PWR
	RATE 1	(R,P,Y)					cb SCS LOGIC 1/2 & 1/4
DIR ULL	pb	X					cb SCS LOGIC 1/2 & 1/4
THRUST ON	pb	X					cb SCS LOGIC 1/2 & 1/4
GDC ALIGN	pb				X		cb SCS LOGIC 1/4 & 3/4
SCS TVC (2)	AUTO			X			LOGIC 2/3 PWR
	RATE CMD			X			LOGIC 2/3 PWR
	ACCEL CMD			X			LOGIC 2/3 PWR
ATVC GAIN	LO			X			LOGIC 2/3 PWR
	HI					X	LOGIC 2/3 PWR
EMS ROLL	on (up)				X		cb SCS LOGIC 1/4 & 3/4
	OFF					X	
.05 G sw	on (up)				X		cb SCS LOGIC 1/4 & 3/4
	OFF		X				LOGIC 2/3 PWR
TVC GMBL DR (2)	1					X	
	AUTO	X					cb SCS LOGIC 1/2 & 1/4
	2			X			LOGIC 2/3 PWR
THC	CW sw		X				LOGIC 2/3 PWR

Figure 6-3. SCS Logic Bus Power Distribution (Sheet 2 of 2)

NORMAL/BACKUP

CAUTION

SCS logic bus power must not be removed from CMC ATT switch if (1) pitch or yaw rate >5°/second, or (2) GDC yaw Euler angle >80° and <280°. Removing power when either of these conditions exist will result in GDC damage.

5. LIMITED USE CONTROLS: G&C circuit breakers, required for G&C operation, are to be closed during the entire mission except in event of malfunctions. (See figure 6-7.) If a malfunction occurs, some circuit breakers may be operated in order to isolate problem areas. Refer to malfunction procedures in Flight Data File (FDF).

   Figure 6-8 defines switches which will remain in same position during major portion of orbital flight time because of functional requirements. Other considerations are to maintain maximum crew safety, increase equipment reliability, and minimize power consumption.

6. ATT SET - IMU FUNCTION: If CMC is on, an overload in IMU resolver circuitry may cause an ICDU oscillation and trigger the ISS warning light (Reference ICD MH01-01325-216). FDAI must be used only as a null meter in this mode of operation. If not, large errors will result because of impedance mismatch. ATT SET switch should be left at GDC when not in use.

   A polarity reversal occurs when ATT SET - IMU option is selected, and roll gimbal angle >±90°. The pitch and yaw attitude error needles become "fly from" indicators rather than "fly to" indicators in this instance.

7. LOGIC 2/3 PWR switch: Required "on" for proper control/display functions (G&N or SCS modes). See figure 6-3 for switches whose positions are dependent on this switch being on for proper system operation.

8. MANEUVER >17°: For CMC maneuvers >17° and during SIVB or Soyuz maneuvers, the BMAGs should be caged to prevent them from hitting their stops.

CONTROL	SCS LOGIC BUS POWER LOSS							
	BUS 1		BUS 2		BUS 3		BUS 4	
	FUNCTION(S) LOST	CORRECTIVE ACTION SELECT	FUNCTION(S) LOST	CORRECTIVE ACTION SELECT	FUNCTION(S) LOST	CORRECTIVE ACTION SELECT	FUNCTION(S) LOST	CORRECTIVE ACTION SELECT
FDAI SCALE			5/5	5/1 50/15			50/15	5/5 5/1
FDAI SEL					1 & 2	1/2	1/2	1 2
FDAI SOURCE			CMC	GDC ATT SET	ATT SET GDC	CMC		
ATT SET			IMU	GDC			GDC	IMU
MAN ATT (3)	ACCEL CMD MIN IMP	RATE CMD						
LIM CYCLE	OFF	on (up)						
ATT DBD	MIN	MAX						
RATE	HI	LO						
THC			CW	neutral				
SC CONT			CMC	CMC	SCS	CMC		
BMAG MODE (3)	RATE 1	ATT 1/RATE 2 RATE 2	(R) RATE 2 ATT 1/RATE 2	(R) RATE 1	(P,Y) RATE 2 ATT 1/RATE 2	(P,Y) RATE 1		
DIR ULL pb	push (logic only)	———						
THRUST ON pb	push							
GDC ALIGN							push	———
SCS TVC (2)					all	———		
ATVC GAIN					LO	HI		
EMS ROLL							on (up)	OFF
.05 G sw			OFF	OFF			.05 G	OFF
TVC GMBL DR (2)	AUTO	1 2			2	1 AUTO		

SM-2A-SL-2019

Figure 6-4. SCS Logic Bus Power Loss

NORMAL/BACKUP

MODE EFFECT	BUS 1 LOSS	BUS 2 LOSS	BUS 3 LOSS	BUS 4 LOSS
CMC CONTROL MODE (SC CONT - CMC)	• No effect	• CMC attitude control may exist since G&N power not affected by LOGIC BUS 2 short • ACCEL CMD (CMC) lost	• No effect	• No effect
RCS CONTROL	Direct RCS: • Operational including direct ullage	Direct RCS: • Operational including direct ullage	Direct RCS: • Operational including direct ullage	Direct RCS: • Operational including direct ullage
	SCS/SM RCS: • Control modes restricted to positions shown for BUS 1 corrective action, figure 6-4	SCS/SM RCS: • P & Y not affected • For manual roll BMAG MODE (R) - RATE 1 MAN ATT (R) - RATE CMD, ACCEL CMD or MIN IMP • For SCS att hold (R) BMAG MODE (R) - ATT 1/RATE 2 LIM CYCLE - on (up)	SCS SM/CM RCS: • MAN ATT (3) - ACCEL CMD operational (CMC or SCS) • MAN ATT (3) - MIN IMP operational if THC - CW • MAN ATT (R) - RATE CMD operational if THC-CW & SC CONT - CMC • MAN ATT (P,Y) - RATE CMD operational if THC-CW & BMAG MODE - RATE 1 or ATT 1/RATE 2 & LIM CYCLE - on (up)	SCS/SM RCS: • No effect
	SCS/CM RCS: • Use direct RCS only • Disable auto RCS RCS CMD - OFF or AUTO RCS (12) - OFF • Use single ring only	SCS/CM RCS: • P & Y not affected • Roll axis BMAG MODE (R) - RATE 1 MAN ATT (R) - RATE CMD or ACCEL CMD • .05 G function operational		SCS/CM RCS: • Roll to yaw coupling loss for post .05 G

SM-2A-SL-2020

Figure 6-5. SCS Logic Bus Power Loss (Special Effects) (Sheet 1 of 4)

MODE EFFECT	BUS 1 LOSS	BUS 2 LOSS	BUS 3 LOSS	BUS 4 LOSS
SPS CONTROL	Gimbal Control: • SCS auto TVC functional • MTVC rate cmd functional with: BMAG MODE (P,Y) - ATT 1/RATE 2 or RATE 2 • No direct ullage (for logic) • ACCEL CMD operational • THC-CW operational • If servo 1 failure TVC GMBL DR (2) - 2	Gimbal Control: • SC CONT - CMC (simultaneous CMC & SCS TVC occurs) • CMC ΔV capability exists if: SCS TVC (2) - ACCEL CMD SCS trim to 0.0° • THC-CW switchover function lost - switch to 2 by TVC GMBL DR (2) - 2	Gimbal Control: • SCS auto TVC lost • MTVC - Rate cmd operational with RATE 1 only • Accel cmd operational with RATE 2 (P,Y) • Manual switch to servo 2 with TVC GMBL DR - 2 is lost - Use: TVC GMBL DR (2) - AUTO THC-CW	Gimbal Control: • No effect
	Thrust on/off: • CMC thrust on not affected • Ullage - THC +X or DIR ULL as backup (no direct ullage for logic function) • SCS thrust on SPS THRUST - on (up) only • SCS thrust termination ΔV THRUST A (B) - OFF	Thrust on/off: • No effect	Thrust on/off: • CMC thrust on not affected • THRUST ON pb operational if THC-CW • ΔV ind operational (for thrust termination)	Thrust on/off: • No effect

SM-2A-SL-2021

Figure 6-5. SCS Logic Bus Power Loss (Special Effects) (Sheet 2 of 4)

NORMAL/BACKUP

MODE EFFECT	BUS 1 LOSS	BUS 2 LOSS	BUS 3 LOSS	BUS 4 LOSS
THC	• No effect	• THC-CW function lost - use SC CONT - SCS	• No effect	• No effect
DISPLAYS	Pre/Post .05 G: • All displays operational except RATE 1 (No source for rate display or for att ref)	Pre- .05 G: • FDAI SEL - 1/2 operational except (ball 2) att error • CMC source (ball 1) operational except CDU error • Total att, att error (ball 2) lost if: FDAI SOURCE - CMC FDAI SEL - 2 • Att error lost if: FDAI SOURCE - ATT SET ATT SET - IMU • FDAI SCALE - 5/5 lost • Yaw rate display indicates roll coupling • R & P rate display normal • BMAG R, P, Y att error (ball 2) lost if: FDAI SEL - 1/2 or FDAI SOURCE - GDC	Pre/Post .05 G: • FDAI SEL - 1/2 operational • FDAI SEL - 1 & 2 lost (for both CMC or GDC) • FDAI SOURCE - ATT SET function lost • All displays (rate, att error, total att) valid for FDAI SEL - 1/2 only • BMAG 1 & 2 rate valid	Pre/Post .05 G: • FDAI SCALE - 50/15 lost • FDAI SEL - 1 or 2 only • FDAI SOURCE - CMC or GDC operational • GDC & RSI align lost

SM-2A-SL-2022

Figure 6-5. SCS Logic Bus Power Loss (Special Effects) (Sheet 3 of 4)

MODE EFFECT	BUS 1 LOSS	BUS 2 LOSS	BUS 3 LOSS	BUS 4 LOSS
		Post .05 G: • FDAI SEL - 1/2 operational • Ball 1 - CMC source operational • Ball 2 - CMC source lost • SCS - total att, rate display, att errors normal		Post .05 G: • Display of roll to yaw coupling not void (actual coupling does not exist)

SM-2A-SL-2023

Figure 6-5. SCS Logic Bus Power Loss (Special Effects) (Sheet 4 of 4)

G&C COMPONENT	G&C FUNCTIONS LOST OR MODIFIED BUS LOSS AC1	AC2	MNA	MNB
BMAG 1	• Rate • Error		• SMRD, C/W, htr • Error	
BMAG 2		• Rate		• SMRD, C/W, htr
RHC 1	• Rate cmd		• 1/2 dir jets (full auth - MNA/MNB) • All dir jets (1/2 auth or full auth - MNA)	• 1/2 dir jets (full auth - MNA/MNB)

Figure 6-6. AC/DC Bus Loss (G&C Effects) (Sheet 1 of 2)

NORMAL/BACKUP

G&C COMPONENT	G&C FUNCTIONS LOST OR MODIFIED			
	BUS LOSS			
	AC1	AC2	MNA	MNB
RHC 2		• Rate cmd	• 1/2 dir jets (full auth - MNA/MNB)	• 1/2 dir jets (full auth - MNA/MNB) • All dir jets (1/2 auth or full auth - MNB)
ECA	• Min impulse • Att hold • Rate damping • RHC 1 rate cmd • SCS auto ΔV • RHC 1 MTVC	• Rate cmd • MTVC • Att hold | No BMAG 2 rate • Auto ΔV |	• Att hold | No BMAG 1 error • Auto ΔV |	• Min impulse (42 msec)
GDC	• R,P,Y att • FDAI roll align	• R,P,Y att • FDAI pitch, yaw align • Roll stab att (RSI)	• R,P att	• Y att • Roll stab att (RSI)
ORDEAL		• Pitch (lcl horiz) att		• Pitch (lcl horiz) att
EDA (FDAI,GPI)	• FDAI 1 (R,P,Y att, rate, error) • GPI 1 (P,Y)	• FDAI 2 (R,P,Y att, rate, error) • GPI 2 (P,Y)	• FDAI 1 (R,P,Y att)	• FDAI 2 (R,P,Y att)
RJEC (RCS)			• Yaw dir ULL jets (D3/B4) • CM RCS 1 auto jets (prior CM/SM sep)	• Pitch dir ULL jets (C3/A4) • CM RCS 2 auto jets (prior CM/SM sep)
SPS			• Bank A • GMBL mot P1, Y1	• Bank B • GMBL mot P2, Y2

Figure 6-6. AC/DC Bus Loss (G&C Effects) (Sheet 2 of 2)

The G&C circuit breakers listed in this chart must be closed throughout the mission except when necessary to correct a malfunction.

Panel 8
- SCS
  - TVC AC1
  - AC (both)
  - ECA/TVC AC2
  - CONTR DIR (4)
  - A/C ROLL (2)
  - B/D ROLL (2)
  - PITCH (2)
  - YAW (2)
  - CONTR AUTO (2)
  - LOGIC BUS 2/3 & 3/4
  - SYS (2)
- ORDEAL (2)
- RCS
  - SM HTRS (4)
  - PRPLNT ISOL (2)
- EMS (2)
- SPS (all except)
  - Gauging (4)

Panel 5
- G/N
  - LTS (both)
  - IMU (2)
  - IMU HTR (2)
  - CMPTR (2)
  - OPT (2)

Panel 229
- EPS
  - GRP 1 (both)
  - GRP 2 (both)
  - GRP 3 (both)
  - GRP 4 (both)
  - GRP 5 (both)

Figure 6-7. Limited Use G&C Circuit Breakers

Switch	Location	Position Major Portion of Mission	When Required	Remarks
CMC ATT	MDC-1	IMU	Normally not touched.	Selection of GDC position causes total attitude display to be lost on both balls. Must not be moved to GDC position if (1) pitch or yaw rate is >5°/sec, or (2) GDC yaw Euler angle is >80° and <280°. GDC damage will result if this is done.
IMU CAGE (guarded)	MDC-1	off (down)	To establish an inertial reference in event of CSS failure or IMU tumbling.	Cage mode zeros the IMU gimbals in a coarse alignment.
EMS ROLL	MDC-1	OFF	Prior to entry.	Refer to Entry and Entry Preparation procedures.
.05 G sw	MDC-1	OFF	At .05 G during entry.	Except for entry, on (up) position is not desirable (cages BMAGs). Off position powered by LOGIC 2/3 PWR - on (up).
Pc IND sw	MDC-1	Pc	Normally not touched	Left in Pc position during entire mission.
LV IND/GPI sw	MDC-1	GPI	Prior to SPS thrusting.	Placed in SIVB position during Prime Crew Prelaunch check. Temporarily placed in GPI position for SPS gimbal check during boost phase.

Figure 6-8. Limited Use Controls (Sheet 1 of 2)

Switch	Location	Position Major Portion of Mission	When Required	Remarks
LV GUID	MDC-2	IU	If inputs to SIVB control system via CMC are required.	Nonfunctional after separation from SIVB.
UP TLM	LEB-122	ACPT	Not normally changed.	Both UP TLM switches (MDC-2, LEB 122) must be in ACPT position for CMC to accept telem data. MDC-2 switch is normally used as control.

Figure 6-8. Limited Use Controls (Sheet 2 of 2)

9. ACCEL CMDs: Acceleration commands are available, via RHCs, any time MAN ATT switches are at ACCEL CMD (SC CONT - CMC or SCS). However, ACCEL CMD position inhibits any CMC outputs to RCS jets.

10. EMS MODE switch: EMS MODE switch should be placed to NORM <30 seconds prior to thrusting. Buildup of ΔV indicator errors, caused by accelerometer bias, minimized if this is done. Errors also minimized if set to STBY immediately after thrusting. Otherwise, ΔV ind continues counting.

11. MAN ATT/BMAG MODE switches: Switches may be set by axis, as desired.

12. SPS GMBL MOTORS: Start motors sequentially at ≈1-second intervals to avoid electrical overload. Turn GMBL MOT switches OFF sequentially to avoid power surge. Turning servo 2 off first minimizes switching in the logic.

13. (R02) IMU STATUS check: Procedure prerequisites signify when ISS should be on and a known orientation required. Assuming that prerequisites have been complied with, program alarm for R02 should not occur. If prerequisites are not complied with, program alarm for ISS not on and/or IMU orientation unknown is treated as shown in 8.1.16.

14. CMC ATT switch: Normally left at IMU position throughout mission. Selection of GDC position causes total attitude display to be lost on both balls. GDC damage will result if GDC position selected and pitch or yaw rate is >5°/sec, or if GDC yaw Euler angle is >80° and <280°.

15. COAS: During COAS installation or removal, verify COAS PWR switch (panel 15) is OFF. If COAS reticle lamp power is lost, the crew penlight may be used for the reticle light source. Ensure that COAS PWR switch (panel 15) is OFF. Remove COAS light bulb; insert and tape penlight in receptacle. Dimming of the reticle may be achieved by tilting penlight away from the longitudinal axis of the COAS.

16. DIGITAL AUTOPILOTS (Docked and Undocked): The Docked RCS DAP (DDAP) will normally be activated (via V45E) only when CSM is docked to the Soyuz; otherwise Undocked RCS DAP (UDAP) will be activated (via V46E). Figure 6-12 describes Docked and Undocked functional differences and capabilities. R03 and R04 are the load routines used with the Undocked and Docked DAPS respectively.

17. **COORDINATE SYSTEM: Figure 6-13 depicts the CSM/DM/SOYUZ cluster coordinate systems. Additionally, the rotations produced by various jet schemes are shown.**

6.1.2 SCS Operations

1. SCS RATE/DEADBAND: During SCS attitude control modes (4.7.1), ATT DBD and RATE switch positions establish rate and deadband response. (See figure 6-9.) For FDAI scaling, see figure 6-10. Refer to 8.2.1 for selection of CMC controlled rate and deadband.

2. SCS JET SEL: Sixteen AUTO RCS switches, consisting of four switch groups titled A/C ROLL, B/D ROLL, PITCH, and YAW with four switches each, enable CM and/or SM jets. Panel nomenclature for AUTO RCS switches summarizes jet characteristics for both SM and CM RCS jets. See figure 6-11. Refer to 6.1.3, note 1d, and 8.2.1 for CMC jet selection.

3. INADVERTENT JET FIRINGS: When powering up SCS, BMAGs should be caged to prevent inadvertent firings of RCS jets.

4. PSEUDO RATE: The pseudo rate function, controlled by LIM CYCLE switch, is used only during SCS attitude hold mode to conserve RCS propellants. However, manual SCS maneuvers with LIM CYCLE switch on cause excessive RCS injector valve cycling and increased propellant consumption. Switch does not function when in computer (CMC) mode. Also refer to note 6.

5. SIG CONDR/DR BIAS PWR switch: Powers RJEC -4 vdc bias power supplies and various SCS signal conditioners for telemetery. To provide increased reliability, switches should not be set on same bus.

6. LIM CYCLE switch: For SCS modes, LIM CYCLE switch should be configured as follows in order to conserve RCS propellant:

   OFF - Manual proportional rate command.
   OFF - Automatic rate damping.
   on (up) - Attitude hold.

7. BMAG PWR switch: When BMAG PWR switches set to OFF, 40-minute warmup may be required (BMAG 1 & 2 TEMP lights out when operating temperature reached) for optimum operation of BMAGs. However, meaningful rate information is available immediately from cold BMAGs. If set from ON to WARMUP, BMAG TEMP lights should remain out.

8. RHC's (interchange): Interchanging of RHC No. 2 with RHC No. 1 to Support an Operational Failure of RHC No. 2 during Mission.

   a. Remove RHC No. 1 and RHC No. 2 from couch armrests by releasing lock and pawl assembly.

   b. Remove cable from six restraints on couch beam starting from controller end.

   c. Loosen handle/clamp which secures couch to beam and disengage couch from clamp (R.H. and L.H. couch).

   d. Remove cable from remaining restraints to connect on junction box.

   e. Install RHC No. 1 to right hand armrest of commander's couch and secure with pawl and lock assembly.

   f. Install RHC No. 2 to left hand armrest of communication couch and secure with pawl and lock assembly.

   g. Route cable utilizing the eleven restraints on each beam and strut supports in configuration as removed.

   h. Reinstall couch in clamp located on couch beam and secure with clamp/handle.

   i. From strut establish a cable service loop approximately 10 inches in diameter atop wire tray and secure with tape as necessary.

9. RHC's (push-to-talk interchange): If the push to talk capability for the No. 1 RHC is desired, the connectors at the junction box must be interchanged since this function is not available electrically at the junction box for RHC No. 1 position. To implement this, the following procedure should be followed in addition to the above procedure for switching RHC's.

   a. Remove RHC connector shroud covers (P1 and P2) attached to the SCS junction box using tool E (stowage item).

   b. Select the off position of the normal and direct switches (2 each) on Panel No. 1 prior to demating connectors.

   c. Disconnect both connectors and remate to opposite receptacles.

   d. Reinstall connector covers using tool E.

   e. Route cables along front side ($+Z_c$) of junction box shroud and secure both cables with strap provided.

   f. Set direct and normal switches to on position.

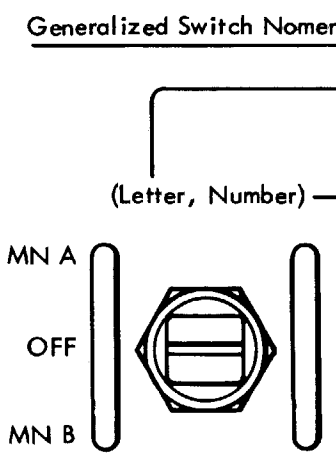
Control Parameter		SWITCH POSITIONS			
		RATE - LOW*		RATE - HIGH	
		ATT DBD:		ATT DBD:	
		MIN	MAX*	MIN	MAX
Attitude Deadband		±0.2°	±4.2°	±4.0°	±8.0°
Commanded Rates	Pitch & Yaw	±0.7°/sec		±7.0°/sec	
	Roll			±20.0°/sec	
Rate Deadband		±0.2°/sec		±2.0°/sec	

*Recommended position to minimize fuel consumption during attitude hold.

Figure 6-9. SCS Rate and Deadband Select Logic

FDAI SCALE SW POS	FLIGHT PHASE	ATT ERROR		SCS RATES
		CMC	SCS	
5/1	Boost & entry	R 20° P&Y 5°	RP&Y 5°	RP&Y 1°/sec
	All other	RP&Y 5°	RP&Y 5°	RP&Y 1°/sec
5/5	Boost & entry	R 20° P&Y 5°	RP&Y 5°	RP&Y 5°/sec
	All other	RP&Y 5°	RP&Y 5°	RP&Y 5°/sec
50/15, 50/10	Boost & entry	R 50°	R 50°	R 50°/sec
		P&Y 15°	P&Y 15°	P&Y 10°/sec
	All other	R 12.5°	R 50°	R 50°/sec
		P&Y 15°	P&Y 15°	P&Y 10°/sec

Figure 6-10. FDAI Scaling



Generalized Switch Nomenclature	Code	Description
(Letter, Number)	A,B,C or D	SM RCS Quad Designation A is -Z Quad B is +Y Quad C is +Z Quad D is -Y Quad
(Letter, Number)	1,2,3, or 4	Individual SM RCS Jet Designation 1 and 2 are roll jets 3 and 4 are quad A/C pitch jets or quad B/D yaw jets Odd nos. (1 and 3) indicate + rotation Even nos. (2 and 4) indicate - rotation
(+ or - sign, Letter)	±X, ±Y, ±Z	Translation Axis and Direction Designation
(Number,* Number*)	1 or 2	CM RCS System Designation 1 is primary system 2 is backup system
(Number,* Number*)	1,2,3,4,5 or 6	Individual CM RCS Jet Designation 1 and 2 are roll jets 3 and 4 are pitch jets 5 and 6 are yaw jets Odd nos. (1, 3 and 5) indicate positive rotation Even nos. (2, 4 and 6) indicate negative rotation

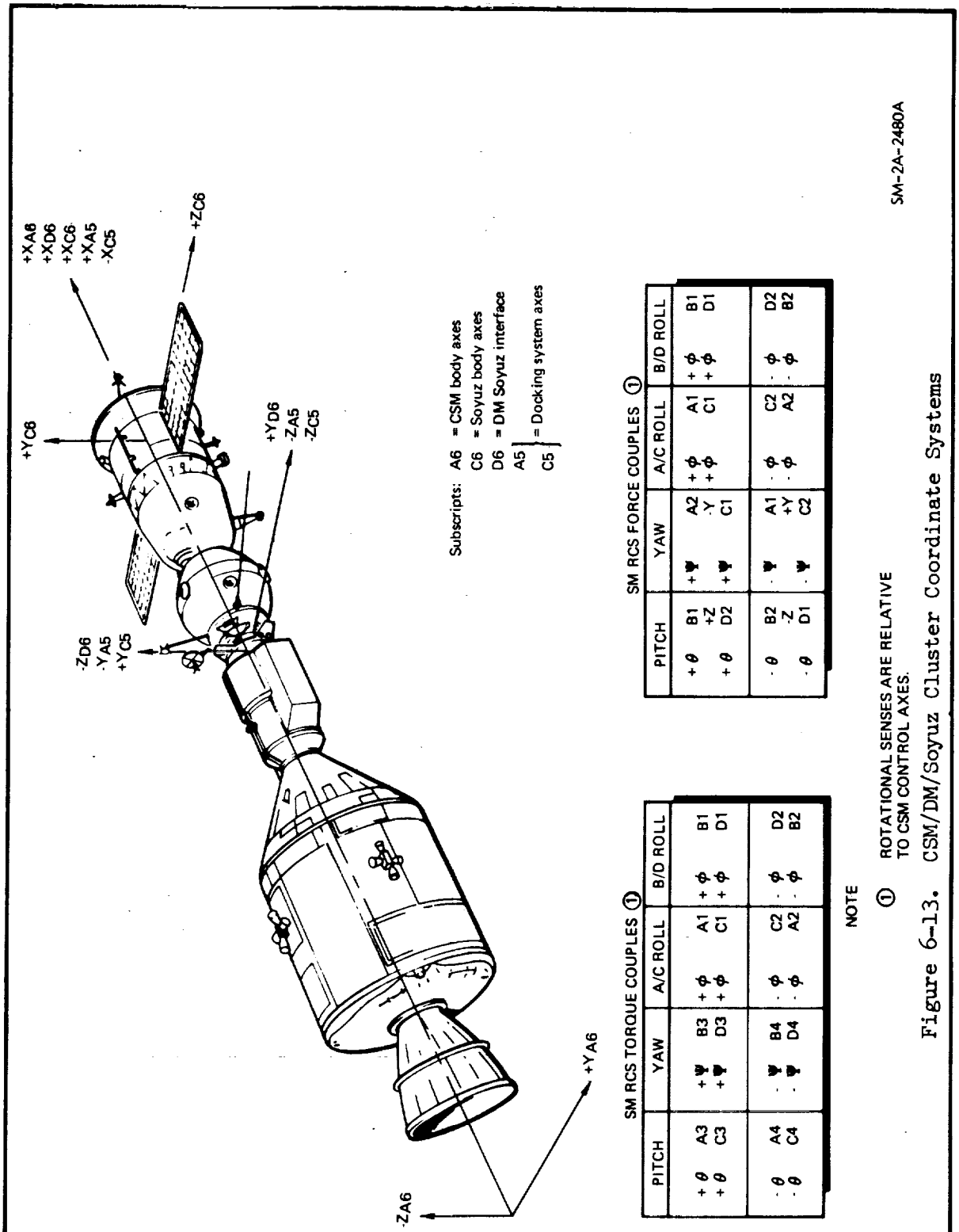
*No number means the switch is not applicable to the CM RCS system (enables only SM RCS A/C roll jets)

SM-2A-1428C

Figure 6-11. SCS Jet Select Logic: MDC-8 Nomenclature

INPUTS	MODES		
	AUTO	HOLD	FREE
GENERAL	Accepts rate and attitude commands from maneuver routine.	UDAP: Holds attitude specified by N46. DDAP: Holds attitude specified by N89.	Free drift.
RHC	UDAP: Rate commands (magnitude specified by N46) about control axes. (Inhibits auto routine.) DDAP: Rate commands (magnitude specified by N89) about control axes. (Inhibits auto routine.)	UDAP: Rate commands (magnitude specified by N46) about control axes. DDAP: Rate commands (magnitude specified by N89) about control axes.	UDAP: Minimum impulse commands (14 ms jet firing). DDAP: Acceleration commands about control axes. For pitch and yaw axes, torque couple or force pair (N87-R1) determines jets to be used for commanded acceleration.
THC	UDAP: X, Y, Z commands combined with rotation commands result in X, Y, Z translation forces to S/C (rotation has priority over translation). DDAP: Only + & -X translation commands honored.	UDAP: X, Y, Z commands combined with rotation commands result in X, Y, Z translation forces to S/C (rotation has priority over translation). DDAP: Only + & -X translation commands honored.	X, Y, Z commands combined with rotation commands result in X, Y, Z translation forces to S/C (rotation has priority over translation). When docked to Soyuz, Y, Z commands actually result in rotation because of the moment arm between CSM quad plane and cluster c.g.
MIC	Ignored	Ignored	Minimum impulse commands UDAP: (14 ms jet firing). DDAP: (50 ms jet firing).

Figure 6-12. Digital Autopilots (Docked & Undocked)



SM RCS TORQUE COUPLES ①

PITCH		YAW		A/C ROLL		B/D ROLL	
+θ	A3	+Ψ	B3	+φ	A1	+φ	B1
+θ	C3	+Ψ	D3	+φ	C1	+φ	D1
-θ	A4	-Ψ	B4	-φ	C2	-φ	D2
-θ	C4	-Ψ	D4	-φ	A2	-φ	B2

SM RCS FORCE COUPLES ①

PITCH		YAW		A/C ROLL		B/D ROLL	
+θ	B1	+Ψ	A2	+φ	A1	+φ	B1
	+Z		-Y	+φ	C1	+φ	D1
+θ	D2	+Ψ	C1				
-θ	B2	-Ψ	A1	-φ	C2	-φ	D2
	-Z		+Y	-φ	A2	-φ	B2
-θ	D1	-Ψ	C2				

NOTE

① ROTATIONAL SENSES ARE RELATIVE TO CSM CONTROL AXES.

Figure 6-13. CSM/DM/Soyuz Cluster Coordinate Systems

6.1.2

6.1.3 G&N Operations

1. GENERAL:

a. IMU STBY PWR: If standby power is removed for more than 20 minutes, ISS calibration is no longer valid.

b. CMC CONTROLLED MANEUVERS: During CMC controlled maneuvers, any input from RHC (RHC out of detent) will be interpreted by CMC as a manual override and will cause immediate termination of auto maneuver calculation. During P20 if RHC is taken out of detent, V58E may be keyed to resume the CMC controlled maneuver.

c. VEC POINT ROUTINE: VEC POINT routine (all CMC auto maneuvers except P20 options 4 and 5 and in R62) may compute large rotations about pointing vector when pointing vector must be rotated 180°. Sensitivity to such changes gets greater as magnitude increases toward 180°. If desired, a manual maneuver (≈30°) may be performed and the solution is then recomputed by keying PRO on FL V50 N18 while not in CMC/AUTO.

d. CMC JET SEL: CMC jet selection is accomplished by performing procedure 8.2.1, V48 (R03, DAP Data Load) or 8.2.2, V44 (R04, docked DAP Data Load). AUTO RCS switches should correspond to RCS DAP configuration.

e. IMU GMBL LOCK: If non-G&N controlled attitude maneuvers are made by crew, care must be taken to avoid IMU gimbal lock. IMU gimbal angles may be monitored by observing ICDUs (V16 N20) or by monitoring FDAI ball. During CMC automatic maneuvers, if MGA >75°, CMC establishes attitude hold to prevent gimbal lock. Crew must manually maneuver, or provide more suitable IMU alignment.

f. CMC PWR: If computer power is switched off, it will be necessary to perform a computer fresh start (V36E) to initialize erasable storage. CMC update program (P27) would have to be done to update the state vector and computer clock time.

g. CLOCK TIME (GET): CMC is capable of maintaining an accurate value of ground elapsed time (GET) for only 23 hours when in standby mode. If CMC is not brought out of standby condition to running condition at least once within 23 hours, CMC value of GET must be updated.

h. IMU ORIENTATION (P51): Time and RCS prplnt may be saved, and subsequent IMU alignment decisions greatly simplified if P51 is performed in such a way as to leave IMU inertially stabilized at an orientation as close as possible to optimum orientation required by future CMC programs.

i. UPLINK ACTY lt: Set when uplink (P27), or in R61 if R60 desired but maneuver inhibited. Reset when ERR RSET, KEY REL, or P27 termination.

2. CSS/ISS INTERFACE: Normally the CMC must be ON before the IMU can be operated. However, the IMU may be powered up while the CMC is at STBY. In this condition, the IMU is caged (if powered up) and remains in a coarse align mode. Caging is accomplished internally and does not require any panel switching. However, if the CMC is at STBY, the IMU can be uncaged by placing the IMU CAGE switch to on (up) for ≈5 seconds. V37 should not be called for 15 seconds after NO ATT light goes out. If V37 is called prior to 15 seconds, the PIPA FAIL bit will not be reset and a PIPA FAIL will go undetected.

3. DSKY OPERATIONS: DSKY operations (MDC-2 and LEB-140) require certain restrictions to operation, loading of data, and display of data which are necessary to proper operation. Some general restrictions are listed below. Detailed information relative to DSKY operations is contained in MIT Report E-2129, "Keyboard and Display Program and Operation."

a. DISPLAY/MONITOR VERBS: For display verbs (01-07), monitor verbs (11-17), and for all load verbs (21-25), the number of components of the verb must not exceed the number of components of the noun being used beginning with noun 04. Noun 01, 02, and 03 may be used with any verb regardless of number of components. If an attempt is made to violate this restriction, the OPR ERR indicator will illuminate when ENTR is pressed to execute the verb/noun action.

b. OCTAL/DECIMAL MIXING: No mixing of octal and decimal data will be allowed for loads having more than one component. If an attempt is made to violate this restriction, the OPR ERR indicator will illuminate when ENTR is pressed for the last entry.

c. DECIMAL/OCTAL LOADS: Octal data loads require only significant digits be keyed (e.g., 5, 4, ENTR). Loading decimal data requires each complete entry be made with a sign (+, -), followed by significant digits. Decimal load of less than 5 digits will be

accepted, just as an octal load. Zeros need not be entered ahead of most significant digit. (E.g., for a data load of +925, entry will be made by pressing DSKY keys +, 9, 2, 5, ENTR, and +, ENTR rather than +, 0, 0, 0, 0, 0, ENTR.) When loading decimal data, ENTR sometimes changes last digit of loaded value.

d. MACHINE ADDRESSES: Machine addresses must be loaded in octal.

e. DATA LOAD: If an attempt is made to load a data word which is too large in magnitude for the noun being used, the OPR ERR indicator will illuminate.

All data loads must be verified before pressing ENTR key for last register being loaded. (CLR key has no effect after last ENTR is pressed.) If any of the data is incorrect, register may be cleared by pressing CLR key. Each successive pressing of CLR key will clear preceding register until first register is cleared. (This backing up action will only operate on components called by load verb used.)

f. VERB/NOUN FLASHES: All VERB/NOUN flashes require operator action and the program in progress is halted until appropriate action is taken.

g. PROGRAM SELECTIONS: At times when program selection is not allowable by astronaut action (V37E XXE), R00 will issue a program alarm (01520) and interrupted activity will resume. Attempts to select nonexistent programs will result in an operator error light and return to interrupted program activity and display.

h. PROGRAM TERMINATION: Any program can be terminated at a flashing display via V34E except:

- P20 (except to FL V06 N49 in R22 or to FL V50 N18 in R60) can be terminated by keying P00 or V56E only. V34E on a prethrust program will turn off that program but not P20.
- V34E with an extended verb running will terminate the extended verb only.
- V34E is ignored in P06, and for response relative to N61 in P62.

STA/T STEP	PROCEDURE	PANEL	REMARKS

i. V96E: V96E may cause significant loss of W-matrix correlation if keyed in:

- After a V37E XXE from a program using average G and before XX appears in PROG lights.
- During a permanent state vector integration in P20 during mark processing.

To recover, V93E is keyed at some time prior to next navigation marks or VHF range input. In all other cases, use of V96E will cause no ill effects providing next program selected is P00.

j. V82E: After V82E, meaningful information in N50 (splash error) is available only during P11 and P00.

k. EXTENDED VERBS: Extended verbs are not restart-protected. If RESTART light goes on during an extended verb, or if software restart occurs (no RESTART light), the verb should be reselected.

l. VG/ΔV DISPLAYS: VG or ΔV displays in control coordinates, N85 or N83, are based on reading accelerometers every 2 seconds. Displays, however, are asynchronous 1-second monitors. Result is a possible 1/2- to 1-1/2-second delay between application of ΔV and visible result.

m. PRO KEY: A PRO key input is rejected if verb windows show a V21, V22, or V23. V33E must be used for these cases, e.g., a V21 PRO (or V25E PRO) will be rejected; a V25 PRO will not. For the V21, V22, V23 and PRO cases, PRO lights OPR ERR light.

n. KEY REL pb/KEY REL lt: Normal and special cases of KEY REL light and KEY REL push-button use are discussed in the following notes.

STA/T STEP	PROCEDURE	PANEL	REMARKS

KEY REL lt - on

- When internal display comes up while operator has DSKY.
- When internal flashing display is currently on DSKY and keystroke is made except for PRO, ENTR, and ERR RSET.
- Suspended monitor: When operator makes keystroke on top of (his own) monitor verbs (verbs 11-17).
- Remains on after V37 until new program is started. Operator should not use keyboard until KEY REL light is out and new program number is displayed.

o. KEY REL lt - out

- When operator relinquishes DSKY by pressing KEY REL.
- When operator terminates his current sequence normally by:

  Final ENTR of load sequence

  or ENTR, after a response to a flashing display (V34E)

  or ENTR, after an extended verb request (V49E).

p. Special cases of KEY REL

- If operator selects a nonmonitor verb display on top of his own previously selected monitor verb, the KEY REL light will flash. Pressing KEY REL will bring back (unsuspend) the monitor and extinguish light. However, if these sequences are performed on top of an internal display, the KEY REL light will not go out when KEY REL is pressed. One more KEY REL operation (total of two) is required to extinguish KEY REL light, and bring back the internal display.

- If operator selects a verb-noun combination (i.e., V16 monitor) on top of an internal flashing display, the internal display can still be answered with V32E, PRO, or V34E, which wipes everything from the DSKY until the next internal display. However, an operator-selected monitor should, as a rule, never be terminated with V34E. V34E may not be the desired response to the internal flashing display. KEY REL should be used instead. KEY REL need not be used if a data load is interrupted by a priority display.

q. N58: N58 should not be loaded, although a data load may not generate OPR ERR.

r. P20 (option 2): The following modes of suspension or termination have the effect shown:

MODE	EFFECT		
	DBD CENTERED	DBD SOURCE	RATES NULLED
RHC deflection	Yes	Unchanged	Yes
V56E	No	DAP (R03)	Yes
V37E 00E	No	DAP (R03)	Yes
SC CONT - SCS	Yes	SCS (Return to CMC re-establishes N79 DBD)	Yes (Return to CMC re-establishes N79 rate)
CMC MODE - FREE/AUTO	Yes	Unchanged	No
V46E	Yes	N79	No
CMC MODE - HOLD	Yes	N79	Poss jet firings
V48E, PRO	No	DAP (R03)	Poss jet firings (although not expected)
|MGA| >75°	No	Unchanged	Yes

s. PRIORITY DISPLAYS: There are three priority displays which will ignore any response for 2 seconds

V06 N49 in R22
V05 N09 in R52
V50 N18 in R60 (during P20)

NORMAL/BACKUP

4. OPTICS MECHANIZATION: Operation of the SCT and SXT requires adherence to certain constraints which are described as follows:

   a. To avoid sun interference, the sun position must be more than 10 degrees from optics shaft-drive axis and more than 15 degrees from star LOS for SXT, and more than 55 degrees from shaft-drive axis for SCT. Within these limits it is possible to use SXT even when sun position is between the SLOS and LLOS. The constraints given, however, do not take into account light scattering which can occur from actual spacecraft configuration.

   b. An adequate portion of the star field must be visible through SCT in order that navigational stars can be recognized. The optics shaft-drive axis thus must be pointed at least 30 degrees above local sunlit earth horizon and at least 20 degrees above local dark earth horizon.

   c. Maximum SXT LOS drive rates are 10 deg/sec for trunnion and 19.5 deg/sec for shaft, with a $\pm$20 percent tolerance.

   d. TRACKER caution light should be ignored during TVC. Optics CDU fail during TVC, sets TRACKER light which will stay on (even with fail removed) until end of TVC or keying RSET.

   e. During auto optics, computation lag between sampling IMU CDUs and driving optics causes optics to lag behind target. Amount of offset is proportional to CSM angular rate. This will not cause an error during manual tracking and marking.

   f. After a fresh start, or restart, or after turning optics power on, optics must be taken out of zero and returned to zero to perform an optics zero since it is not position of switch but change to zero position that triggers zeroing program.

   g. Optics may be damaged (when zeroing) by being driven into soft or hard stops if trunnion angle >10°. To preclude possible damage, manually drive optics <10° before initiating zeroing procedure (refer to 8.1.4).

STA/T STEP	PROCEDURE	PANEL	REMARKS
	6.2 VERB LIST		
	Regular Verbs		
	01 Disp oct compnt 1 (R1)		
	02 Disp oct compnt 2 (R1)		
	03 Disp oct compnt 3 (R1)		
	04 Disp oct compnt 1, 2 (R1, R2)		
	05 Disp oct compnt 1, 2, 3 (R1, R2, R3)		
	06 Disp dec (R1 or R1, R2 or R1, R2, R3)		
	07 Disp DP dec - test only (R1, R2)		
	11 Mon oct compnt 1 (R1)		
	12 Mon oct compnt 2 (R1)		
	13 Mon oct compnt 3 (R1)		
	14 Mon oct compnt 1, 2 (R1, R2)		
	15 Mon oct compnt 1, 2, 3 (R1, R2, R3)		
	16 Mon dec (R1 or R1, R2 or R1, R2, R3)		
	17 Mon DP dec - test only (R1, R2)		
	21 Load compnt 1 (R1)		V33E must be used for accept option if V21, V22, or V23 is in verb window. PRO is not accepted and turns on OPR ERR light.
	22 Load compnt 2 (R2)		
	23 Load compnt 3 (R3)		
	24 Load compnt 1, 2 (R1, R2)		
	25 Load compnt 1, 2, 3 (R1, R2, R3)		
	27 Disp fixed memory		
	30 Request exec		
	31 Request waitlist		

NORMAL/BACKUP

STA/T STEP	PROCEDURE	PANEL	REMARKS
32	Recycle		
33	Proceed		
34	Terminate		
35	Test lights		Use in P00 only.
36	Req fresh strt		Blanks DSKY displays. May compromise stored state vector requiring a P27 update and IMU orientation determination.
37	Change prog (major mode)		
	Extended Verbs		
*40	Zero CDU		Ensures sync between ISS CDU counters and CDU counters in CMC. Terminates coarse align and enters fine align.
41	Coarse align CDU (with N20 & N91)		N20 - Aligns IMU to gimbal angles specified by crew. To coarse align to 0, 0, 0 when GMBL LOCK and coarse align. N91 - To drive optics to shaft and trunnion angles specified by crew (V41 N91 from P00 only).
42	Fine align IMU		Pulse torque gyros.
43	Load FDAI att err needles (test only)		P00 only.
44	Strt DDAP data load		Calls routine R04. DDAP = Docked DAP.
*45	Activate DDAP		
*46	Activate UDAP		UDAP = Undocked DAP.
*47	Set Soyuz state vctr into CSM state vctr		
48	Strt UDAP data load		Calls routine R03.
49	Strt crew defined mnvr (R62)		P00 only.
	*Callable with another extended verb in use & does not lock out other extended verbs.		

VERB LIST

STA/T STEP	PROCEDURE	PANEL	REMARKS
50	Please perform		
51	Please mrk		Used in P03, R53.
53	Please mrk alternate LOS		Used in R23, R56.
54	Strt rndz backup sighting mrk (R23)		
55	Increment CMC time (dec)		
*56	Term tracking (P20)		
57	Partial/full track option		Both VHF and/or optics mark data.
*58	Rset stick flag, set V50N18 flag		Allows auto maneuvers.
*59	Enable all jets		Enables all jets previously inhibited in R04.
*60	Set att err ref to present att		N17 = N20.
*61	Sel mode 1 (disp DAP att err)		Mode 1. FDAI error needles show difference between current and DAP commanded ICDU angles.
*62	Sel mode 2 (disp tot att err)		Mode 2. Display difference between desired final ICDUs (N22) and present ICDUs (N20) resolved into CSM control axes. (N22 -N20.)
*63	Sel mode 3 (disp tot astronaut att err)		Mode 3. Display difference between astronaut total attitude (N17) and present ICDUs (N20) resolved into CSM control axes. (N17 -N20.)
64	Req opt angle transform (R64)		V64E calls R64.
*65	Strt opt verif of prelaunch align - P03		V65E calls for P03 (during P02 only).
*66	Set CSM state vctr into Soyuz state vctr		
67	Strt W matrix RSS err disp		
*69	Restrt		

*Callable with another extended verb in use & does not lock out other extended verbs.

NORMAL/BACKUP

STA/T STEP	PROCEDURE	PANEL	REMARKS
70	Strt CMC update - liftoff time (P27)		V70 through V73 are allowed only during P00, P02 or options 1, 2 and 5 of P20 (running alone).
71	Strt CMC update - block ADR (P27)		
72	Strt CMC update - single ADR (P27)		
73	Strt CMC update - CMC time (P27)		
*74	Init erasable dump via downlink		
*75	Backup liftoff		
76	Enable R27 in R22		
*77	Disable R27 in R22		
*78	Update prelaunch az		Selected only during P02.
*80	Enbl **Soyuz state vctr update**		
*81	Enbl CSM state vctr update		
82	Req orb param disp (R30)		V82E calls R30.
83	Req rndz param disp #1 (R31)		V83E calls R31 (MINKEY controller initiates V83 for P37 call).
85	Req rndz param disp #2 (R34)		V85E calls R34.
*86	Reject rndz backup sighting mrk		
*87	Set VHF range flag		
*88	Rset VHF range flag		
89	Strt rndz fnl att routine (R63)		V89E calls R63 from P00 only.
90	Req rndz out of plane disp (R36)		V90E calls R36.
91	Banksum		P00 only.
*93	Enbl W matrix init		
*96	Term integration & go to P00.		
97	SPS thrust fail (R40)		
99	Enbl eng ign		

*Callable with another extended verb in use & does not lock out other extended verbs.

STA/T STEP	PROCEDURE		PANEL	REMARKS
6.3	NOUN LIST			All nouns may be loaded via DSKY entry. However, registers containing units of XXBXX cannot be loaded and nouns containing such register data cannot be loaded by V24 or V25.
01	Specify address (fract)		.XXXXX	
	.		.XXXXX	
			.XXXXX	
02	Specify address (whole)		XXXXX.	
			XXXXX.	
			XXXXX.	
03	Specify address (deg)		XXX.XX	
			XXX.XX	
			XXX.XX	
04	Att error		XXX.XX DEG	This is a no load noun (OPR ERR).
			XXX.XX DEG	
			XXX.XX DEG	
+05	Angular err/diff		XXX.XX DEG	
			XXX.XX DEG	
+06	Option code ID		OCT	
	Option code		OCT	
+07	Flagword	ECADR	OCT	ECADR $\leq$30 (octal) will select appropriate channel (except that channel 7 attempts will be ignored).
		BIT ID	OCT	
		ACTION	OCT	
08	Alarm data	ADRES	OCT	
		BBCON	OCT	
		ERCOUNT	OCT	
09	Alarm codes	FIRST	OCT	
		SECOND	OCT	
		LAST	OCT	
10	Chan to be specified		OCT	

+Nouns not manually callable with valid data at any time.

STA/T STEP	PROCEDURE		PANEL	REMARKS
11	GETI (NCC)		OOXXX. HRS OOOXX. MIN OXX.XX SEC	
+12	Option code		OCT OCT	Used only with extended verbs.
13	GETI (NSR)		OOXXX. HRS OOOXX. MIN OXX.XX SEC	
14	OGA (star tracker) IGA (star tracker)		XXXXX. ARC MIN XXXXX. ARC MIN	Star tracker azimuth. Star tracker elevation.
15	Increment address		OCT	Used with N01, N02, and N03.
+16	Time of event		OOXXX. HRS OOOXX. MIN OXX.XX SEC	Used by extended verb only. (See N24 for limitations.)
17	Astronaut tot att	R P Y	XXX.XX DEG XXX.XX DEG XXX.XX DEG	Used in Mode 3 needles (V63).
18	Auto mnvr	R P Y	XXX.XX DEG XXX.XX DEG XXX.XX DEG	
19	OGA (star tracker)		OCT OCT	Star tracker azimuth.
20	ICDU angles	OG-R IG-P MG-Y	XXX.XX DEG XXX.XX DEG XXX.XX DEG	Present angles.
21	PIPAS	X Y Z	XXXXX. Pulses XXXXX. Pulses XXXXX. Pulses	

+Nouns not manually callable with valid data at any time.

STA/T STEP	PROCEDURE	PANEL	REMARKS
22	New ICDU angles OG-R	XXX.XX DEG	
	IG-P	XXX.XX DEG	
	MG-Y	XXX.XX DEG	
23	NB to ATM angles	XXX.XX DEG XXX.XX DEG XXX.XX DEG	Euler angles. (May apply to Soyuz coord. sys.)
+24	Δ time for CMC clock	00XXX. HRS 000XX. MIN 0XX.XX SEC	V25 N24 display initiated by V55E. (Max time = 745 hrs, 39 min, 14.55 sec.)
+25	Checklist	XXXXX.	Used with V50. (Refer to checklist codes, 6.5.)
26	Prio/delay	OCT	Used with V30, V31.
	ADRES	OCT	
	BBCON	OCT	
27	Self-test on/off sw	XXXXX.	
28	GETI (NC2)	00XXX. HRS 000XX. MIN 0XX.XX SEC	
+29	Xsm launch az	XXX.XX DEG	Xsm - X stable member.
+30	Trgt code (gyro compassing verif)	XXXXX. XXXXX. XXXXX.	
31	Time of RNDZ W-matrix last r/v initialization	00XXX. HRS 000XX. MIN 0XX.XX SEC	
32	TF perigee	00XXX. HRS 000XX. MIN 0XX.XX SEC	Time from perigee. (See N24 for limitations.)
33	GETI	00XXX. HRS 000XX. MIN 0XX.XX SEC	GETI - ground elapsed time of ignition. (See N24 for limitations.)

+Nouns not manually callable with valid data at any time.

STA/T STEP	PROCEDURE		PANEL	REMARKS
+34	Time of evnt		00XXX. HRS 000XX. MIN 0XX.XX SEC	GET. (See N24 for limitations.)
35	Time from evnt		00XXX. HRS 000XX. MIN 0XX.XX SEC	GET. (See N24 for limitations.)
36	Time of CMC clock		00XXX. HRS 000XX. MIN 0XX.XX SEC	See N24 for limitations.
37	GETI (TPI)		00XXX. HRS 000XX. MIN 0XX.XX SEC	See N24 for limitations.
38	Time of state vctr		00XXX. HRS 000XX. MIN 0XX.XX SEC	
39	GETI (last mnvr)		00XXX. HRS 000XX. MIN 0XX.XX SEC	Time of last maneuver (P38). (See N24 for limitations.)
40	TF GETI/TFC		XXBXX MIN-SEC	This is a no load noun (OPR ERR).
	VG		XXXX.X FPS	Velocity to be gained (counts down).
	ΔV (accum)		XXXX.X FPS	Velocity gained this burn.
+41	Trgt	Az	XXX.XX DEG	N41 - 2 component noun.
		Elev	XX.XXX DEG	
42	Ha		XXXX.X NM	Apogee altitude.
	Hp		XXXX.X NM	Perigee altitude.
	ΔV (req)		XXXX.X FPS	
43	Lat (+N)		XXX.XX DEG	
	Long (+E)		XXX.XX DEG	
	Alt		XXXX.X NM	

+Nouns not manually callable with valid data at any time.

STA/T STEP	PROCEDURE	PANEL	REMARKS
44	Ha	XXXX.X NM	Apogee altitude. This is a no load noun (OPR ERR).
	Hp	XXXX.X NM	Perigee altitude.
	TFF	XXBXX MIN-SEC	Time of freefall to 49.4 NM (300,000 ft) above launch pad radius.
45	Mrks (VHF/opt)	XXBXX MKS	This is a no load noun (OPR ERR).
	TF GETI (next burn)	XXBXX MIN-SEC	
	MGA	XXX.XX DEG	
46	DAP config (R03)	OCT	Undocked DAP.
		OCT	
47	CSM wt	XXXXX. LB	Undocked DAP
	LM wt	XXXXX. LB	Undocked DAP. LM wt not normally used for ASTP.
48	Pitch trim	XXX.XX DEG	Loads gimbal pitch and yaw trim angles.
	Yaw trim	XXX.XX DEG	
49	ΔR	XXX.XX NM	
	ΔV	XXXX.X FPS	
	Code (VHF/opt)	0000X.	
50	Splash err	XXXX.X NM	Negative for undershoot, positive for overshoot. This is a no load noun (OPR ERR).
	Hp	XXXX.X NM	
	TFF	XXBXX MIN-SEC	Time of freefall.
52	CENTANG (CSM)	XXX.XX DEG	Central angle of CSM.
53	R	XXX.XX NM	Range calculated from state vector.
	R dot	XXXX.X FPS	Range rate calculated from state vector.
	Phi (lcl horiz/SLOS)	XXX.XX DEG	0 to 180° = SLOS above plane.
54	R	XXX.XX NM	Range calculated from state vector.
	R dot	XXXX.X FPS	Range rate calculated from state vector.
	θ (lcl horiz/CSM +X)	XXX.XX DEG	0 to 180° = +X above plane.

STA/T STEP	PROCEDURE	PANEL	REMARKS
55	NN	0000X.	Display definition depends on using program/routine.
	E	XXX.XX DEG	Elevation.
56	Veh rate	X.XXXX DEG/SEC	This is a no load noun (OPR ERR).
		X.XXXX DEG/SEC	
		X.XXXX DEG/SEC	
57	1/2 revs	XXXXX.	
	ΔH (NCC)	XXXX.X NM	
	ΔH (NSR)	XXXX.X NM	
58	ΔV (TPI)	XXXX.X FPS	
	ΔV (TPF)	XXXX.X FPS	
	ΔT (TPI -TPI nom)	XXBXX MIN-SEC	
59	ΔVX (LOS)	XXXX.X FPS	
	ΔVY (LOS)	XXXX.X FPS	
	ΔVZ (LOS)	XXXX.X FPS	
60	G max	XXX.XX G	
	V pred	XXXXX. FPS	
	Gamma EI [lcl horiz/VI (+up)]	XXX.XX DEG	
61	Impact Lat (+N)	XXX.XX DEG	
	Impact Long (+E)	XXX.XX DEG	
	Hds up/down (+Hds up)	+/-00001.	
62	VI	XXXXX. FPS	Inertial velocity.
	H dot	XXXXX. FPS	Altitude rate.
	H pad	XXXX.X NM	Altitude above pad radius.
63	RTOGO (.05 G to splash)	XXXX.X NM	One shot display, should always be positive. .05 G represents pad loaded altitude. This is a no load noun (OPR ERR).
	VIO (at .05 G)	XXXXX. FPS	Predicted inertial velocity.
	TFE (time from .05 G)	XXBXX MIN-SEC	

STA/T STEP	PROCEDURE	PANEL	REMARKS
64	Drag accel	XXX.XX G	
	VI	XXXXX. FPS	Inertial velocity.
	Range to splash	XXXX.X NM	Negative and counting down when approaching target; positive and counting up when leaving target.
65	Sampled CMC time	00XXX. HRS 000XX. MIN 0XX.XX SEC	Fetched in interrupt.
66	Beta	XXX.XX DEG	Commanded bank angle.
	CRSRNG ERR	XXXX.X NM	Positive to right of plane (LATANG +South); negative to left of plane (-North).
	DNRNG ERR	XXXX.X NM	Negative for undershoot (PREDANGLE -θ); positive for overshoot.
67	Range to splash	XXXX.X NM	Negative counting down for approaching target; positive counting up for leaving target.
	Lat [Present pos (+N)]	XXX.XX DEG	
	Long [Present pos (+E)]	XXX.XX DEG	
68	Beta	XXX.XX DEG	Commanded bank angle.
	VI	XXXXX. FPS	Inertial velocity.
	H dot	XXXXX. FPS	Altitude rate.
69	Beta	XXX.XX DEG	Beta - commanded bank angle.
	DL	XXX.XX G	DL - drag acceleration at end of up-control.
	VL	XXXXX. FPS	VL - velocity at end of up-control.
70	Trgt code (before mrk)	OCT	Sensor/star code.
71	Trgt code (after mrk)	OCT	Sensor/star code.

STA/T STEP	PROCEDURE	PANEL	REMARKS
72	Time of R27 optim	00XXX. HRS 000XX. MIN 0XX.XX SEC	Time of R27 optimization.
73	Alt/10	XXXXX. NM	On call in P21.
	VI	XXXXX. FPS	
	Gamma	XXX.XX DEG	
74	Beta	XXX.XX DEG	
	VI	XXXXX. FPS	
	Drag accel	XXX.XX G	
75	Δ alt (NSR)	XXXX.X NM	
	ΔT (TPI -NSR)	XXBXX MIN-SEC	
	ΔT (TPI -nom TPI)	XXBXX MIN-SEC	
76	VHF R	XXX.XX NM	Current R27 values (R22, P25, P48).
	VHF R dot	XXXX.X FPS	
	Time from R27 optim	XXBXX MIN-SEC	
77	VHF R	XXX.XX NM	Optimized R27 values (R22, P25, P48).
	VHF R dot	XXXX.X FPS	
	θ/ϕ	XXX.XX DEG	R27 θ/ϕ. (ϕ in R22, θ in P48).
78	Y (gamma)	XXX.XX DEG	P20 yaw angle.
	P (rho)	XXX.XX DEG	P20 pitch angle.
	Az	XXX.XX DEG	P20 azimuth contraint.
79	Rate	X.XXXX DEG/SEC	P20 (option 2) rotation rate.
	DBD	XXX.XX DEG	P20 maneuver deadband.
80	TF GETI/TFC	XXBXX MIN-SEC	
	VG	XXXXX. FPS	
	ΔV (accum)	XXXXX. FPS	
81	ΔVX (lcl vert)	XXXX.X FPS	(ΔV components).
	ΔVY (lcl vert)	XXXX.X FPS	
	ΔVZ (lcl vert)	XXXX.X FPS	

STA/T STEP	PROCEDURE		PANEL	REMARKS
82	VGX (NSR)		XXXX.X FPS	
	VGY (NSR)		XXXX.X FPS	
	VGZ (NSR)		XXXX.X FPS	
83	ΔVX (cont)		XXXX.X FPS	(ΔV components) control = CSM control axes.
	ΔVY (cont)		XXXX.X FPS	
	ΔVZ (cont)		XXXX.X FPS	
84	VG (next mnvr)		XXXX.X FPS	
	ΔH (next mnvr)		XXXX.X NM	
	VG (3rd mnvr)		XXXX.X FPS	
85	VGX (cont)		XXXX.X FPS	(VG vector components) control = CSM control axes.
	VGY (cont)		XXXX.X FPS	
	VGZ (cont)		XXXX.X FPS	
86	ΔVX (lcl vert)		XXXXX. FPS	
	ΔVY (lcl vert)		XXXXX. FPS	
	ΔVZ (lcl vert)		XXXXX. FPS	
87	DAP config (R04)		OCT	Docked DAP.
			OCT	
			OCT	
88	Planet	X	.XXXXX	
		Y	.XXXXX	
		Z	.XXXXX	
89	DAP rate		X.XXXX DEG/SEC	Docked DAP.
	DAP DBD		XXX.XX DEG	
90	Rndz out of	Y CSM)	XXX.XX NM	Active vehicle.
	plane param	Y DOT(CSM)	XXXX.X FPS	Active vehicle.
		Y DOT(Soyuz)	XXXX.X FPS	Passive vehicle.
91	Present OCDU	Shft	XXX.XX DEG	
	angles	Trun	XX.XXX DEG	
92	New OCDU	Shft	XXX.XX DEG	
	angles	Trun	XX.XXX DEG	

NORMAL/BACKUP

STA/T STEP	PROCEDURE	PANEL	REMARKS
93 Δ gyro angles	X Gyro	XX.XXX DEG	
	Y Gyro	XX.XXX DEG	
	Z Gyro	XX.XXX DEG	
94 Alternate LOS	Shft	XXX.XX DEG	
	Trun	XX.XXX DEG	
95 GETI (NC1)		00XXX. HRS	
		000XX. MIN	
		0XX.XX SEC	
96 Rndz out of plane param	Y (CSM)	XXX.XX NM	
	Y Dot(CSM)	XXXX.X FPS	
	Y Dot(Soyuz)	XXXX.X FPS	
+97 Sys test inputs		XXXXX.	
		XXXXX.	
		XXXXX.	
+98 Sys test results and inputs		XXXXX.	
		.XXXXX	
		XXXXX.	
99 POS ERR		XXXXX. FT	RSS value of position error.
VEL ERR		XXXX.X FPS	RSS value of velocity error.
Option code		0000X	Option code (initially 00000). 00000 - No initialization 00001 - RNDZ (W-matrix initialization)

+Nouns not manually callable with valid data at any time.

STA/T STEP	PROCEDURE	PANEL	REMARKS

6.4 STAR LIST

NO.	STAR NAME (Numerical)		NO.	STAR NAME (Alphabetical)
1	Alpheratz	(α And)	6	Acamar
2	Diphda	(β Cet)	4	Achernar
3	Navi	(γ Cas)	25	Acrux
4	Achernar	(α Eri)	11	Aldebaran
5	Polaris	(α UMi)	27	Alkaid
6	Acamar	(θ Eri)	21	Alphard
7	Menkar	(α Cet)	32	Alphecca
10	Mirfak	(α Per)	1	Alpheratz
11	Aldebaran	(α Tau)	40	Altair
12	Rigel	(β Ori)	33	Antares
13	Capella	(α Aur)	31	Arcturus
14	Canopus	(α Car)	34	Atria
15	Sirius	(α CMa)	14	Canopus
16	Procyon	(α CMi)	13	Capella
17	Regor	(γ^2 Vel)	41	Dabih
20	Dnoces	(ι UMa)	43	Deneb
21	Alphard	(α Hya)	23	Denebola
22	Regulus	(α Leo)	2	Diphda
23	Denebola	(β Leo)	20	Dnoces
24	Gienah	(γ Crv)	44	Enif
25	Acrux	(α^1 Cru)	45	Fomalhaut
26	Spica	(α Vir)	24	Gienah
27	Alkaid	(η UMa)	7	Menkar

Vis Mag, Right Ascension and Declination data are in sequence with the numerical list.

Vis Mag	Right Ascension (hr)	(min)	(sec)	Declination (deg)	(min)	(sec)
2.1	0	05	48.1	+28	48	48.5
2.2	0	41	05.2	-18	15	37.9
2.8	0	53	40.4	+60	26	47.4
0.6	1	35	51.6	-57	29	25.6
2.1	1	48	52.9	+89	01	43.6
3.4	2	56	21.8	-40	30	14.6
2.8	2	59	39.7	+03	53	39.4
1.9	3	20	44.5	+49	41	05.6
1.0	4	33	03.0	+16	24	33.2
0.3	5	12	08.0	-08	15	28.7
0.2	5	12	59.6	+45	56	48.3
-0.8	6	22	50.6	-52	40	02.9
-1.5	6	42	55.6	-16	39	15.7
0.4	7	36	40.1	+05	20	53.0
1.9	8	07	59.5	-47	11	18.2
3.1	8	55	46.6	+48	14	16.6
2.1	9	25	7.8	-08	26	26.8
1.3	10	05	42.3	+12	12	44.6
2.2	11	46	29.8	+14	51	03.1
2.7	12	13	13.6	-17	15	51.4
1.5	12	23	48.0	-62	49	19.8
1.2	13	22	33.2	-10	54	04.1
1.9	13	45	34.0	+49	33	43.8

STA/T STEP	PROCEDURE	PANEL	REMARKS

NO.	STAR NAME (Numerical)		STAR NAME (Alphabetical)	NO.	Vis Mag	Right Ascension (hr)	(min)	(sec)	Declination (deg)	(min)	(sec)
30	Menkent	(θ Cen)	Menkent	30	2.2	14	03	42.9	-36	07	41.7
31	Arcturus	(α Boo)	Mirfak	10	0.2	14	13	21.0	+19	25	45.0
32	Alphecca	(α CrB)	Navi	3	2.3	15	32	34.4	+26	52	52.7
33	Antares	(α Sco)	Nunki	37	1.2	16	26	20.2	-26	19	22.5
34	Atria	(α TrA)	Peacock	42	1.8	16	43	21.2	-68	56	20.7
35	Rasalhague	(α Oph)	Polaris	5	2.1	17	32	36.9	+12	35	36.7
36	Vega	(α Lyr)	Procyon	16	0.1	18	35	15.0	+38	44	16.2
37	Nunki	(σ Sgr)	Rasalhague	35	2.1	18	52	10.0	-26	21	39.5
40	Altair	(α Aql)	Regor	17	0.8	19	48	21.4	+08	44	14.6
41	Dabih	(β Cap)	Regulus	22	3.2	20	18	12.3	-14	56	26.5
42	Peacock	(α Pav)	Rigel	12	2.1	20	21	42.3	-56	53	52.0
43	Deneb	(α Cyg)	Sirius	15	1.3	20	39	43.5	+45	06	03.2
44	Enif	(ε Peg)	Spica	26	2.5	21	41	43.8	+09	38	41.8
45	Fomalhaut	(α PsA)	Vega	36	1.2	22	54	54.1	-29	53	19.5

STAR LIST

STA/T STEP	PROCEDURE	PANEL	REMARKS
	6.5 CHECKLIST REFERENCE CODES (V50 N25)		
	R1 Code ACTION FUNCTION		
	00013 Perform Coarse align or pulse torque		
	00014 Perform Fine align option		
	00015 Perform Trgt acq		Target (celestial body) acquisition - Used in conjunction with N70, N71 and the following celestial body codes: 00 - Planet (any planet except Earth) 01 to 45 - Star 46 - Sun 47 - Earth
	00016 Key in Term mrk seq		
	00017 Perform MINKEY Rndz (displayed if REFSMFLG = 1)		Initiated when targeting programs P31 through P38 called by V37.
	00020 Perform MINKEY NPC torquing		
	00041 Sw CM/SM sep to up		Occurs in P52 during MINKEY plane change sequence.
	00062 Key in CMC pwr down		
	00204 Perform Enbl gmbl trim option		

STA/T STEP	PROCEDURE	PANEL	REMARKS

6.6 OPTION CODES (V04 N06 or V04 N12)

R1 Code	Purpose	Input for R2	
00001	Specify IMU orientation	1 = PREF 2 = NOM 3 = REFSMMAT	Specified option codes will be displayed in R1 in conjunction with V04 N06 or V04 N12. Requests desired option be loaded into R2.
00002	Specify veh	1 = CSM 2 = Soyuz	
00004	Specify state of tracking (FULTKFLG)	0 = Full track 1 = Partial track	P20, VHF and optics marks. P20, VHF or optics marks.
00012	Specify P50 option	1 = Sun sensor 2 = Sun sensor & star tracker 3 = Angles from independent source	
00013	Specify P55 option	1 = Celestial body & IMU orient 2 = Celestial body, opt mark & Soyuz solar inertial att	

STA/T STEP	PROCEDURE	PANEL	REMARKS
	R1 Code: 00024 — Purpose: Specify tracking option — Input for R2: 0 = Rndz (VECPOINT); 1 = Celestial body (VECPOINT); 2 = Rotation; 4 = Rndz (3-axis); 5 = Celestial body (3-axis)	P20.	

6.6 OPTION CODES (V04 N06 OR V04 N12)

STA/T STEP	PROCEDURE	PANEL	REMARKS
	6.7 ALARM CODES (V05 N09)		Alarms for V05 N09 (ERR RSET zeros R1 and R2; leaves R3 alone) R1 - first alarm to occur R2 - second alarm to occur R3 - last alarm to occur (There is no indication as to whether 3 or more than 3, alarms have occurred)
	Codes are listed numerically by the four least significant digits. Codes beginning with 2 or 3 signifiy the following:		The following list shows general numbering logic for alarm codes excluding interface and exceptions: 00100-00200 Optics subsystem 00200-00300 IMU subsystem 00400-00600 Rendezvous 01100-01200 Computer hardware malfunctions 01200-01300 List overflows (all aborts) 01300-01400 Interpreter errors 01400-01500 Display alarms 01500-01600 Keyboard and display programs 01600-01700 System test alarms 01700-01800 DAP display alarms
	Codes starting with 2 signifies POODOO routine: generates software restart (if ave G running or display type extended verb active, same as BAILOUT; if not, goes to ROO). Will not turn on RESTART lt		
	Codes starting with 3 signifies BAILOUT routine: generates software restart (returns to interrupted program). Does not turn on RESTART lt		
	00107 Star tracker angles out of limits		P55.
	00110 Mrk reject has been entered but ignored (continue)		Either no marks have been received or there have been no marks since last mark reject.
	00113 No chan 16 inbits (continue)		If alarm recurs, use MDC DSKY.

STA/T STEP	PROCEDURE	PANEL	REMARKS
00114	More mrks made than desired (continue)		
00115	V41 N91 keyed with OPT MODE not in CMC		Set OPT MODE - CMC and OPT ZERO - OFF. OPR ERR also lights.
00116	Opt sw altered before 15 sec zero time elapsed		Set OPT ZERO - ZERO (≈15 sec to zero).
00117	V41 N91 keyed but CMC has reserved OCDU		V41 N91 not yet available. May occur from start of drive test until end of burn. (not expected since V41 N91 is restricted to P00).
00120	Opt torque has been req but opt have not been zeroed since last FRESH START or RESTART		Set OPT ZERO - OFF then ZERO (≈15 sec to zero).
00121	SC att rates of ≥ two-thirds deg per sec will result in auto reject of sighting mrks		Repeat mark.
00205	PIPA saturated		Use SCS control. Refer to G&N malfunction procedures, symptom 12. While thrusting navigation (average G) is operating, a PIPA output in excess of 6399 pulses in a 2-second period has been detected.
00206	IMU zero routine has been entered with both GMBL LOCK lt and NO ATT lt on		Coarse align to 0, 0, 0. Reselect V40E. IMU mode switching.
00207	ISS turn-on req not present for 90 sec		Redo IMU turn on. Refer to G&N malfunction procedures, symptom 12.
00210	ISS not on		Redo IMU turn on. If alarm recurs, perform fresh start (V36E). Consult STDN. Refer to malfunction procedures, symptom 12. Used by IMU zero routine, R02, P51, and P53.

STA/T STEP	PROCEDURE	PANEL	REMARKS
00211	Coarse align err		If P51, 53/P52, 54 in progress, record gyro torquing angles and perform fine align check in P52, 54. Otherwise, refer to V41 N20. Refer to G&N malfunction procedures, symptom 12. Following coarse align, an ICDU is found not to be within 2° of its desired value.
00212	PIPA fail, but PIPA not being used		PIPA BIAS check. Refer to G&N malfunction procedures, symptom 6, step 7. A PIPA fail signal has been received by CMC but PIPAs are not being used (average G not on); or CMC has just finished with PIPAs and finds a PIPA fail signal. For latter case, ISS warning light is extinguished.
00213	IMU not operating with turn-on req		Refer to 00210. CMC has detected an ISS turn-on request but finds ISS operate not present.
00214	Prog using IMU when turned off		Refer to 00210 or exit program. IMU not in use (IMUSE flag reset). IMU in use (IMUSE flag set).
00217	IMU coarse align or pulse torque difficulty has occurred		If 00211 concurrent with 00217, proceed per 00211 recovery. If not, reinitiate current program. If alarm recurs, terminate use of ISS. Refer to G&N malfunction procedures, symptom 12. This alarm is issued in alignment program, P5X, if coarse align or gyro torquing attempted during IMU turn-on, while a cage command is present or while IMU zeroing is taking place. It is also issued if coarse align failure has occurred (code 211) or if CMC detects ISS warning light on at end of a "successful" coarse alignment or gyro torquing process.

STA/T STEP	PROCEDURE	PANEL	REMARKS
00220	IMU orient unknown		R02. Align or if aligned, set REFSMFLG.
00401	Desired middle gmbl angle excessive		If MGA >75°, CMC establishes attitude hold. Call N22 - maneuver, or realign IMU. Alarm will be generated if MGA >60° is calculated during: a. Realignment in P52/54 b. Entry attitude in P62 and P64 (if velocity is <27K FPS at .05 G point). c. P20 (options 4 or 5).
00402	Honor second MINKEY torque request		P52 - During MINKEY plane change, if first gyro torquing done, second torquing must be done.
00404	Trgt out of view (90 deg test)		P52. A trunnion angle >90° required to acquire star. This is a priority alarm and will be displayed by CMC with a flashing V05 N09.
00405	Acpt star pair not avail		In P52 and P54, CMC searches for pair of nav stars which are not <30° and not >76° apart. In addition, neither star may be occulted by earth, sun or moon, and each star must be within 38° of optics shaft axis. If no such pair can be found, alarm is displayed automatically by computer with a flashing V05 N09.
00406	Rndz nav not oper		V54 has been entered but rendezvous tracking is not operating. CMC ignores request for marks and reinstates interrupted display, if any. Select P20 (option 0 or 4), or continue.

STA/T STEP	PROCEDURE	PANEL	REMARKS
00421	W-matrix overflow		Notify STDN but continue. W-matrix automatically reinitialized at next mark.
20430	Orb integration		Notify STDN. Probable state vector uplink required. This may happen if CMC attempts to integrate a state vector that intersects earth. A state vector update may be required.
00500	Not enough jets for some pitch or yaw rotation		Docked DAP.
00501	Not enough jets for some roll rotation		Docked DAP.
00600	Failure in phase match iterations		
00601	Failure in either NC2 or NCC height mnvr iterations		
00602	Failure in outer (phase) loop iterations		
00603	Failure in QRDTPI iterations		
20607	No solution from time θ or time radius		Reselect program. Vehicle will be in a hyperbolic orbit, or entry angle too steep.
00611	No TIG for given ELEV angle		P34, P35.
00777	ISS warning caused by PIPA fail		Refer to G&N malfunction procedures, symptom 6.
01102	CMC self test err		Self check.
31104	Delay routine busy		Reselect extended verb or continue with program. Notify STDN. An internal routine (DELAYJOB) used by CMC to cause variable time delays, has received requests from more than 4 jobs.
01105	Downlink too fast		Rset. If alarm recurs, DOWNLINK FAILURE. Refer to G&N malfunction procedures, symptom 12.
01106	Uplink too fast		Rset. If alarm recurs, UPLINK FAILURE. Refer to G&N malfunction procedures, symptom 12.

ALARM CODES (V05 N09)

STA/T STEP	PROCEDURE	PANEL	REMARKS
01107	Phase table failure - assume erasable memory is destroyed		Perform: 1. V74 CMC DOWNLINK 2. P27 as necessary 3. V48 or V44 as necessary (V46/V45) 4. Re-establish REFSMMAT via P51 as necessary. If FRESH START recurs, CMC FAILURE. Refer to malfunction procedures, symptom SSR-3. During CMC restart, a phase table disagreement was found. CMC will perform an automatic fresh start if this condition exists.
31201	Exec overflow - no VAC area		Reselect extended verb and/or continue program.
31202	Exec overflow - no core sets		Refer to 31201.
31203	Waitlist overflow - too many tasks		Refer to 31201.
21204	Neg or zero waitlist call		If average G on or display type extended verb active, continue. Otherwise reselect program.
21206	Second job attempts to go to sleep via keyboard and disp prog		Refer to 21204.
21210	Second attempt is made to stall		Reselect program. Do not attempt use of device while CMC is using it. While performing certain IMU mode switching functions CMC begins a function and then "stalls" until appropriate job has been completed. If a second attempt is made to stall for the same reason (i.e., IMU mode switch), this alarm is generated.

STA/T STEP	PROCEDURE	PANEL	REMARKS
31211	Illegal interrupt of extended verb		Reselect extended verb after optics marking completed. If an internal request for marks (SXTMARK) made, CMC tests to see if mark system already busy or if an extended verb active. If either condition is discovered, alarm is generated.
01301	Arcsin or arccos input >1		Notify STDN, continue.
21302	SQRT called with neg argument		Refer to 21204.
01407	VG incr		P40. Refer to G&N malfunction procedures, symptom 12. CMC has determined that last measured value of ΔV was in such a direction as to cause VG to increase rather than decrease. As long as this condition exists, value of time to go to cutoff is not recalculated (although R1 of N40 will continue to count down) and an automatic engine-off command will not be sent by CMC.
01426	IMU unsatisfactory		Realign or use SCS. Neither +Y stable member axis nor -Y stable member axis within 30° of $\underline{V} \times \underline{R}$ where $\underline{V}$ and $\underline{R}$ are present vehicle velocity and position vectors respectively. The test for this condition performed at beginning of P61 and P62.
01427	IMU reversed		Note FDAI operation is inverted. The -Y stable member axis is within 30° of $\underline{V} \times \underline{R}$ (cf. code 1426).
21501	Keyboard and disp alarm during internal use (NVSUB).		Refer to 21204.
21502	Illegal flashing disp		Refer to 21204.

ALARM CODES (V05 N09)

STA/T STEP	PROCEDURE	PANEL	REMARKS
01520	V37 req not permitted at this time		Wait until COMP ACTY light not on continuously, reselect V37 or if P62/P67, select P00 and then desired program. Alarm will be generated if a V37 request made with IMU as follows: a. In its 90-second turn-on period b. Being caged c. Being zeroed. It will also be generated if V37 request is made for a program other than P00 after entry DAP has been started in P62, during P77, P00 integration (including P20 options 1, 2, 5 periodic integration), and P06.
21521	P01 illegally sel		Refer to 21204.
01600	Overflow in drift test		This is ground test alarm only.
01601	Bad IMU torque abort		Refer to 01600. Generated in P01, P02, or P07.
01703	Insufficient time for integration		P40, P41. Will occur between TIG -42.5 and TIG -35 seconds.
32000	DAP JASK still in process when next JASK attempted		Docked DAP.
03777	ISS warning caused by ICDU fail		Refer to G&N malfunction procedures, symptom 6.
04777	ISS warning caused by ICDU and PIPA fail		Refer to G&N malfunction procedures, symptom 6.
07777	ISS warning caused by IMU fail		Refer to G&N malfunction procedures, symptom 6.
10777	ISS warning caused by IMU and PIPA fail		Refer to G&N malfunction procedures, symptom 6.
13777	ISS warning caused by IMU and ICDU fail		Refer to G&N malfunction procedures, symptom 6.
14777	ISS warning caused by IMU, ICDU, and PIPA fail		Refer to G&N malfunction procedures, symptom 6.

STA/T STEP	PROCEDURE	PANEL	REMARKS

6.8 CMC PROGRAM - ROUTINE INDEX

6.8.1 Programs

Phase	Program No.	Program Title	Contains Crew Interface Routines
Pre-Launch & Service	00	CMC idling	R00
	01	Prelaunch or service init	None
	02	Prelaunch or service gyro compassing	None
	03	Prelaunch or service opt verif of gyro compassing	None
	06	CMC pwr down	R00
	07	System test	
Boost	11	Earth orb insertion monitor	R00
Coast	20	Universal track & rndz nav	R00,R02,R07, R21,R22, R23,R27, R52,R60, R61,R67
	21	Grd track determ	R00
	25	Contingency R dot	R00,R27
	27	CMC update	None
	29	Time of Longitude	R00

Do not select the following program sequences:

a. P40/P41 - P27 - P52
(P27 overwrites preferred attitude computations) Redo P40/P41 up to V50 N18, then reselect P52

b. P27 - P40/P41 - P52
Reload preferred REFSMMAT from ground.

STA/T STEP	PROCEDURE		PANEL	REMARKS
Phase	Program No.	Program Title	Contains Crew Interface Routines	
Pre-Thrusting	30	External ΔV	R00	
	31	NC1 targeting	R00,R07	
	32	NC2 targeting	R00,R07	
	33	NCC targeting	R00,R07	
	34	NSR targeting	R00,R07	
	35	TPI targeting	R00,R07	
	36	TPM targeting	R00,R07	
	37	TPF targeting	R00,R07	R00 via R31.
	38	NPC targeting	R00,R07	
Thrusting	40	SPS	R02,R07,R40, R41,R60,R00	
	41	RCS	R02,R07,R41, R60,R00	
	47	Thrust mon	R02,R41,R00	
	48	RNDZ thrust mon (final phase)	R02,R07,R27, R41,R00	Called as final program in MINKEY rendezvous sequence.
Align-ment	50	Soyuz orient determ	R00,R02,R53	
	51	IMU orient determ	R02,R53,R54, R00	
	52	IMU realign	R02,R07,R50, R00,R52, R53,R54 R55	
	53	Back-up IMU orient determ	R56,R54,R00	

STA/T STEP	PROCEDURE		PANEL	REMARKS
Phase	Program No.	Program Title	Contains Crew Interface Routines	
	54	Back-up IMU realign	R02,R50,R00, R56,R54,R55	
	55	Soyuz Star Tracker Gimbal Angle Program	R02,R53,R00	
Entry	61	Entry prep	R02	
	62	CM/SM sep and pre-entry mnvr	R02	
	63	Entry init	None	
	64	Post 0.05 G	None	
	65	Entry upcontrol	None	Although P65 and P66 are included in the ASTP, they are bypassed in Earth orbit missions and, therefore, are not included in the Entry procedures, sec 14. (For Earth orbit missions, P64 automatically calls P67 as next program.)
	66	Ballistic entry	None	
	67	Fnl phase	R00	
Post thrusting	77	CSM velocity vector update	R00	

STA/T STEP	PROCEDURE	PANEL	REMARKS
6.8.2 Routines			
Routine	Routine Title		
00	Fnl auto req term		
01	Erasable & chan modification		
02	IMU stat check		
03	Undocked DAP (UDAP) data load		Manually selected by crew (V48E).
04	Docked DAP (DDAP) data load		Manually selected by crew (V44E).
07	MINKEY controller		Initiated by selection of a rndz targeting program.
08	VHF radar read		Selected by R22 when enabled by V87E (disabled by V88E). Selected by R22 via R27 when enabled by V76E (disabled by V77E). Selected by P25 and P48 via R27.
21	Rndz tracking sighting mrk		P20 (options 0, 4). Selected by MARK or MARK REJ.
22	Rndz tracking data processing		P20 (options 0, 4).
23	Backup rndz tracking sighting mrk		Manually selected by crew (V54E).
27	VHF range/range rate filter		Selected auto by either P25 or P48. Selected by R22 via V76E (disabled by V77E or by P20 initialization).
30	Orb param disp		May be called by crew (V82E).
31	Rndz param disp routine No. 1		Displays range, range rate, and the angle between CSM +X axis and local horizontal (theta). Selected by crew (V83E), or automatically by MINKEY controller via P37.

STA/T STEP	PROCEDURE	PANEL	REMARKS
Routine	Routine Title		
34	Rndz param disp routine No. 2		Displays range, range rate, and angle between optics star line of sight and local horizontal (phi). Selected by crew (V85E).
36	Rndz out of plane disp		Selected by V90E.
40	SPS thrust fail		Selected by P40.
41	State vctr integration (mid to ave)		Selected by P40, P41, P47, P48.
50	Coarse align		Selected by P52, P54.
52	Auto opt positioning		Automatically selected by P20 or P52. It is self-perpetuating and terminated by R53 for star sightings.
53	Sighting mrk		Selected in R52 by OPT MODE - MAN or OPT ZERO - ZERO. Selected in P50, N06 (options 1 or 2). Selected auto in P51, P52. Selected in P55, N06 (option 2).
54	Sighting data disp		Selected auto by P51, P52, P53, P54.
55	Gyro torquing		Selected auto by P52, P54.
56	Alternate LOS sighting mrk		Used to perform sighting marks for backup alignment programs P53 and P54.
60	Att mnvr		Selected by P40, P41, R61(P20), R62(V49E), R63(V89E).
61	Tracking att		Orients CSM properly with respect to target vehicle during target tracking. Selected auto by P20 and by R52 during P20.
62	Crew defined mnvr		Selected by (V49E) via P00 only.
63	Rndz fnl att		Selected by (V89E) via P00 only.
64	Opt angle transform		Selected by (V64E).
67	Rotation mnvr		P20 (option 2).

6.9 CMC PROGRAM - FLAG LISTING (Defines Location & Utilization)

Title	Code	Flag Word	Memory Address	Bit	When Set	When Reset
	P29FLAG	0	00074	1	P29 running. 1st pass in progress	P29 finished with 1st pass
Rendezvous	NC12FLG	0	00074	5	P32 (NC2)	P31 (NC1)
Sighting mark	SGTMK	0	00074	6	FL V51 initiated	FL V51 not initiated
Rendezvous	RNDVZFLG	0	00074	7	P20 (option 0 or 4) initiated	P20 (option 1, 2, 5) initiated
IMU	IMUSE	0	00074	8	IMU in use	IMU not in use
Alignment	P50FLAG	0	00074	10	P50 initiated	P50 not initiated
	P50.1FLG	0	00074	12	P50 option 1 selected	P50 option 1 not selected
	P55.1FLG	0	00074	13	P55 option 1 selected	P55 option 1 not selected
Marking	MARKFLG	1	00075	4	Mark accepted, allow mark reject	Mark not accepted, do not mark reject
Track	TRACKFLG	1	00075	5	P20 tracking	P20 not tracking
Update	UPDATFLG	1	00075	7	State vector updating by marks allowed	State vector updating by marks not allowed

Title	Code	Flag Word	Memory Address	Bit	When Set	When Reset
State vctr	CSMUPDAT	1	00075	8	CSM state vector to be updated by nav measurement. Can be set by V81E.	Soyuz state vector to be updated by nav measurement. Can be reset by V80E.
Trgt 1	SWSTRG	1	00075	10	Sighting Soyuz	Not sighting Soyuz.
Prelaunch	NODOP01	1	00075	12	Inhibits P01 (set 1 near start of P11)	Enables P01 (set 0 by pad load)
Stick flag	STIKFLAG	1	00075	14	RHC out of detent or |MGA| >75° (auto maneuver not enabled)	RHC in detent & |MGA| <75° (auto maneuver enabled)
Preferred att	PFRATFLG	2	00076	4	Preferred SC attitude computed	Preferred SC attitude not computed
Final computation	FINALFLG	2	00076	6	Final pass through rendezvous program computations	Interim pass through rendezvous program computations
External ΔV	XDELVFLG	2	00076	8	External ΔV VG computations	Lambert VG computations
	ITERFLG	2	00076	13	15 iterations have occurred	15 iterations have not occurred
Marking (P20)	R21MARK	2	00076	14	P20 (options 0 or 4) active (special mark processing & optics rather than B/U marks being processed). Set on V54 (R23) exit.	P20 (options 1, 2, 5) active

CMC PROGRAM - FLAG LISTING

Title	Code	Flag Word	Memory Address	Bit	When Set	When Reset
Gyro drift compensation	DRIFTFLG	2	00076	15	Drifting flight gyro compensation performed	Drifting flight gyro compensation not performed
Docked/Undocked DAPS	45/46FLG	3	00077	6	V45E	V46E
IMU orientation known (REFSMMAT)	REFSMFLG	3	00077	13	REFSMMAT good	REFSMMAT not good
Maneuvers	GLOKFAIL	3	00077	14	Gimbal lock has occurred	Not in gimbal lock
Auto maneuvers	V50N18FL	3	00077	15	Start of P20, V37E, or V58E (unless P00 selected). If Δ angle >10° in R61, R60 entered	Upon completion of R61
(No OH listing)		4	00100			
W matrix (rndz nav)	RENDWFLG	5	00101	1	W matrix for rendezvous navigation is valid	W matrix for rendezvous navigation is invalid
Liftoff discrete	BKUPLO	5	00101	5	V75E backup of L/O discrete	Prior to L/O. Remains reset if no V75E
3 axis	3AXISFLG	5	00101	6	Maneuver specified by 3-axes: P20 (option 4, 5), V49	Maneuver specified by VECPOINT P20 (option 0, 1), P40/P41, V89
Rendezvous	ITSWICH	7	00103	14	Solution for TPI time not reached	Solution for TPI time reached
Terminate	TERMIFLG	7	00103	15	Terminate R52 and R53	Do not terminate

Title	Code	Flag Word	Memory Address	Bit	When Set	When Reset
Tracking (P20)	R67FLAG	8	00104	2	R67 (P20 option 2) rotation active	R67 rotation not active
P00 integration	V96ONFLG	8	00104	3	P00 integration inhibited. Set by V96E	Integration proceeding normally (P00 selected)
Tracking (P20)	UTFLAG	8	00104	9	P20 (options 1, 2, 5) selected	P20 (options 0, 4) selected, or by P00, V56E, P06, P00D00 or IMU turn off
Select R31/R34	R31FLAG	9	00105	4	V83E (request R31)	V85E (request R34)
Terminate periodic P00 integration	QUITFLAG	9	00105	5	V96E (stop P00 periodic state vector integration)	Reset in P00 (if found to be set) remains reset until new prog (other than P27) selected.
FDAI error (N22 or N17)	N22ERNDS	9	00105	6	V62E	V63E
Marking (R22)	R22CAFLG	9	00105	7	Optics mark being processed	Optics mark not being processed
Marking (R22)	VHFSOURC	9	00105	8	VHF radar used as input source for marks	Optics mark used as input source
VHF ranging	VHFRFLAG	9	00105	9	V87E Process VHF ranging data (periodically)	V88E (or R00) do not process VHF ranging data

CMC PROGRAM - FLAG LISTING

Title	Code	Flag Word	Memory Address	Bit	When Set	When Reset
Targeting (P38)	PCFLAG	10	00106	1	In P38 (P38 plane change trgting to be done)	Not P38, PRO on V50 N25 (R1 = 17), in P52 if pulse torquing done.
Marking	FULTKFLG	10	00106	2	Either optics or VHF marks to be taken (set in V57)	Both optics and VHF marks to be taken (reset in V57)
Targeting (P35)	TPIMNFLG	10	00106	3	TPI targeting complete	TPI targeting not complete
	PTV93FLG	10	00106	4	V93 to be done after maneuver	Maneuver and V93 done
	MANEUFLG	10	00106	5	Indicates no mark has been processed since last final computation cycle of a targeting program (except P38). Set on PRO response to FL V50 N25 (R1 = 00017)	Mark incorporated in R22
Plane change	TCOMPFLG	10	00106	6	(- then + torque)	(+ then - torque)
MINKEY rendezvous	AUTOSEQ	10	00106	7	Automatic rendezvous (MINKEY) sequence running	Non-MINKEY rendezvous selected
Rendezvous	P35FLAG	10	00106	8	MCC targeting done	MCC targeting not done

Title	Code	Flag Word	Memory Address	Bit	When Set	When Reset
Ranging (P20)	EXTRANGE	10	00106	9	In R61	In R00
Tracking	HDSUPFLG	10	00106	11	Heads-up attitude	Heads-down attitude
Marking	REJCTFLG	10	00106	12	Mark to be rejected in R22 by MARK REJ or V86	No mark reject in R22 (reset in R22 after mark processing)
Maneuver (P20)	PCMANFLG	10	00106	15	P20 NPC maneuver	No P20 NPC maneuver
Rendezvous	R27UP1	11	00107	1	1st pass in R27 complete	1st pass not complete
Rendezvous	R27UP2	11	00107	2	2nd pass in R27 complete	2nd pass not complete
Rendezvous	TDFLAG	11	00107	3	TD angle in R27 computed	TD angle in R27 not computed
Ranging	P25FLAG	11	00107	4	P25 operating	P25 not operating
Thrusting	P48FLAG	11	00107	5	P48 operating	P48 not operating
Rendezvous	SNAPFLAG	11	00107	6	Inhibit R22 mrk processing	Allow R22 mrk processing
Rendezvous	FIXFLAG	11	00107	7	R27 in optimizing mode	R27 in current mode
Tracking (P20)	AZIMFLAG	11	00107	8	P20 (options 4, 5). Indicates 3-axis maneuver desired in R61	P20 (options 0, 1, 2) and by V89 before maneuver calculated

CMC PROGRAM - FLAG LISTING

Title	Code	Flag Word	Memory Address	Bit	When Set	When Reset
Ranging	N77FLAG	11	00107	9	N77 = optimized R dot	Allow current state in N77
Display	NOUNFLG	11	00107	10	Display N77	Display N76
Rendezvous	CYCLFLAG	11	00107	11	R27 processing mark	R27 ready for new mark
Rendezvous	R27FLAG	11	00107	12	Allow R27 in P20 (V76E)	Inhibit R27 in P20 (V77E)
NON-FLAGS						
ISS zero	IMODES30		01323	9	IMU operate bit present (set to 0)	IMU operate bit not present (reset to 1)
Att hold	HOLDFLAG		01330			

(+) Sample CDU angles before resuming attitude hold and resetting HOLDFLAG to (+0).

(+0) Remain in attitude hold at previously established reference angles. Set (this state) by DAP when |MGA| >75°

(-) Enable automatic steering.

STA/T STEP	PROCEDURE	PANEL	REMARKS
	7.0 G&C REFERENCE MODES		
	This section provides information about basic G&C functions by defining them in terms of system operating prerequisites and switch positions which together represent reference modes. Their scope is limited to independent system functions. These reference modes are repeatable and are applicable to all G&C procedures and thus are referenced in all subsequent sections of G&C procedures. The modes, however, are NOT intended to be complete or self-contained procedures.		
	Wherever a step in one of these G&C reference modes references another mode, the title and paragraph number of the referenced mode is shown and the recommended options in the mode, if any, are specified. Only those switches which are required to be in unique positions are shown in the affected step after the mode is referenced.		
	During time-critical mission phases, reference to other sections of the handbook cannot be accommodated, and, therefore, all time-critical operations are self-contained. Modes similar to those shown in this section, however, are contained or repeated within the time-critical procedures.		
	For general G&C operating data, refer to operating notes, 6.1.		
	7.1 ATTITUDE CONTROL		
	7.1.1 SCS Channel Selection		Provides methods for enabling RCS auto coils without undesirable jet firings.
	1 Set pwr sw		
AC	LOGIC 2/3 PWR - on (up)	7	Supplies 28 vdc to SC CONT switch, THC CW switch and ATT 1/RATE 2 and RATE 2 positions of BMAG MODE switches.
	SIG CONDR/DR BIAS PWR (both) - AC1 or AC2		6.1.2, note 5.

STA/T	STEP	PROCEDURE	PANEL	REMARKS
	2	Enable auto coils		
AC		For CMC cont SC cont - CMC/FREE SC CONT - CMC CMC MODE - FREE	1	For post CM/SM separation, AUTO RCS A/C ROLL switches should be OFF, and DAP configured for B/D roll. Also refer to 6.1.1, note 8.
		MAN ATT (3) - MIN IMP or RATE CMD		6.1.1, note 9.
		AUTO RCS (16) - as desired	8	
		For SCS cont		
		a. SC cont - SCS SC CONT - SCS	1	
		or SC CONT - CMC THC - CW		
		b. BMAG MODE (3) - RATE 2		BMAG MODE or MAN ATT switching prevents attitude error signals from causing jet firings.
		or MAN ATT (3) - MIN IMP or ACCEL CMD		
		c. AUTO RCS (16) - MNA or MNB	8	For SCS control, switches should be set by quad and rotation axis, as desired. Only one roll quad should be enabled for SCS control to optimize RCS fuel consumption. One exception is 3-axis translation when all quads required.

SCS CHANNEL SELECTION

STA/T	STEP	PROCEDURE	PANEL	REMARKS
		7.1.2 SCS Minimum Impulse		
	1	Set pwr sw		
AC		ELEC PWR - GDC/ECA or ECA	7	Either position required for minimum impulse generator.
		LOGIC 2/3 PWR - on (up)		Supplies 28 vdc to SC CONT and THC CW switches. 6.1.2, note 5.
		SIG CONDR/DR BIAS PWR (both) - AC1 or AC2		
		RHC PWR NORM (both) - AC/DC	1	
	2	Sel min imp cont		
		SC cont - SCS/MIN IMP		Switches should be set by axis as desired.
		SC CONT - SCS		
		MAN ATT - MIN IMP		
		or SC CONT - CMC		
		MAN ATT - MIN IMP		
		THC - CW		
	3	Enable auto coils, 7.1.1		
		7.1.3 SCS Acceleration Command		
	1	Set pwr sw		
		LOGIC 2/3 PWR - on (up)	7	Supplies 28 vdc to SC CONT switch. 6.1.2, note 5.
		SIG CONDR/DR BIAS PWR (both) - AC1 or AC2		
		RHC PWR NORM (both) - AC/DC	1	
	2	Sel accel cmd cont		
		MAN ATT - ACCEL CMD		Switches should be set by axis as desired.
	3	Enable auto coils, 7.1.1		Either CMC or SCS control permissible while enabling coils.

STA/T	STEP	PROCEDURE	PANEL	REMARKS
		7.1.4 SCS Attitude Hold/Rate Command		
	1	Set pwr sw		
AC		LOGIC 2/3 PWR - on (up)	7	Supplies 28 vdc to SC CONT switch.
		ELEC PWR - GDC/ECA or ECA		
		SIG CONDR/DR BIAS PWR 1 - AC1 or AC2		Provides SCS signal conditioner power for RHC proportional rate command TLM. Also refer to 6.1.2, note 5.
		BMAG PWR (both) - ON		If rate damping only desired, BMAG 1 need not be turned ON but should be set to WARMUP.
		RHC PWR NORM (1, 2 or BOTH) - AC/DC	1	If manual override of attitude hold desired.
	2	Enable auto coils, 7.1.1		6.1.1, note 8.
	3	Establish att hold/rate cmd		Switches may be set by axis as desired. Also refer to 6.1.2, note 6.
		SC cont - SCS/RATE CMD		
		SC CONT - SCS		
		MAN ATT - RATE CMD		
		or SC CONT - CMC		
		MAN ATT - RATE CMD		
		THC - CW		
		SC cont - SCS/att hold		MAN ATT - RATE CMD and BMAG MODE - ATT 1/RATE 2 inclusive required to establish attitude hold.
		SC CONT - SCS		
		MAN ATT - RATE CMD		

SCS ATTITUDE HOLD/RATE COMMAND

STA/T STEP	PROCEDURE	PANEL	REMARKS
AC	or SC CONT - CMC MAN ATT - RATE CMD THC - CW	1	
	BMAG MODE - ATT 1/RATE 2		
	7.1.5 CMC Minimum Impulse		
	1 The following are req CMC - on, 8.1.3 RCS DAP - load & activate, 8.2.1		CMC, ISS, and RCS DAP enable autopilot control. Minimum impulse controller (MIC), located on panel 122 in LEB, and RHC provide minimum impulse command capability in this mode. RHC will provide normal acceleration commands providing MAN ATT switches at ACCEL CMD.
	ISS - on (desired), 8.1.3		For display of ISS total attitude and errors.
	2 Set pwr sw LOGIC 2/3 PWR - on (up) SIG CONDR/DR BIAS PWR (both) - AC1 or AC2	7	Supplies 28 vdc to SC CONT switch. 6.1.2, note 5.
	RHC PWR NORM (both) - AC/DC	1	
	3 Establish CMC Cont SC cont - CMC/MIN IMP SC CONT - CMC CMC MODE - FREE MAN ATT (3) - MIN IMP		ACCEL CMD position cannot be used (inhibits CMC outputs to jets).

STA/T	STEP	PROCEDURE	PANEL	REMARKS
AC		or SC CONT - CMC CMC MODE - FREE MAN ATT (3) - RATE CMD BMAG MODE (3) - RATE 2	1	
		For accel cmds MAN ATT (3) - ACCEL CMD		6.1.1, note 9.
	4	Enable Auto Coils, 7.1.1		
		7.1.6 CMC Attitude Control - Auto/Hold		
	1	The following are req CMC - on, 8.1.3 ISS - on, 8.1.3 RCS DAP - load & activate, 8.2.1		CMC, ISS, and RCS DAP enable autopilot control.
	2	Set pwr sw LOGIC 2/3 PWR - on (up) SIG CONDR/DR BIAS PWR (both) - AC1 or AC2	7	Supplies 28 vdc to SC CONT switch. 6.1.2, note 5.
	3	Enable auto coils, 7.1.1		
	4	Establish att cont SC cont - CMC/AUTO SC CONT - CMC CMC MODE - AUTO MAN ATT - MIN IMP	1	AUTO position must be selected when CMC automatic maneuver desired.

STA/T	STEP	PROCEDURE	PANEL	REMARKS
AC		or SC CONT - CMC CMC MODE - AUTO MAN ATT - RATE CMD	1	
		SC cont - CMC/HOLD SC CONT - CMC CMC MODE - HOLD MAN ATT - MIN IMP		
		or SC CONT - CMC CMC MODE - HOLD MAN ATT - RATE CMD		
		7.1.7 SIVB Attitude Control		Describes condition required to enable RHC rate control of SIVB.
	1	The following are req CMC - on, 8.1.3		
		LOGIC 2/3 PWR - on (up)	7	Supplies power for caging BMAGs via BMAG MODE switches.
		ISS - on (desired), 8.1.3		For display of ISS total attitude and errors.
	2	Enable att cont		
CP		Saturn DAP activated, 8.2.1	2,140	Load 3 in configuration option of DAP activation procedure. Also refer to 6.1.1, note 8. When RCS CMD - ON, AUTO RCS switches should be off to prevent SM jet firing.
		LV GUID sw - CMC	2	SIVB attitude control for boost normally provided by IU. Switch is set to CMC if SIVB takeover required.

NORMAL/BACKUP

STA/T	STEP	PROCEDURE	PANEL	REMARKS
		7.1.8 Direct RCS		Provides RCS direct coil commands when RHC deflected (≈11°) to direct switches. Direct commands inhibit SCS and CMC commands to auto coils in respective axis (or axes). RCS continues to fire as long as direct commands present. G&N and/or SCS systems may be on or off.
AC		SIG CONDR/DR BIAS PWR 1 - AC1 or AC2	7	Provides SCS signal conditioner power for RHC direct enable TLM. Also refer to 6.1.2, note 5.
	1	Enable direct RCS Full authority RHC PWR DIR (1, 2 or both) - MNA/MNB		All RCS direct coils enabled.
		or RHC PWR DIR 1 - MNA RHC PWR DIR 2 - MNB		
		Maneuver RHC - deflect to hardstops		If G&N/SCS systems on, and configured to fire RCS jets, will have momentary firing of auto coils until direct switches close (in axis). Closing direct switches inhibits both + and - auto commands.
		Half authority		Configures direct RCS for half authority, which prevents more than two SM RCS roll thrusters and more than one pitch and yaw thruster from firing in any one direction. If consideration essential, also provides method of minimizing RCS propellant consumption in direct RCS mode.

STA/T STEP	PROCEDURE	PANEL	REMARKS
AC	cb SCS CONTR DIR 1 MNB (MNA) - open cb SCS CONTR DIR 2 MNA (MNB) - open	8	Enables following direct thrusters:
	RHC PWR DIR (both) - MNA/MNB	1	

AXIS	cb's open: DIR 1 MNB, DIR 2 MNA — Jets enabled	cb's open: DIR 1 MNA, DIR 2 MNB — Jets enabled
+P	C3	A3
-P	A4	C4
+Y	B3	D3
-Y	D4	B4
+R	C1, A1	D1, B1
-R	C2, A2	D2, B2

Maneuver
RHC - deflect to hardstops

2 To terminate direct RCS
RHC - neutral

3 To inhibit direct RCS
RHC PWR DIR (1, 2 or both) - OFF

7.2 DYNAMIC DISPLAY MONITOR

7.2.1 Rate Display

Provides methods for displaying rate information on rate needles of FDAI 1 or FDAI 2, or both, as desired.

1 Set pwr sw
FDAI/GPI PWR - 1, 2 or BOTH — 7

Provides power for display electronics. Position chosen depends on which FDAI(s) desired.

NORMAL/BACKUP

STA/T	STEP	PROCEDURE	PANEL	REMARKS
AC		LOGIC 2/3 PWR - on (up)	7	6.1.1, note 7.
		BMAG 2 PWR - ON (req if BMAG 2 desired) BMAG 1 PWR - ON (req if BMAG 1 desired)		Either BMAG 1 or BMAG 2 may be selected to provide information. BMAG 2 normally used and BMAG 1 provides backup capability.
	2	Sel desired rate source BMAG MODE - RATE 2 or ATT 1/RATE 2	1	Switches should be set by axis as desired. Selects BMAG 2.
		or BMAG MODE - RATE 1		Selects BMAG 1.
	3	Sel disp configuration FDAI SEL - 1		Displays rate from BMAG 1 or 2 on FDAI 1 only.
		or FDAI SEL - 2		Displays rate from BMAG 1 or 2 on FDAI 2 only.
		or FDAI SEL - 1/2		Displays rate from BMAG 1 or 2 on both FDAIs.
		7.2.2 Attitude Error Display - BMAG Source		Provides methods for displaying BMAG 1 attitude error information on FDAI 1 or FDAI 2. Needles display attitude excursion from point at which BMAGs are uncaged up to a maximum of 17°.
	1	Set pwr sw FDAI/GPI PWR - 1, 2 or BOTH	7	Provides power for display electronics. Position chosen depends on which FDAI(s) desired.

ATTITUDE ERROR DISPLAY - BMAG SOURCE

STA/T STEP	PROCEDURE	PANEL	REMARKS
AC	LOGIC 2/3 PWR - on (up)	7	Supplies power for caging BMAGs via BMAG MODE switches.
	BMAG 1 PWR - ON		Powers BMAGs in gyro assembly 1, the only BMAGs capable of providing attitude error information.
2	Provide att err info MAN ATT - RATE CMD	1	Switches should be set by axis as desired. RATE CMD position required to uncage BMAG 1. However, RHC breakout and MAN ATT switches overridden by IGN 2 logic signal during thrusting to uncage BMAGs.
	BMAG MODE - ATT 1/RATE 2 .05 G sw - OFF (verify)		On (up) position not desirable (cages BMAGs).
	RHC - neutral		If RHC breakout switches activated, BMAGs caged (by axis) and attitude hold lost.
3	Sel disp configuration		
	a. FDAI SEL - 1/2		Displays attitude error from BMAG 1 on FDAI 2.
or	b. FDAI SEL - 1 or 2 FDAI SOURCE - GDC		Displays attitude error from BMAG 1 on FDAI 1 or 2. This position required when only one FDAI selected.
7.2.3	Attitude Error Display - CMC Source		Provides G&N computed attitude error in control axes. Information meaningful only when computer program defines desired attitude.
1	The following are req CMC - on, 8.1.3 ISS - on, 8.1.3		Required to compute error and mode CDUs. Required for attitude information.

STA/T	STEP	PROCEDURE	PANEL	REMARKS
AC	2	Set pwr sw FDAI/GPI PWR - 1, 2 or BOTH	7	Provides power for display electronics. Position chosen depends on which FDAI(s) desired.
		LOGIC 2/3 PWR - on (up)		Provides power for FDAI switches.
	3	Sel disp scaling FDAI SCALE 5/5 or 5/1	1	Positions provide for compatible scaling between CMC and display electronics in roll axis during orbital flight. If 50/15, 50/10 position chosen, roll scaling 12.5° full scale.
	4	Sel disp configuration		
		a. FDAI SEL - 1/2		Displays attitude error from CDUs on FDAI 1.
	or	b. FDAI SEL - 1 or 2 FDAI SOURCE - CMC		Displays attitude error from CDUs on FDAI 1 or 2. This position required when only one FDAI selected.
	7.2.4	Attitude Error Display - Attitude Set Source		Provides methods for displaying attitude difference between attitude set indicators and GDC (body error) or IMU gimbal angles (Euler error). Polarity reversal occurs when ATT SET - IMU option selected and roll gimbal angle >±90°. Pitch and yaw attitude error needles become "fly from" indicators rather than "fly to" indicators in this instance.
	1	Set pwr sw & disp logic FDAI/GPI PWR - 1, 2 or BOTH	7	Provides power for display electronics. Position depends on which FDAI desired.

ATTITUDE ERROR DISPLAY - ATTITUDE SET SOURCE

STA/T	STEP	PROCEDURE	PANEL	REMARKS
AC		LOGIC 2/3 PWR - on (up)	7	
		FDAI SEL - 1 or 2	1	Display not available at 1/2 position.
		FDAI SOURCE - ATT SET		Required to enable attitude set input to FDAI.
		.05 G sw - OFF (verify)		On (up) position not desirable (cages BMAGs).
	2	Sel att ref		
		a. SCS		
		ELEC PWR - GDC/ECA	7	Provides power to GDC electronics.
		BMAG 2 PWR - ON		
		ATT SET - GDC	1	
		BMAG MODE - RATE 2 or ATT 1/RATE 2		Switches should be set by axis as desired.
		b. ISS		
		ISS - on, 8.1.3		6.1.1, note 6.
		ATT SET - IMU		
	7.2.5	Total Attitude		Provides methods for displaying Euler angles on FDAI ball from GDC or IMU.
	1	Set pwr sw & enable FDAI		
		FDAI/GPI PWR - 1, 2 or BOTH	7	Provides power for display electronics. Position depends on which FDAI(s) desired.
		LOGIC 2/3 PWR - on (up)		Supplies power for FDAI, BMAG MODE switches and ATT SET switch (IMU position).
	2	Sel disp & disp source	1	
		a. ISS disp		
		ISS - on, 8.1.3		
		FDAI 1 disp		Enables IMU resolver outputs to FDAI 1 ball drive. There are three possible switch combinations.

NORMAL/BACKUP

STA/T STEP	PROCEDURE	PANEL	REMARKS
AC	FDAI SEL - 1/2	1	This position also enables GDC total attitude to FDAI 2.
	or FDAI - 1/CMC FDAI SEL - 1 FDAI SOURCE - CMC		
	or FDAI - 1/ATT SET/IMU FDAI SEL - 1 FDAI SOURCE - ATT SET ATT SET - IMU		6.1.1, note 6.
	FDAI 2 disp FDAI - 2/CMC FDAI SEL - 2 FDAI SOURCE - CMC		Enables IMU resolver outputs to FDAI 2 ball drive. There are two possible switch combinations.
	or FDAI - 2/ATT SET/IMU FDAI SEL - 2 FDAI SOURCE - ATT SET ATT SET - IMU		6.1.1, note 6.
	b. GDC disp ELEC PWR - GDC/ECA	7	Provides power to GDC electronics.
	BMAG 2 PWR - ON BMAG MODE - RATE 2 or ATT 1/RATE 2	1	Switches should be set by axis as desired.
	xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx		
	BMAG 1 PWR - ON (if BMAG 2 fails)	7	
	BMAG MODE - RATE 1	1	
	xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx		

TOTAL ATTITUDE

STA/T STEP	PROCEDURE	PANEL	REMARKS
AC	FDAI 2 disp FDAI SEL - 1/2	1	Enables GDC resolver outputs to FDAI 2 ball drive. There are three possible switch combinations.
	or FDAI - 2/GDC FDAI SEL - 2 FDAI SOURCE - GDC		
	or FDAI - 2/ATT SET/GDC FDAI SEL - 2 FDAI SOURCE - ATT SET ATT SET - GDC		
	FDAI 1 disp FDAI - 1/GDC FDAI SEL - 1 FDAI SOURCE - GDC		Enables GDC resolver outputs to FDAI 1 ball drive. There are two possible switch combinations.
	or FDAI - 1/ATT SET/GDC FDAI SEL - 1 FDAI SOURCE - ATT SET ATT SET - GDC		
	7.2.6 ORDEAL - Local Horizontal Attitude		Provides methods for displaying local horizontal reference established by ORDEAL on FDAI 1 and/or FDAI 2 balls. Only pitch axis affected.
	1 Set pwr sw FDAI/GPI PWR - 1, 2 or BOTH	7	Provides power for display electronics. Position chosen depends on which FDAI(s) desired.

NORMAL/BACKUP

STA/T	STEP	PROCEDURE	PANEL	REMARKS
AC		EARTH/LUNAR - EARTH	13	
		LTG - BRT or DIM		
	2	Sel disp configuration		Reference system may be GDC or IMU, 7.2.5.
		FDAI 1 disp		
		FDAI - 1/ORB RATE		
		FDAI SEL - 1 or 1/2	1	
		FDAI 1 sw - ORB RATE	13	
		FDAI 2 disp		
		FDAI - 2/ORB RATE		
		FDAI SEL - 2 or 1/2	1	
		FDAI 2 sw - ORB RATE	13	
		FDAI 1 & 2 disp		
		FDAI - both/ORB RATE		
		FDAI SEL - 1/2	1	
		FDAI sw (both) - ORB RATE	13	
	7.3	GDC ALIGN		Aligns GDC to ATT SET thumbwheels.
		ELEC PWR - GDC/ECA	7	Supplies power to GDC electronics.
		ATT SET - GDC	1	Enables attitude set inputs to GDC.
		Verify tw settings		
		GDC ALIGN pb - push		Enables attitude set inputs to GDC and disables BMAG inputs.

STA/T	STEP	PROCEDURE	PANEL	REMARKS
		7.4 SPS THRUSTING CONTROL		
		7.4.1 TVC Initialization		Defines safe switch configuration required before initiation of thrusting procedures.
AC		LOGIC 2/3 PWR - on (up)	7	Provides power to SCS TVC switches.
		SIG CONDR/DR BIAS PWR (both) - AC1 or AC2		Required for RCS jet on-off and MTVC TLM.
		SPS THRUST - NORM	1	Lever lock.
		SCS TVC (2) - RATE CMD (if burn is G&N or MTVC)		
	or	SCS TVC (2) - AUTO (SCS burn)		
		TVC GMBL DR (2) - AUTO		The 1 or 2 positions may be used as backup if required.
		ATVC GAIN - HI or LO		Required only for SCS/SPS auto thrusting. Position depends on whether auto or manual (tw) control of SPS gimbals desired. LO position provides proper response for tw control of SPS gimbals.
		FDAI/GPI PWR - 1, 2 or BOTH	7	Position chosen depends on whether redundant GPI displays desired. To enable redundant GPI indicators, FDAI/GPI PWR switch must be set to BOTH.
		LV IND/GPI sw - GPI	1	
		7.4.2 SPS Gimbal Control		
	1	CMC Cont		
		ISS - on (req), 8.1.3		Provides attitude information and power to ECDUs.
		CMC - on (req), 8.1.3		
		Servo loop activated (step 4)		
		Gmbl mot on		Operating time limited depending on operating conditions. MN BUS TIE (2) must be on before gimbal motors started.
		SC CONT - CMC		

NORMAL/BACKUP

STA/T	STEP	PROCEDURE	PANEL	REMARKS
AC		LOGIC 2/3 PWR - on (up) THC - neut	7	Supplies power to SC CONT switch.
	2	SCS Cont - AUTO Servo loop activated (step 4) Gmbl mot on	1	Operating time is limited depending on operating conditions. MN BUS TIE (2) must be on before gimbal motors are started.
		LOGIC 2/3 PWR - on (up)	7	Supplies power to SC CONT, BMAG MODE, SCS TVC, and THC CW switches.
		ELEC PWR - ECA or GDC/ECA BMAG PWR (both) - ON		Supplies power to control electronics. Rate and attitude sensors required.
		BMAG MODE - ATT 1/RATE 2	1	BMAGs in gyro assembly 1 will uncage if MAN ATT switches at RATE CMD. If not, uncaging will occur when IGN 2 logic signal present.
		.05 G sw - OFF (verify) SCS TVC (2) - AUTO IGN 2 logic sig present		On (up) position not desirable (cages BMAGs). Provided by thrust control logic at engine on until 1 second after engine off.
		SC CONT - SCS THC - neut		
	or	SC CONT - CMC THC - CW		

STA/T	STEP	PROCEDURE	PANEL	REMARKS
AC	3	MTVC cont - RATE CMD/ACCEL CMD	1	Stick integrator is enabled when IGN 2 logic signal is present. The IGN 2 logic signal present at SPS on until 1 sec after SPS - off, is provided by thrust control electronics.
		Servo loop activated (step 4) Gmbl mot on		Operating time is limited depending on operating conditions. MN BUS TIE A/C or B/C must be on before gimbal motors are started.
		LOGIC 2/3 PWR - on (up)	7	Provides power for SC CONT, BMAG MODE, SCS TVC and THC - CW switches.
		SIG CONDR/DR BIAS PWR (both) - AC1 or AC2 ELEC PWR - ECA or GDC/ECA BMAG 2 PWR - ON (for RATE CMD) BMAG MODE (3) - ATT 1/RATE 2 or RATE 2 RHC PWR NORM (both) - AC/DC	1	Required for RCS jet on-off and MTVC TLM. Supplies power to RHCs and control electronics. Rate information required for RATE CMD MTVC.
		Rate Cmd		
		a. SCS TVC (2) - AUTO SC CONT - SCS THC - CW		
or		b. SCS TVC (2) - RATE CMD SC CONT - SCS		
	or	SC CONT - CMC THC - CW		

STA/T STEP	PROCEDURE	PANEL	REMARKS
AC	Accel Cmd		
	a. SCS TVC (2) - ACCEL CMD SC CONT - SCS	1	
	or SC CONT - CMC THC - CW		
4	Servo Loop Activation		
	a. Servo loop No. 1 TVC SERVO PWR 1 - AC1/MNA	7	Provides power to clutches and servo drive electronics. Alternate position of this switch (AC2/MNB) should be used only in the event of an AC1 bus failure to provide additional redundancy. AC1/MNA position should be used in all other cases to be compatible with dc power source for gimbal motors (dc MNA bus power).
	TVC GMBL DR (2) - 1	1	
	or TVC GMBL DR (2) - AUTO THC - neut GMBL MOT 1 - operating		No. 1 gimbal motor must be on with no overcurrent failure sensed.
	or TVC SERVO PWR 2 - OFF	7	

STA/T STEP	PROCEDURE	PANEL	REMARKS
	b. Servo loop No. 2		
AC	TVC SERVO PWR 2 - AC2/MNB	7	Alternate position of this switch (AC1/MNA) should be used only in the event of an AC2 bus failure to provide additional redundancy. AC2/MNB position should be used in all other cases to be compatible with dc power source for gimbal motors (dc MNB bus power).
	TVC GMBL DR (2) - 2	1	
	or TVC GMBL DR (2) - AUTO LOGIC 2/3 PWR - on (up) THC - CW	7	Provides power to THC - CW switch.
	or TVC GMBL DR (2) - AUTO GMBL MOT 1 - not operating	1	If No. 1 gimbal motor off or an overcurrent sensed, control transferred to No. 2 servo loop.
	7.4.3 Thrust On-Off Control		
1	CMC Cont		
	ISS - on (req), 8.1.3		
	CMC - on (req), 8.1.3		
	SPS Gmbl Cont (desired), 7.4.2		
	SC CONT - CMC		To satisfy CMC control, THC must not be CW.
	LOGIC 2/3 PWR - on (up)	7	Supplies 28 vdc to SC CONT switch.
	SPS THRUST - NORM	1	DIR ON will override CMC thrust-on control.
	ΔV THRUST A(B) - NORM		Guarded.

NORMAL/BACKUP

STA/T	STEP	PROCEDURE	PANEL	REMARKS
		Thrust on		
AC		CMC eng on cmd (P40)	1	
		Thrust off		
		CMC eng off cmd (P40)		
		or ΔV THRUST A &/or B - OFF		Guarded.
	2	SCS Cont		
		SPS Gmbl Cont (desired), 7.4.2		
		SC CONT - SCS		
		or SC CONT - CMC		This option may establish SCS MTVC mode depending on position of SCS TVC switches.
		THC - CW		
		LOGIC 2/3 PWR - on (up)	7	Supplies 28 vdc to SC CONT switch.
		SPS THRUST - NORM	1	DIR ON will override SPS thrust control.
		ΔV THRUST A(B) - NORM		Guarded.
		Thrust on		
		ΔV ind - not zero		Required only if EMS FUNC in ΔV or ΔV TEST.
		THC - +X		
		or DIR ULL pb - push		
		THRUST ON pb - push		
		Thrust off		
		EMS FUNC - ΔV		
		ΔV ind - zero		
		or ΔV THRUST A &/or B - OFF		Guarded.

THRUST ON-OFF CONTROL

STA/T	STEP	PROCEDURE	PANEL	REMARKS
	3	Dir Cont SPS Gmbl Cont (desired), 7.4.2		
		Thrust on		
AC		ΔV THRUST A &/or B - NORM	1	Guarded.
		SPS THRUST - DIR ON		Lever lock.
		Thrust off		
		ΔV THRUST A &/or B - OFF		Guarded.
		7.5 OPTICS CONTROL		
		7.5.1 Auto Optics Positioning		Permits CMC control of optics.
	1	The following are req ISS - on, & orient known, 8.1.3 & sec 13 CMC - on, 8.1.3 Opt - on, 8.1.4		
	2	Establish CMC cont		
CP		OPT ZERO - OFF	122	
		OPT TELTRUN - SLAVE TO SXT		Required for SCT trunnion drive.
		OPT MODE - CMC		
		7.5.2 Manual Optics Control		Permits manual control of optics using optics hand control (OHC).
	1	The following are req Opt - on, 8.1.4		

NORMAL/BACKUP

STA/T	STEP	PROCEDURE	PANEL	REMARKS
CP	2	Establish man cont & sighting options	122	
		Optics - MAN/DIR		
		OPT ZERO - OFF		
		OPT MODE - MAN		
		OPT COUPLING - DIR		Permits desired image motion in FOV. In DIRECT mode, OHC left, right motion drives optics shaft, while up, down motion drives trunnion. RSLV mode provides motion resolved into SC body coordinates. Motion appears to be target motion corresponding to direction of OHC movement.
		or Optics - MAN/RSLV		
		OPT ZERO - OFF		
		OPT MODE - MAN		
		OPT COUPLING - RSLV		
		OPT TELTRUN - SLAVE TO SXT		
		or 0°		Provides zeroing of SCT trunnion axis.
		or 25°		Provides greater scanning capability for star sightings.
		OPT SPEED - HI, MED or LO		Set as desired.
		7.5.3 Manual Optics Drive		Permits manual optics operation (no power) using optics tool.
	1	The following are req		
		G/N LTS - AC1 or AC2	100	Supplies power for condition lamps and reticle.
		G/N OPT PWR - OFF		
	2	Obtain opt tool from tool kit		

MANUAL OPTICS DRIVE

STA/T	STEP	PROCEDURE	PANEL	REMARKS
CP	3	Perform man opt drive		
		RETCL BRT tw - as req	122	
		SHAFT - as desired	121	
		TRUN - as desired		
		7.6 ENTRY MONITOR SYSTEM (EMS)		
		7.6.1 ΔV Test & Null Bias Check		
	1	Initial EMS prep		
AC		EMS FUNC - OFF (verify)	1	
		cb EMS (2) - close (verify)	8	
		EMS MODE - STBY	1	
	2	EMS FUNC - ΔV SET		Enables slewing of ΔV ind.
		Adj alphanumeric brightness (option)		
		EMS MODE - NORM		6.1.1, note 10.
		Set ΔV ind to +1586.8 fps		
	3	EMS FUNC - ΔV TEST		ΔV TEST checks ΔV circuitry.
		SPS THRUST lt - on		
		ΔV ind decr (10 sec)		
		SPS THRUST lt - out ≈-0.1 fps on ΔV ind		
		ΔV ind stops at -0.1 to -41.5 fps		
	4	EMS MODE - STBY		
	5	EMS FUNC - ΔV SET		
		Slew ΔV ind to -100.0 fps		ΔV indicator zeroed to start accelerometer null bias check.

NORMAL/BACKUP

STA/T	STEP	PROCEDURE	PANEL	REMARKS
AC		Report ΔV ind reading to STDN	1	Used by STDN with data recorded in step 9 to calculate ΔVc for use on next burn.
CP	6	CMC MODE - FREE (til meas complete)		Inhibits auto RCS jet firings which could create ΔV's during the bias measurement.
	or	BMAG MODE (3) - RATE 2		
	or	MAN ATT (3) - ACCEL CMD		
AC	7	EMS FUNC - ΔV (wait 5 sec)		Allows accelerometer time to stabilize before switching from STBY mode.
T=0	8	EMS MODE - NORM		
T-100 sec	9	EMS MODE - STBY Rcd ΔV ind & report to STDN If ΔV drift $\leq$1 fps, do not bias counter If ΔV drift >1 fps but <10 fps bias if desired If ΔV drift >10 fps, EMS is no-go for all functions CAUTION Do not turn EMS FUNC - OFF prior to ΔV, or null bias will be invalid.		Acceleration $\leq$0.01 fps^2. Acceleration $\geq$0.01 fps^2 but <0.1 fps^2. Counter bias not required for SPS ΔV. Acceleration >0.1 fps^2.

ΔV TEST & NULL BIAS CHECK

STA/T	STEP	PROCEDURE	PANEL	REMARKS
		7.6.2 ΔV Setup		Specifies required steps necessary to initialize EMS for monitoring ΔVs and to generate the SPS engine cutoff signal for SCS controlled SPS ΔVs.
		ΔV TEST & NULL BIAS CHECK (desired), 7.6.1		
AC		cb EMS (2) - close	8	
	1	EMS MODE - STBY EMS FUNC - ΔV SET	1	
	2	Set ΔV ind - req ΔV		
	3	EMS FUNC - ΔV		6.1.1, note 10.

8.0 G&C GENERAL PROCEDURES

The procedures in this section involve both the G&N and SCS and are used most frequently during the orbital phase. Because they are fundamental to G&C operation, they are included or referenced in various forms in the more complex G&C procedures contained in sec 9 through sec 21.

Applicable G&C Reference Modes, sec 7, have been referenced throughout these procedures.

For general G&C operating data, refer to operating notes, 6.1.

NORMAL/BACKUP

STA/T	STEP	PROCEDURE	PANEL	REMARKS
		8.1 G&N GENERAL		
		8.1.1 (P00) CMC Idling Program		Indicates that CMC in operate condition but not performing control or computation operations requiring coordination with other crew tasks. Maintains CMC in readiness for entry into most programs. CSM and Soyuz state vectors and W-matrix (rendezvous) are updated. (Refer to 5.6.12 of R-693, section 5.)
CP		Key V37E 00E DSKY - P00	2,140	
		8.1.2 CMC/IMU Power Down		
		(P06) CMC Power Down		Transfers CMC from operate to standby. V69E may be used to recover from an inadvertent entrance into P06. Otherwise, when P06 selected, CMC must be powered down to standby.
	1	Key V37E 06E DSKY - P06		
	2	FL V50 N25 00062 (CMC pwr down) PRO (push till STBY lt - on) CMC blanks DSKY disp		

STA/T	STEP	PROCEDURE	PANEL	REMARKS
		IMU Power Down		Transfers IMU from operate to standby.
AC	1	CMC MODE - FREE	1	
CP	2	G/N IMU PWR - OFF	100	Guarded. Loss of IRIG wheel power will send IMU FAIL discrete to CMC. 5 minutes should be allowed between IMU power down and ISS startup to permit gyro rundown prior to re-applying power (minimizes possibility of damaging gyros).
	3	If CMC operating Key V37E XXE	2,140	Select program not requiring IMU.
		CAUTION Only in case of emergency shall IMU be powered down beyond stby:		If standby power removed for >20 minutes, ISS calibration no longer valid.
DP		cb G/N IMU HTR (2) - open	5	
		8.1.3 Startup		Transfers ISS/CMC from standby to operate condition. Startup procedure will be first procedure selected after returning from standby, since time 2/time 1 is invalid until this is done.
		CMC Startup		
		C/W INPUT 10C - ENBL (verify)	201	Enables C/W input to CMC warning light (panel 2).
CP		PRO - (push until STBY lt out) Poss CMC warning lt (20 sec max) Poss RESTART lt - on Poss PROG alarm RSET DSKY - P06 FL V37 Key 00E	2,140	When PRO released, CMC may revert to STBY mode. Repeat PRO until STBY light out. These alarms should be ignored if they can be reset.

NORMAL/BACKUP

STA/T	STEP	PROCEDURE	PANEL	REMARKS
		If state vctr update		
SPT		Key V96E	2,140	V96E suspends state vector integration.
		Perform CSM - (P27) CMC Update, 8.1.5		
		Key V37E 00E		Re-enables P00 integration suspended by V96E.
		Key V37E XXE		
		ISS Startup		5 minutes should be allowed between IMU power down and ISS startup to permit gyro rundown prior to re-applying power (minimizes possibility of damaging gyros).
		If CMC on		
		C/W INPUT 10D - ENBL (verify)	201	Enables C/W input to ISS warning light (panel 2).
		G/N IMU PWR - on (up)	100	Guarded.
		NO ATT lt - on (90 sec)	2,140	
		NO ATT lt - out (wait 15 sec)		15 seconds allows PIPA inhibit reset.
		Key V37E XXE		Select IMU alignment program desired.
		If CMC not on		
		G/N IMU PWR - on (up)	100	Guarded. IMU drives to 0,0,0.
		Wait 90 sec		
CDR		IMU CAGE - on (up) ≈5 sec then off (down)	1	Guarded. Releases IMU.
	8.1.4	Optics Power Control		
	1	Opt pwr up		6.1.3, note 4g.
SPT		G/N LTS - AC1 or AC2	100	Provides power to reticle and condition lights in LEB.
		OPT ZERO - OFF	122	OPT ZERO switch should be left at ZERO until optics use required. It is not position of this switch,
		OPT MODE - MAN		
		G/N OPT PWR - on (up)	100	but change to ZERO position that triggers zeroing routine.
		OHC - drive trun <10°		
		OPT ZERO - ZERO (≈15 sec to zero)		
		COND LAMPS - ON		
		RETCL BRT tw - adj		

OPTICS POWER CONTROL

STA/T	STEP	PROCEDURE	PANEL	REMARKS
	2	Opt pwr down		6.1.3, note 4g.
CP		OHC - drive trun <10°		
		OPT ZERO - ZERO	122	
		G/N OPT PWR - OFF	100	
		G/N LTS - OFF		Removes power from reticle and condition lights in LEB.
		8.1.5 (P27) CSM - CMC Update		P27 may be entered only from P00, P02, P20 (options 1, 2, 5), or after V96E.
		CMC - on (req), 8.1.3		
		If P00, P02, P20 (opt 1, 2, 5) or V96E		
		Go to 1		
		If other		
		Key V96E	2,140	
	or	Key V37E 00E		
		Auto Update		
	1	UP TLM CM - ACPT	2	
		UP TLM - ACPT	122	
		UPLINK ACTY lt - on		
	2	Update complete		
		UPLINK ACTY lt - out	2,122	
		DSKY P00/P02/P20		
		UP TLM CM - BLOCK	2	

STA/T	STEP	PROCEDURE	PANEL	REMARKS
CP		or UP TLM - BLOCK	122	
		Voice Transmission Update		
	1	Liftoff time - V70E		
		or Load data block - V71E		
		or Load singular data - V72E	2,140	
		or Oct time increment - V73E		
		Poss OPR ERR		If another extended verb active.
	2	DSKY - P27		P27 may be terminated by responding to flashing display with V34E. Data will not be incorporated for use by CMC.
	3	FL V21 N01 R1 Blank R2 Blank R3 AAAAA		
		Key in update data, XXXXXE (R1) CMC increments R3 by 1		
		Repeat 3 until all data loaded		
	4	FL V21 N02 R1 Blank R2 Blank R3 00330		

(P27) CSM - CMC UPDATE

STA/T	STEP	PROCEDURE	PANEL	REMARKS
CP		Accept update V33E	2,140	6.1.3, note 3m.
		P00, P02 or P20 - sel auto		Data transferred from buffer storage to appropriate cells
		If V96 previously keyed Key V37E 00E		Reinstates periodic P00 integration.
		Reject update Load Oct ID (XXE) of word to be corrected Return to 3		
		Time Update (Decimal)		
	1	Key V55E		
		Poss OPR ERR		If another extended verb active.
	2	FL V21 N24 (V25)		All registers initially blank.
		Δ time (CMC clock) 00XXX. HRS 000XX. MIN 0XX.XX SEC		Delta time change must all be provided in decimal.
		Accept Load ΔT		CMC adds ΔT to CMC clock time.
		Reject V33E or V34E		6.1.3, note 3m. V33E or V34E does not update clock time.
	3	Check Updated CMC Time Key V06 N65E Key V37E 00E		DSKY displays R1, R2, R3 for crew verification. CMC returns to P00.

STA/T	STEP	PROCEDURE	PANEL	REMARKS
		Erasable Memory Update		
CP	1	Key V37E 00E	2,140	
	2	For Consecutive Address V21 N01E Load first address XXXXE Load first data word XXXXXE N15E Verify CMC increments address by one (R3) Load second data word XXXXXE,E Load third data word XXXXXE,E Continue until last address in seq filled		
	3	For Non-consecutive Address V21 N01E Load first address XXXXE Load first data word XXXXXE,E Load second address XXXXE Load second data word XXXXXE,E		
	4	To Monitor Data Loaded in Consecutive Address V01 N01E Load first address XXXXE Check first data word in R1 N15E Check second data word in R1 ENTR Check third data word in R1 ENTR		

STA/T	STEP	PROCEDURE	PANEL	REMARKS
CP	5	To Monitor Data Loaded in Non-consecutive Address V01 N01F Load first address in R3 XXXXE Check first data word in R1 ENTR Load second address in R3 XXXXE Check second data word in R1 ENTR	2,140	
		8.1.6 (P47) G&N Thrusting Monitor Program		Monitors vehicle acceleration during non-G&N controlled thrusting maneuvers, and displays ΔV applied to vehicle by thrusting maneuver. Selection of P47 during P20 destroys least significant half of N78 (R1). Refer to P20, 10.2.1.
		CMC - on (req), 8.1.3 ISS - on & aligned (req), 8.1.3 & sec 13 CMC ATT - IMU (verify)		
	1	Key V37E 47E	2	G&N monitor of ΔV highly desirable, if available, but not a requirement. P47 should be called just prior to thrusting and terminated as soon as possible thereafter in order to minimize errors of bias and average G. Range, range rate, and theta may be displayed by using V83 (R31). Range, range rate, and phi may be displayed during P47 by using V85 (R34). Orbital parameters may be displayed by using V82 (R30). Also, an SCS orbit change can be monitored by P40 if properly combined with G&N Prethrusting and Thrusting Procedures, sec 11 and sec 12. N62 (VI, H dot, H) available during P47.
		Poss PROG alarm (8.1.15)		R02.

STA/T	STEP	PROCEDURE	PANEL	REMARKS
CP	2	FL V16 N83 ΔVX, Y, Z (cont) XXXX.X FPS	2	Displayed when average G turned on. CMC requires 12.5 seconds to turn on average G if integration required is < a time step plus 1.4 seconds for each additional time step. Time step = 240 seconds.
		(To rezero registers - V32E)		Provides capability to monitor another burn without going through R00.
		Monitor for burn completion Rcd ΔV PRO (exit P47)		When P47 termination desired.
	3	FL V37 Key XXE		If average G on, R00 turns off average G. It also sets or resets RNDVZFLG, TRACK, and UPDATE flags, depending on which programs in progress or called, and may also recycle into P20.
		8.1.7 (P48) Rendezvous Thrust Monitor		Monitors vehicle acceleration during non-G&N controlled thrusting maneuvers, and displays ΔV applied to vehicle by thrusting maneuver. The program also displays range and range rate (R & R dot) from a source independent of vehicle state vectors (i.e., VHF, R27), and provides the opportunity to specify a time at which R & R dot will be optimized by loading N72 with the desired time.
		CMC - on (req), 8.1.3 ISS - on & aligned (req), 8.1.3 & sec 13 VHF - on (req), 5.6.3 CMC ATT - IMU (verify) .05G sw - OFF (verify)	1	
	1	If MINKEY auto call Go to 2		P48 should be called just prior to thrusting (allow time for R27 convergence) and terminated as soon as possible thereafter in order to minimize errors of bias and average G.
	or	Key V37E 48E	2,140	

STA/T STEP	PROCEDURE	PANEL	REMARKS
			Range, range rate, and theta/phi (as calculated from state vectors) may be displayed during P48 by using V83 (R31) and V85 (R34) respectively. Additionally, orbital parameters may be displayed by using V82 (R30). Optimization time [T (R27 optimized) in N72] is initialized to zero (for current time) and may be changed by V25 N72E and loading desired time (step 2).
CP	Poss PROG alarm (8.1.15)	2,140	R02.
2	FL V16 N77		
	R XXX.XX NM R dot (- closing) XXXX.X FPS		VHF range to Soyuz. Range rate.
	θ XXX.XX DEG		Angle between CSM +X and local horizontal plane (0 to 360°). P48 initializes θ to -00001.
	Accept PRO, go to 4 Reject V32E If N72 = 0, recycle 2 If N72 ≠ 0, go to 3		Reinitializes N83 cells. N77 current/optimized values are defined as follows: If N72 = 0; R, R dot, & θ = current values. If N72 ≠ 0. -01B35 < TFO < +00B02, R & R dot = fixed at last current value. +00B02 < TFO < +01B35, R & R dot = optimizing values. TFO > 01B35, R & R dot = optimized values. TFO < -00B20, θ = current value. -00B20 < TFO < +00B02, θ = -00001. TFO > +00B02, θ = optimized value. New optimization is done every 4 minutes.

NORMAL/BACKUP

STA/T	STEP	PROCEDURE		PANEL	REMARKS
		To optimize N77 values			
CP		Key V25 N72E		2,140	Initialized zero upon P48 entry.
		T (R27 optimized)	OOXXX. HRS OOOXX. MIN OXX.XX SEC		GET at which optimized R, R dot & θ desired.
		Load desired optimization time V32E, go to 3			
	3	FL V16 N76			For TFO (-01B35 < TFO < +01B35), R & R dot are being optimized, otherwise R & R dot are current values.
		R	XXX.XX NM		VHF range to Soyuz.
		R dot (- closing)	XXXX.X FPS		Range rate.
		TFO	XXBXX MIN-SEC		Time from optimization (determined by N72). +59B59 if no optimization requested.
		Accept PRO, return to 2			
		Reject V32E, recycle 3			Reinitializes N83 cells.
	4	FL V16 N83			
		ΔVX, Y, Z (cont)	XXXX.X FPS		Initially zero. Updated at 2-second intervals.
		Accept PRO, go to 5			
		Reject V32E If N72 = 0, return to 2 If N72 ≠ 0, return to 3			To re-initialize N83.
	5	FL V37 Key XXE			

STA/T	STEP	PROCEDURE	PANEL	REMARKS
		8.1.8 CMC Self-Check Procedure		Procedure used to check CMC's ability to write into and read out of erasable memory and performs internal fixed memory banksum.
		CMC - on (req), 8.1.3		
CP	1	Key V25 N01E 1365E E, E, E	2,140	Zero self-check cells: ERCOUNT, SCOUNT, SCOUNT +1.
	2	Key V15 N01E - establish monitor of self-check 1365E		Begin monitor of self-check cells.
	3	Key V21 N27E 10E - starts self-check		Starts complete self-check.
	4	Monitor R2 & PROG lt		
		a. R2 becomes ≥3 Self-check has been successfully completed at least once Key V21 N27E 0E terminates self-check		Turns off self-check.
		b. If PROG lt comes on Coord with STDN &/or perform G/N malfunc SSR-1		
		8.1.9 Measurement and Loading of PIPA Bias		
		CMC - on (req), 8.1.3 ISS - on (req), 8.1.3		ISS should be on at least one hour prior to performing this procedure to allow PIPAs to stabilize.

NORMAL/BACKUP

STA/T	STEP	PROCEDURE	PANEL	REMARKS
		SCS - on (desired), 8.4.2		Provides display and SCS control capability.
AC		CMC ATT - IMU (verify) .05 G sw - OFF (verify) LOGIC 2/3 PWR - on (up)	1 7	
	1	Set Evnt Tmr 00:00	1	
	2	Sel Att Cont desired, 7.1 Maintain SC Rates <0.1°/sec		
AC,CP 00:00	3	Key V25 N21E, E, E, E/start Evnt Tmr	2,140	Zeros noun 21 cells.
CP	4	Key V06 N21 (do not ENTR)		
01:04	5	Key ENTR		
	6	Rcd PIPA counts (X)R1____(Y)R2____(Z)R3____ ±XXXAB		If PIPA count > 99 (XXX≠000), CMC incapable of adjusting PIPA bias.
	7	Key V21 N01E (adj PIPA bias) Load 1452E (calculated X bias) ±AB000E, E 1454E (calculated Y bias) ±AB000E, E 1456E (calculated Z bias) ±AB000E		
	8	Key V37E 00E		

MEASUREMENT AND LOADING OF PIPA BIAS

STA/T STEP	PROCEDURE	PANEL	REMARKS

8.1.10 ΔR and ΔV Threshold Change Procedure

CMC - on (req), 8.1.3

CP — Key V24 N01E — 2,140
Key 2002E

Load erasable value for desired ΔR
(from following table)

Load erasable value for desired ΔV
(from following table)

Desired ΔR NM	Erasable Value	Desired ΔV FPS	Erasable Value
0.00	77776	0.00	77776
0.001	0	0.0001	0
0.1	6	2.5	1
0.2	14	5.12	2
0.3	21	7.68	3
0.4	27	10.24	4
0.5	35		

NORMAL/BACKUP

STA/T STEP	PROCEDURE	PANEL	REMARKS
	8.1.11 Flagword Monitor and Change Procedure		
CP	Flagword Monitor		
	Key V10 N01E Key XXXE (flagword address)		6.9 for flagword addresses.
	R1 XXXXX (flag bit) R3 00XXX (flagword address)		
	Check flag bit in R1 KEY REL		
	Flagword Change		
	Key V25 N07E Key XXXE (flagword address)	2,140	ECADR $\leq$30 (octal) will select appropriate channel (except that channel 7 attempts will be ignored).
	Key XXXXXE (bit ID) Key 1 or 0 (1 = set flag bit, 0 = reset flag bit)		Load code for bit to be changed (bit ID) as follows:

	A			B			C			D			E		
Bit	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
code	4	2	1	4	2	1	4	2	1	4	2	1	4	2	1

FLAGWORD MONITOR AND CHANGE PROCEDURE

STA/T STEP	PROCEDURE	PANEL	REMARKS
CP	Example: To set REFSMFLG (flagword 3, bit 13) Key V25 N07E 77E 10000E 1E		
	8.1.12 Chan 31/33 Control Mode Override (C31FLWRD)		Provides flexibility for crew to specify desired control mode (via C31FLWRD) if, because of hardware failure, SC CONT, CMC MODE, OPT MODE, and OPT ZERO switch position changes are not recognized by CMC. C31FLWRD is an erasable memory cell of the form AXXDX and must be manually loaded; A & D preferably padloaded zero. Used by CMC to determine whether channel 31 and 33 representation of control switch configurations are to be used, or if backup indicators are to be used.
	Key V21 N01E 0373E FL V21 N01 AXXDX (C31FLWRD)		A = 0 or 4 (Chan 31 bits 13, 14, 15 = valid control mode representation). D = 0 or 4 (Chan 33 bits 4, 5 = valid control mode representation).

NORMAL/BACKUP

STA/T STEP	PROCEDURE	PANEL	REMARKS
			A or D ≠ 0 or 4 (CMC uses A or D as backup indicator of desired control mode as loaded in R1 from the following):
CP	Load A (or D) B/U option in R1		Digit A backup option: 1 - G&N control FREE 2 - G&N control ATT HOLD 3 - G&N control AUTO 5 - } 6 - } SCS control modes 7 - }
	ENTR	2,140	Digit D backup option: 1 or 5 - OPT mode CMC 2 or 6 - OPT mode ZERO 3 or 7 - OPT mode MAN
	8.1.13 G&N Passive Thermal Control Procedure		Nominal G&N PTC and orb rate capabilities contained in Universal Tracking (P20) procedures, 10.2.1. For SCS passive thermal control procedures, refer to 8.4.9 and 10. Refer to 8.2.5 for PTC (P20 option 2) procedures.
	CMC - on (req), 8.1.3 ISS - on & orient known (req), 8.1.3 & sec 13 RCS DAP - Load & activate (req), 8.2.1		0.5° deadband and 0.2°/second rate recommended.
1	Perform (V49E) R62, 8.3.4 (PRO on auto mnvr req, FL V50 N18)		This option required to ensure erasable memory is properly set up.

G&N PASSIVE THERMAL CONTROL PROCEDURE

STA/T	STEP	PROCEDURE	PANEL	REMARKS
AC CP	2	Disable two adjacent RCS quads Att hold for 20 min	8	Provides fuel conservation and lower rates (panel 8 switches or R03 may be used to disable engines).
AC	3	MAN ATT P&Y (2) - ACCEL CMD Enable all RCS jets	1 8	
CP	4	Set att hold Key V21 N01E 1330E, E (Set HOLDFLAG zero)	2,140	Sets HOLDFLAG zero and inhibits maneuver until after data load.
		Establish desired rate		

+0.1°/sec	-0.1°/sec	+0.3°/sec	-0.3°/sec
V24 N01E	V24 N01E	V24 N01E	V24 N01E
3154E	3154E	3154E	3154E
3E	77774E	12E	77765E
24400E	53400E	35400E	42400E
V21E	V21E	V24E	V24E
3227E	3227E	3226E	3226E
35101E	42676E	2E	77775E
		27303E	50474E

	5	Start roll mnvr Key V21 N01E 1330E 70000E		Initiates maneuver.
AC	6	MAN ATT ROLL - ACCEL CMD	1	Disables roll jets for duration of PTC.
CP	7	Perform RCS DAP Att Dbd Change, 8.2.3		±30° deadband is recommended.

NORMAL/BACKUP

STA/T	STEP	PROCEDURE	PANEL	REMARKS
AC	8	AUTO RCS (16) - OFF	1	
	9	To term PTC MAN ATT (3) - ACCEL CMD (verify) AUTO RCS (16) - MNA or MNB	8	Re-establishes attitude hold within attitude deadband selected in R03.
		V46E or Cycle SC CONT sw MAN ATT (3) - RATE CMD	1	
		8.1.14 Saturn Rate Change		
		CMC - on (req), 8.1.3		
CP	1	Key V24 N01E 3342E XXXE YYYYYE	2,140	

SIVB RATE	SAT RATE +1 (3342) XXX	SAT RATE +2 (3343) YYYYY
0.05°/sec RPY	161	77616
0.1°/sec RPY	210	77567
0.2°/sec RPY	266	77511
0.3°/sec RPY	344	77433
0.5°/sec R, 0.3°/sec P&Y	476	77301

SATURN RATE CHANGE

STA/T	STEP	PROCEDURE	PANEL	REMARKS
	8.1.15	(R02) IMU Status Check		Checks whether IMU aligned to an orientation known by CMC and, if not, whether it is on. R02 automatically called by programs requiring ISS. Provides for program alarms if ISS not on and/or IMU orientation unknown.
	1	ISS not on		
CP		PROG alarm	2,140	Occurs only if ISS not on.
		FL V37		
		Key V05 N09E (to verify alarm)		Alarm stored; must key V05 N09E to display alarm code.
		00210 (ISS not on)		
		Perform ISS turnon		
		Key XXE		Return to PXX at completion of ISS turnon.
	2	ISS on but orientation unknown		
		PROG alarm		
		Key V05 N09E (to verify alarm)		Alarm stored; must key V05 N09E to display alarm code.
		00220 (IMU orient unknown)		
		FL V37		RSET and KEY REL pressed when nature of problem determined. When CMC regains control, program cycles through R00, which may set or reset RNDVZFLG, TRACK, and UPDATE flags, depending on which programs are in progress or called.
		Key XXE		Reinitiate desired program.

NORMAL/BACKUP

STA/T STEP	PROCEDURE	PANEL	REMARKS
	8.1.16 DSKY 8's Clear Procedure		DSKY relay failure mode will cause an all-eights display on DSKY. Affects display capability of DSKY but will not affect input/output or control functions.
CP	Key V99 N99	2,140	
	Key V25 N01E		
	00000E		
	+99999E		
	+99999E		
	+99999 CLR, CLR, CLR		
	00000E		
	00000E		
	00000E		
	If OPR ERR		
	Start over		
	If DSKY does not clear		
	Repeat proced		
	8.1.17 (Deleted)		

STA/T STEP	PROCEDURE	PANEL	REMARKS
	8.2 DIGITAL AUTOPILOT (DAP)		
	8.2.1 (V48) Undocked DAP Data Load (R03)		For CMC control modes (CSM alone), DAP data load procedure is used to select rate, deadband, and quads. When under computer control, operating program will establish SC rates and attitude error deadbands, or crew may select other desired error deadbands via DSKY. In addition, crew has capability of selecting RCS quads for computer command of manual translation, attitude hold, or automatic and manual manuvers. Also refer to 6.1.1, note 16.
	CMC - on (req), 8.1.3		
1	Key V48E	2,140	Extended verb 48 program calls DAP data 1, 2, and 3 in sequential order. DAP data 1, 2, or 3 may also be displayed individually by using respective verb/ noun combinations, i.e., V04 N46, V06 N47, or V06 N48.
2	FL V04 N46 R1 - A B C D E R2 - A B C D E Accept PRO Reject V24E load desired data		

	Vehicle Config.	Quad A/C for $\ddot{X}$	Quad B/D for $\ddot{X}$	Err Deadband	Rate Select
R1	0 = No Dap 1 = CSM 2 = CSM & SOYUZ 3 = CSM & SIVB 6 = CSM & DM	0 = Fail A/C 1 = Use A/C	0 = Fail B/D 1 = Use B/D	0 = ± 0.5° 1 = ± 5.0°	0 = 0.05°/sec 1 = 0.2°/sec 2 = 0.5°/sec 3 = 2.0°/sec
	Roll Quad Select	**Quad A**	**Quad B**	**Quad C**	**Quad D**
R2	0 = Use B/D 1 = Use A/C	0 = Fail 1 = Use	0 = Fail 1 = Use	0 = Fail 1 = Use	0 = Fail 1 = Use

If quads A/C and B/D (4 jets) desired for ±X translation, R1-B and R1-C may be set to 0,0, or 1,1.

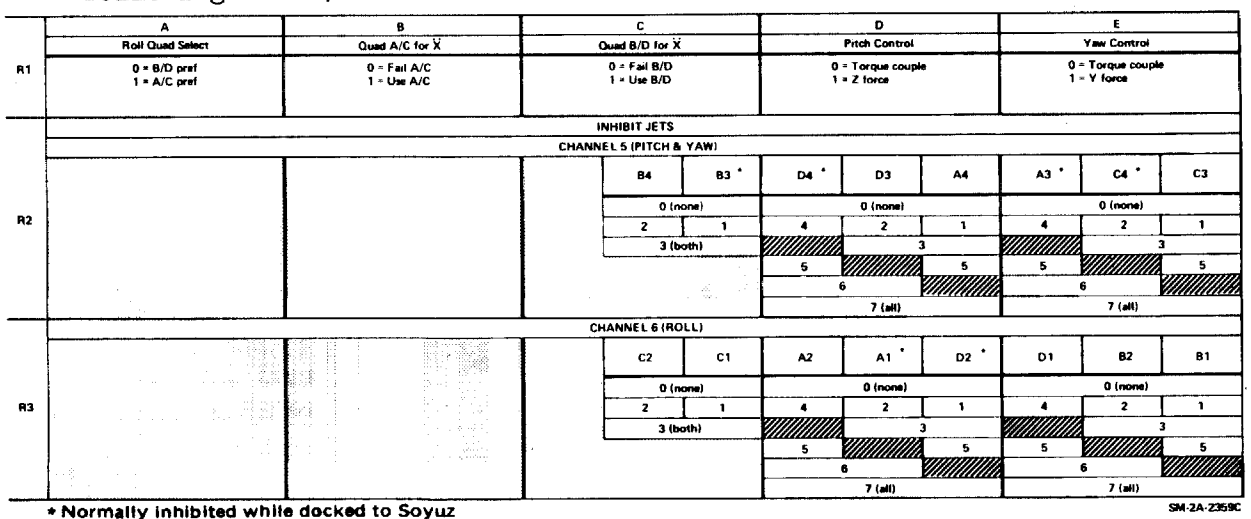
For operational considerations, R1-A codes 2 & 6 are referred to as (CSM & Soyuz) and (CSM & DM) respectively; however, the MIT software listing for these codes are (CSM & LM) and (CSM & LM ascent stg only).

If A is failed, CMC assumes C is good. If B is failed, CMC assumes D is good.

NORMAL/BACKUP

STA/T	STEP	PROCEDURE	PANEL	REMARKS
CP	3	FL V06 N47	2,140	Value of mass used in non-DAP coding not updated unless vehicle configuration digit is 1. P40 reduces value for weight linearly, as function of SPS maneuver time. Maneuvers performed without using P40 could cause CMC's knowledge of weight to be compromised.
		CSM wt XXXXX. LBS		
		Other vehicle wt XXXXX. LBS		This may be either the DM weight or the Soyuz weight if R03 is selected for control.
		Accept PRO		
		Reject Key V21E, V22E or V24E Load correct data		
	4	FL V06 N48		
		P Trim XXX.XX DEG		If burn >0.42 second, trim values will be updated by CMC during burn. Do not load engine gimbal trim angles >9°.
		Y Trim XXX.XX DEG		
		Accept PRO - Return to prog in progress		
		Reject Key V21E, V22E or V24E Load correct data		
	5	To activate DAP		To be done first time DAP started or after fresh start.
AC		CMC MODE - FREE	1	Prevents inadvertent jet firings.
CP		Key V46E	2,140	Activates R03.
	8.2.2	(V44) Docked DAP Data Load (R04)		For CMC control modes, DAP data load procedure is used to select rate, deadband, and jets. When under computer control, operating program will establish SC rates and attitude error deadbands, or crew may select other desired deadbands via DSKY. In addition,
		CMC - on (req), 8.1.3		
	1	Key V44E		

STA/T STEP	PROCEDURE	PANEL	REMARKS
			crew has capability of selecting RCS jets for computer command of manual translation, attitude hold, or automatic and manual maneuvers. Included under the maneuver functions are the automatic tracking and universal pointing options of P20. Also refer to 6.1.1, notes 16 and 17.
CP 2	FL V05 N87 R1 - ABCDE (quad sel & cont) R2 - 00CDE (CH5FAIL) R3 - 00CDE (CH6FAIL) Accept PRO Reject Key V25E Load desired data (from following table)	2,140	If A/C used for X translation, force control preference should be specified for pitch. If B/D used, force control preference should be specified for yaw. Figure 6-13 describes jet selection options for torque couples or force pairs when docked CSM controlled maneuvers are desired.



	To re-enable inhibited jets Key V59E	Re-enables all jets previously inhibited in R04.

NORMAL/BACKUP

STA/T	STEP	PROCEDURE	PANEL	REMARKS
CP	3	FL V06 N89 DAP rate X.XXXX DEG/SEC DAP DBD XXX.XX DEG Accept PRO (exit R04) Reject Key V21E, V22E or V24E Load correct data	2,140	
	4	To activate DAP CMC MODE - FREE Key V45E		To be done first time DAP started or after fresh start. In addition, V45E is necessary if R04 re-entered to change DAP deadband (N89). Prevents inadvertent jet firings. Activates DDAP and inhibits UDAP functions. P40 selected and V45E = OPR ERR. Once DDAP has been activated and attempt is made to fire jets, alarms 00500 and/or 00501 may occur. The alarms will not be repeated until R04 is again performed (flags associated with alarms are reset in R04, and set after DDAP activation if insufficient jets available for control of vehicle). R04 jet selection should be examined for sufficient jets enabled to allow DDAP to control vehicle.
		8.2.3 <u>RCS DAP Attitude Deadband Change Procedure</u> CMC - on (req), 8.1.3 ISS - on (req) & orient known (desired), 8.1.3 & sec 13 RCS DAP - activate (req), 8.2.1 SCS - on (desired), 8.4.2		This procedure will change RCS DAP (UDAP) att deadband to ±2.5, 10, 15, 20, 25, or 30°. Additional method of establishing desired deadbands is via N79 load in P20 procedures.
	1	Sel CMC Att Cont - auto, 7.1.6		
	2	Sel 5.0° dbd in RCS DAP, 8.2.1		

RCS DAP ATTITUDE DEADBAND CHANGE PROCEDURE

STA/T	STEP	PROCEDURE	PANEL	REMARKS
CP	3	Key V21 N01E 3306E Load D Band (see table)		

Desired dbd	D Band
±2.5°	0343E
±10°	1616E
±15°	2525E
±20°	3434E
±25°	4343E
±30°	5252E

	4	To return to 5.0° dbd THC - CW, then neut		Center of deadband shifted.
		or Key V48E PRO PRO PRO	2,140	Center of deadband not affected.
		8.2.4 RCS DAP Orbital Rate Procedure CMC - on (req), 8.1.3 ISS - on & orient known (req), 8.1.3 & sec 13 SCS - on (desired), 8.4.2 RCS DAP - load & activate (req), 8.2.1 Ysm aligned to V x R (If R x V, complement numbers for ZZZZZ)		P20 (option 2) may be used to effect orb rate. P20 universal tracking (options 1 and 5) may be used, operationally, to produce a maneuver similar to orb rate. (These options provide a computed maneuver to maintain a specified body vector aligned with the LOS to the celestial body specified, as opposed to a "rate" type maneuver; e.g., option 2.) Refer to 8.2.6 for Orb Rate (P20 option 2) procedures.
	1	Perform (V49) R62, 8.3.4 Load gmbl angles for init of orbrate		Gimbal angles loaded are those that are to be at initiation of orbital rate rotation (necessary to initialize erasable memory). MGA should be zero.
	2	If desired Key V37E XXE (non-att cont prog)		

STA/T	STEP	PROCEDURE	PANEL	REMARKS
CP	3	Establish orbrate For rates 0.1°/sec or less, load oct numbers corresponding to desired mnvr rate from following table For rate 0.5°/sec, go to 5		
		Key V21 N01E 1330E,E (Set HOLDFLAG zero)	2,140	Sets HOLDFLAG to zero and inhibits maneuver until after data load.
		Key V24 N01E 3156E VVVVVE WWWWWE		
		Key V24E 3160E XXXXXE YYYYYE		
		Key V21E 3231E ZZZZZE		
		Key V21E 1330E 70000E (Set HOLDFLAG negative)		Final ENTR initiates maneuver.
		Mnvr in progress		

RCS DAP ORBITAL RATE PROCEDURE

STA/T STEP	PROCEDURE	PANEL	REMARKS

4 To term mnvr, go to 8

ORBRATE deg/sec	CDUX 0 deg	+90 deg	+180 deg	+270 deg
-0.100	VVVVV = 77774 WWWWW = 54300 XXXXX = 00000 YYYYY = 61300 ZZZZZ = 42676	00000 61300 00003 23500 42676	00003 23500 00000 16500 42676	00000 16500 77774 54300 42676
-0.095	VVVVV = 77774 WWWWW = 62200 XXXXX = 00000 YYYYY = 62000 ZZZZZ = 44250	00000 62000 00003 15600 44250	00003 15600 00000 16000 44250	00000 16000 77774 62200 44250
-0.090	VVVVV = 77774 WWWWW = 70000 XXXXX = 00000 YYYYY = 62600 ZZZZZ = 45622	00000 62600 00003 10000 45622	00003 10000 00000 15200 45622	00000 15200 77774 70000 45622
-0.085	VVVVV = 77774 WWWWW = 75600 XXXXX = 00000 YYYYY = 63400 ZZZZZ = 47173	00000 63400 00003 02200 47173	00003 02200 00000 14400 47173	00000 14400 77774 75600 47173

...continued

STA/T STEP	PROCEDURE			PANEL	REMARKS
ORBRATE deg/sec	CDUX				
	0 deg	+90 deg	+180 deg	+270 deg	
-0.080	VVVVV = 77775 WWWWW = 43400 XXXXX = 00000 YYYYY = 64100 ZZZZZ = 50545	00000 64100 00002 34400 50545	00002 34400 00000 13700 50545	00000 13700 77775 43400 50545	
-0.075	VVVVV = 77775 WWWWW = 51300 XXXXX = 00000 YYYYY = 64700 ZZZZZ = 52117	00000 64700 00002 26500 52117	00002 26500 00000 13100 52117	00000 13100 77775 51300 52117	
-0.070	VVVVV = 77775 WWWWW = 57100 XXXXX = 00000 YYYYY = 65500 ZZZZZ = 53467	00000 65500 00002 20700 53467	00002 20700 00000 12300 53467	00000 12300 77775 57100 53467	
-0.065	VVVVV = 77775 WWWWW = 64700 XXXXX = 00000 YYYYY = 66300 ZZZZZ = 55041	00000 66300 00002 13100 55041	00002 13100 00000 11500 55041	00000 11500 77775 64700 55041	
...continued					

RCS DAP ORBITAL RATE PROCEDURE

STA/T STEP	PROCEDURE				PANEL	REMARKS
	ORBRATE deg/sec	CDUX 0 deg	+90 deg	+180 deg	+270 deg	
	-0.060	VVVVV = 77775 WWWWW = 72500 XXXXX = 00000 YYYYY = 67100 ZZZZZ = 56413	00000 67100 00002 05300 56413	00002 05300 00000 10700 56413	00000 10700 77775 72500 56413	
	-0.055	VVVVV = 77776 WWWWW = 40300 XXXXX = 00000 YYYYY = 67600 ZZZZZ = 57765	00000 67600 00001 37400 57765	00001 37400 00000 10200 57765	00000 10200 77776 40300 57765	
	-0.050	VVVVV = 77776 WWWWW = 46200 XXXXX = 00000 YYYYY = 70400 ZZZZZ = 61337	00000 70400 00001 31600 61337	00001 31600 00000 07400 61337	00000 07400 77776 46200 61337	
CP	5 Ysm aligned to V x R (If R x V, complement numbers for AAAAA and ZZZZZ)				2,140	
	6 Key V21 N01E 1330E,E (set HOLDFLAG zero)					Sets HOLDFLAG zero and inhibits maneuver until after data load.

STA/T	STEP	PROCEDURE	PANEL	REMARKS
CP	7	Establish orbrate (0.5°/sec) Load oct numbers corresponding to mnvr rate from following table	2,140	
		Key V24E 3156E VVVVVE WWWWWE		
		Key V24E 3160E XXXXXE YYYYYE		
		Key V24E 3230E AAAAAE ZZZZZE		
		Key V21E 1330E 70000E (set HOLDFLAG negative)		Final ENTR initiates maneuver.

	CDUX			
	0°	180°	7.25°	187.25°
VVVVV	77755	00022	77722	00022
WWWWW	76077	01700	71351	06426
XXXXX	77775	00002	---	---
YYYYY	66367	11410	---	---
AAAAA	77773	77773	77773	77773
ZZZZZ	56272	56272	56272	56272

RCS DAP ORBITAL RATE PROCEDURE

STA/T	STEP	PROCEDURE	PANEL	REMARKS
AC	8	To term mnvr CMC MODE - HOLD	1	
CP		or Key V49E, return to 1	2,140	
		or Key V46E		
		or RHC - out of detent		
		or Key V37E 00E		
	8.2.5	PTC (P20 option 2)		Provides PTC maneuver by implementing P20 rotation (option 2). Also refer to 6.1.3, note 3r.
		CMC - on (req), 8.1.3 ISS - on & orient known (req), 8.1.3 & sec 13		
		SCS - on (desired), 8.4.2		Provides display and SCS control capability.
		RCS DAP - load & activate (req), 8.2.1		
AC		CMC ATT - IMU (verify) .05 G sw - OFF (verify)	1	
		LOGIC 2/3 PWR - on (up)	7	If SCS - on option not selected.
	1	RHC (2) - LOCKED FDAI SCALE - 5/1		
	2	Mnvr to PTC att Perform V49 (R62), 8.3.4		
		When att satisfactory, damp vehicle rates Disable all jets on two adjacent quads		Final ENTR in V49.

STA/T	STEP	PROCEDURE	PANEL	REMARKS
		Sel single jet (roll) compatible with DAP load		
		Wait 20 min		To damp existing vehicle rates.
	3	Configure RCS jets		
		+ Roll		
AC		AUTO RCS A/C ROLL A1, C1 - MNA or MNB	8	
		or AUTO RCS B/D ROLL B1, D1 - MNA or MNB		
		- Roll		
		AUTO RCS A/C ROLL A2, C2 - MNA or MNB		
		or AUTO RCS B/D ROLL B2, D2 - MNA or MNB		
		AUTO RCS (remaining 12) - OFF		
		MAN ATT ROLL - RATE CMD	1	
	4	Perform P20 (option 2), 10.2.1		Load N78/N79 with desired PTC body vector, rate and deadband.
	5	Disable RCS & terminate P20		
		AUTO RCS (16) - OFF	8	
		RHC PWR DIR (2) - OFF (verify)	1	
CP		V56E	2,140	Terminates P20.
	6	To terminate mnvr		
AC		CMC MODE - FREE	1	
		AUTO RCS - as desired	8	
CP		Verify P00	2,140	
AC		CMC MODE - AUTO (verify)	1	

STA/T	STEP	PROCEDURE	PANEL	REMARKS
		8.2.6 Orb Rate (P20 option 2)		Provides orb rate maneuver by implementing P20 rotation (option 2). Also refer to 6.1.3, note 3r.
		CMC - on (req), 8.1.3		
		ISS - on & orient known (req), 8.1.3 & sec 13		
		SCS - on (desired), 8.4.2		Provides display and SCS control capability.
		RCS DAP - load & activate (req), 8.2.1		
		CMC ATT - IMU (verify)	1	
		.05 G sw - OFF (verify)		
		LOGIC 2/3 PWR - on (up)	7	If SCS - on option not selected.
AC	1	RHC (2) - LOCKED	1	
		FDAI SCALE - 5/1		
	2	Mnvr to orb rate att		
		Perform V49 (R62), 8.3.4		
		When att satisfactory		
		Damp vehicle rates		Final ENTR in V49.
		Sel single jet (roll) compatible with DAP load		
	3	Configure RCS jets		
		AUTO RCS - as desired	8	
		MAN ATT (3) - RATE CMD	1	

NORMAL BACKUP

STA/T	STEP	PROCEDURE	PANEL	REMARKS
AC	4	Perform P20 (option 2), 10.2.1		Load N78/N79 with desired orb rate body vector, rate and deadband.
	5	To terminate mnvr RHC - out of detent		
CP		or V56E	2,140	Terminates P20.
		or Key V37E 00E		
AC		or SC CONT - SCS	1	

ORB RATE (P20 OPTION 2)

STA/T	STEP	PROCEDURE	PANEL	REMARKS
		8.3 EXTENDED VERBS		
		8.3.1 (V35) DSKY Condition Light Test		Procedure designed to test CMC/caution and warning, DSKY interface.
		CMC - on (req), 8.1.3		
CP	1	Key V37E 00E (req)	2,140	Must be performed while in P00.
	2	Key V35E		
	3	Monitor the following events		
		a. All DSKY condition lts - on		
		b. ISS warning lt - on CMC warning lt - on MASTER ALARM lt - on		CMC lt on allows PIPAs to drift, generates alarm 00212 and may cause PIPA bias shift.
		c. All DSKY numerical windows disp 8 Sign positions in R1, R2, R3 show + V, N windows flash		
		Wait 5 sec		
		d. All DSKY warning lts - out (except PROG lt, if IMU on)		NO ATT will be left on if coarse align occurring. PROG lt remains on for ≈10 seconds.
		e. ISS lt - out CMC lt - out Reset MASTER ALARM lt		
		f. DSKY - P00 Interrupted disp (if any) will be restarted		

STA/T	STEP	PROCEDURE	PANEL	REMARKS
CP	g.	Wait 10 sec		Because V35E removes power to PIPAs, 10 seconds should be allowed after V35 completion before the PIPAs are used.
		Key RSET		Unless in R3, clears fail registers of 00212 (PIPA fail) alarm.
	8.3.2	(V42) Torque Gyros		Fine aligns stable member by torquing gyros (primarily for ground use).
		CMC - on (req), 8.1.3 ISS - on (req) & orient known (desired), 8.1.3 & sec 13		
	1	Key V37E 00E	2,140	
	2	For Load <100° Key V42E		
		Poss OPR ERR		If another extended verb active.
	or	For Load >99.999° Key V21 N02E 2757E XXXXXE N15E XXXXXEE YYYYYEE YYYYYEE ZZZZZEE ZZZZZE Key V42E		Load >90 deg should not be performed during flight.
		Poss OPR ERR		If another extended verb active.
	3	FL V21 N93 (request load)		If SC CONT at CMC and CMC MODE at AUTO or HOLD, DAP will maneuver vehicle to follow the platform as it moves.

STA/T STEP	PROCEDURE	PANEL	REMARKS
CP	Δ Gyro X, Y, Z XX.XXX DEG	2,140	Registers initially blank.
	Accept Load desired data DSKY displays V42 NO ATT lt - out		
	Reject V33E DSKY displays V42 NO ATT lt - out		Key V33E if gyro torquing registers loaded prior to keying V42E. Also refer to 6.1.3, note 3m.
	Poss OPR ERR		If IMU stall routine in use.
	8.3.3 (V43) Load FDAI Error Needles		Loads crew specified angles into FDAI error needles (primarily for ground use).
	CMC - on (req), 8.1.3 ISS - on (req), 8.1.3 RCS DAP - off		Prevents undesirable jet firing.
	1 Key V37E 00E		V43E can be executed only from P00.
	2 Key V43E		
	Poss OPR ERR		V43E cannot be executed if CMC not in P00, IMU in coarse align or zero ICDU mode, or if another extended verb active. (Latter is constraint after liftoff.)
	3 FL V21 N22 (request load) R, P, Y XXX.XX DEG		Registers initially blank.
	Load desired err angles		Maximum effective angle which may be loaded is ±16.88 degrees.

NORMAL/BACKUP

STA/T	STEP	PROCEDURE	PANEL	REMARKS
		8.3.4 (V49) CSM Crew Defined Maneuver (R62)		Provides method of performing CMC controlled maneuver to crew defined attitude.
		CMC - on (req), 8.1.3 ISS - on (req) & orient known (desired), 8.1.3 & sec 13 SCS - on (req), 8.4.2		
AC		CMC ATT - IMU (verify) .05 G sw - OFF (verify)	1	
CP	1	Key V37E 00E	2,140	Routine R62 may be called from P00 only.
	2	Sel Tot Att (ISS) Disp, 7.2.5		Both FDAIs recommended so either reference system (IMU or GDC) may be monitored. (CMC attitude error and rate displays available.)
	3	Key V49E Poss OPR ERR		If another extended verb active.
	4	FL V06 N22 (fnl gmbl angles) R, P, Y XXX.XX DEG Accept PRO Reject V25E load desired gmbl angles		
		(R60 - Attitude Maneuver Routine)		Provides for maneuver (automatically or manually) to specified attitude.
	5	FL V50 N18 (auto mnvr request) R, P, Y XXX.XX DEG		Required gimbal angles.

STA/T	STEP	PROCEDURE	PANEL	REMARKS
AC	Accept	BMAG MODE (3) - RATE 2 Sel CMC Att Cont Auto, 7.1.6	1	
CP		PRO	2,140	May be performed second time as attitude trim.
		V06 N18 (auto mnvr) R, P, Y XXX.XX DEG		Non-flashing display until completion of auto maneuver then returns to FL V50 N18. Maneuver rates will be as specified by last DAP data load (R03/R04).
		Monitor auto mnvr on FDAI Recycle 5		
	Reject	Key V62E		Selects Mode 2, total attitude error on FDAI needles.
		RHC - Null FDAI needles		Any input from RHC (RHC out of detent) will be interpreted by CMC as a manual override and will cause immediate termination of auto maneuver calculation and return to FL V50 N18.
		When att satisfactory ENTR		Exit R60/R62.
	8.3.5	(V57) Full Track Flag Specification		Displays status of full track flag (FULTKFLG), and allows change by DSKY entry. Flag is examined only during auto W-matrix reinitialization following TPI (MINKEY) rendezvous sequence (TPIMNFLG set). FULTKFLG indicates whether full track (VHF and optics marks), or partial track (VHF or optics marks) will be used to update the state vector.
		CMC - on (req), 8.1.3		
	1	Key V57E		
		Poss OPR ERR		If another extended verb active.

STA/T	STEP	PROCEDURE	PANEL	REMARKS
CP	2	FL V04 N12	2,140	
		00004 (full track option) 0000X X = 1 (partial track) X = 0 (full track)		R2, current status of FULTKFLG. P20, VHF or optics marks (FULTKFLG set). P20, VHF and optics marks (FULTKFLG reset).
		Accept PRO (exit) Reject Key V22E Load desired option		
		If priority disp appears after N12 load Key V32E		Ensures desired flag setting.
		FL V04 N12 PRO (exit)		Get third N12 display.
		8.3.6 (V64) Optics Angles Transform (R64)		Displays the tracking angles corresponding to given optics angles, and automatically alters spacecraft tracking axis (as contained in N78) since R61 constructs the tracking vector from the contents of N78.
		CMC - on (req), 8.1.3		
	1	Key V64E		
		Poss OPR ERR Exit R64		If another extended verb in process.
	2	FL V06 N94 SA XXX.XX DEG TA XX.XXX DEG		

STA/T STEP	PROCEDURE	PANEL	REMARKS
CP	Accept PRO	2,140	
	Reject Key V24E		
	Load desired data		
3	FL V06 N78		If P20 active when this routine performed, the values displayed in N78 may be used for tracking. Each time MINKEY is initiated, N78 R1 and R2 will be overwritten.
	Y	XXX.XX DEG	P20 yaw angle (gamma).
	P	XXX.XX DEG	P20 pitch angle (rho).
	Az	XXX.XX DEG	
	Accept PRO		
	Reject Key V25E		
	Load desired data		
4	Return to prog in progress		
8.3.7	(V67) Start W-Matrix RSS Error Display		Provides display of RSS position and velocity errors, and opportunity to load new initialization values. However, initialization will not take place until next opportunity.
	CMC - on (req), 8.1.3		
1	Key V67E		
	Poss OPP EPR		If another extended verb in process.
	Exit		
2	FL V06 N99		
	POS ERR	XXXXX. FT	RSS value of position error.
	VEL ERR	XXXX.X FPS	RSS value of velocity error.

STA/T STEP	PROCEDURE	PANEL	REMARKS
CP	Option code 0000X	2,140	Option code: (initially 00000) 00000 - No initialization 00001 - RNDZ W-matrix reinitialization.
	Accept PRO		Bypasses reinitialization, if R3 = 00000.
	Reject Key V25E		R3 must contain 00001 to allow initialization.
	Load desired data (per following tables)		To initialize at new values. Initialization occurs next time a measurement is made. V93E required to enable r/v W-matrix initialization.
	Key V93E		

W-MATRIX TABLE (V67)

WRENDPOS		2000-P20	WRENDVEL		2001-P20
N99 R1	1000 ft	OCT	N99 R2	fps	OCT
10000	10	137	10	10	762
08000	8	114	8	8	620
06000	6	71	6	6	453
04000	4	46	4	4	307
02000	2	23	2	2	144
01000	1	11	1	1	61
00800	.8	7	.8	.8	50
00600	.6	5	.6	.6	34
00400	.4	3	.4	.4	24
00300	.2	2	.2	.2	10
00100	.1	1	.1	.1	5

N99 values to be loaded to obtain desired POS ERR and VEL ERR elements with corresponding octal values for erasable.

(V67) START W-MATRIX RSS ERROR DISPLAY

STA/T	STEP	PROCEDURE	PANEL	REMARKS
		8.3.8 (V74) Initialize Erasable Dump Via Downlink		Dumps all eight banks of erasable memory via downlink.
		CMC - on (req), 8.1.3		
CP	1	Key V74E (V74 will deliver two complete dumps)	2,140	
		8.3.9 (V91) Display Banksum		Displays sum of each bank for comparison.
		CMC - on (req), 8.1.3		
	1	Key V37E 00E		Procedure must be performed in P00.
	2	Key V91E		
		Poss OPR ERR		If another extended verb active.
	3	FL V05 N01		
		Banksum XXXXX		Sum of bits of chosen bank.
		Bank No. XXXXX		Number of bank being read.
		Bugger word XXXXX		Factor required to make |R1| = |R2|.
		Accept V34E (halt summing)		Expected bank and banksum acceptable (|R1| = |R2|).
		Reject PRO, recycle 3 (next bank)		43 (octal) banks (i.e., R2 = 00043 in V05 N01 display). Banks are numbered 00 to 43 (octal) corresponding to 00 to 35 (decimal) = 36 decimal banks.

STA/T	STEP	PROCEDURE	PANEL	REMARKS
		8.4 SCS GENERAL		
		8.4.1 SCS Power Down		Describes safe power-down configuration.
	1	Provide Safe Sys Configuration		
AC		EMS - STBY/OFF	1	
		EMS FUNC - OFF		
		EMS MODE - STBY		
		AUTO RCS (16) - OFF	8	
		BMAG MODE (3) - RATE 2	1	
		SPS THRUST - NORM		Normal position selected to prevent inadvertent SPS firing.
	2	Remove SCS Pwr		
		TVC SERVO PWR (both) - OFF	7	
		FDAI/GPI PWR - OFF		
		LOGIC 2/3 PWR - OFF		
		ELEC PWR - OFF		
		SIG CONDR/DR BIAS PWR (both) - OFF		
		BMAG PWR (both) - WARMUP		
		RHC PWR NORM (both) - OFF	1	
		xxxxxxxxxxxxxxxxxxxxx		
		For tot pwr down		6.1.2, note 7.
		BMAG 1 PWR - OFF	7	
		xxxxxxxxxxxxxxxxxxxxx		
	3	Pwr Down ORDEAL		
		FDAI sw (both) - INRTL	13	
		EARTH/LUNAR - PWR OFF		
		LTG - OFF		

STA/T	STEP	PROCEDURE	PANEL	REMARKS
	4	Pwr Down COAS		
DP		COAS PWR - OFF	15	
AC				
CP	5	Miscellaneous		
		THC - neut, LOCKED		
		RHC (both) - LOCKED		
	6	Remove Logic Sw Pwr		Optional step to place panel 1 switches on logic buses in their OFF position. Relationship between switch positions and logic buses described in 6.1.1, figure 6-3.
AC		FDAI SCALE - 5/1	1	
		FDAI SEL - 1 or 2		
		ATT SET - GDC		ATT SET switch should be left at GDC when not in use. Also refer to 6.1.1, note 6.
		MAN ATT (3) - RATE CMD		
		LIM CYCLE - on (up)		
		DBD/RATE - MAX/LO		
		ATT DBD - MAX		
		RATE - LO		
		EMS ROLL - OFF		
		.05 G sw - OFF (verify)		Remains OFF throughout mission except entry. Refer to 6.1.1, note 5. Off position powered by LOGIC 2/3 PWR - on (up).
		TVC GMBL DR (2) - 1		
	8.4.2	SCS Power Up		Used to power up display and control electronics of SCS.
	1	Provide Safe Sys Configuration		
		AUTO RCS (16) - OFF	8	
		BMAG MODE (3) - RATE 2	1	Cages BMAGs and prevents attitude error signal, if any, from causing jet firings when RCS enabled.

NORMAL/BACKUP

STA/T	STEP	PROCEDURE	PANEL	REMARKS
	2	Set Pwr Switches		
AC		LOGIC 2/3 PWR - on (up)	7	Configures G&C for future command/control functions. Provides power for control and GDC electronics.
		ELEC PWR - GDC/ECA		
		SIG CONDR/DR BIAS PWR (both) - AC1 or AC2		Switch 1 also provides SCS signal conditioner power for the following TLM functions: rate and attitude error, SCS auto TVC, MTVC, gimbal position transducer and RHC proportional rate commands. Switch 2 provides SCS signal conditioner power for TVC pitch and yaw differential clutch current TLM. For increased reliability, switches should not be set on same bus. Also refer to 6.1.2, note 5.
CP		BMAG TEMP 1t (2) - out	2	
AC		FDAI/GPI PWR - OFF	7	If FDAIs are powered when BMAGs come up to speed, rate needles will oscillate full scale.
		BMAG PWR (both) - ON		Provides rate and attitude source for control and display functions.
		FDAI/GPI PWR - BOTH		Provides power for display electronics.
		RHC PWR NORM (both) - AC/DC	1	Provides power to RHC for manual control functions if needed.
	8.4.3	Drift Rate Adjust		Permits periodic adjustment of finite drift rates of <1 deg/sec. It is intended for use during long periods of drift such as in thermal control where high power consumption undesirable.
	1	Set Up Pwr Sw		
		LOGIC 2/3 PWR - on (up)	7	Powers panel 1 controls for command/control functions. Powers control electronics.
		ELEC PWR - ECA		

DRIFT RATE ADJUST

STA/T	STEP	PROCEDURE	PANEL	REMARKS
CP		BMAG TEMP lt (2) - out	2	
AC		FDAI/GPI PWR - OFF	7	If FDAIs are powered when BMAGs come up to speed, rate needles will oscillate full scale.
		BMAG 2 PWR - ON		Provides rate source for control and display functions.
		FDAI/GPI PWR - 1		Provides power for display electronics.
		SIG CONDR/DR BIAS PWR (both) - AC1 or AC2		6.1.2, note 5.
		RHC PWR NORM (both) - AC/DC	1	
	2	Establish Rate Disp for Ball 1, 7.2.1		
		FDAI SEL - 1		
		BMAG MODE - RATE 2		
		.05 G sw - OFF (verify)		
	3	Establish SCS Min Imp, 7.1.2		
		MAN ATT (3) - MIN IMP		
		SC CONT - SCS		
		AUTO RCS - MNA or MNB	8	Single jet control in each axis preferred to allow fuel conservation.
	4	Adj Veh Rates		FDAI SCALE - 5/1 recommended since expected rates will be <1 deg/sec.
		RHC - ARMED		
		Adj rates using FDAI 1		
		RHC - LOCKED		

STA/T	STEP	PROCEDURE	PANEL	REMARKS
		8.4.4 Minimum Power SCS Attitude Hold (Three or Two Axes)		Provides attitude hold in two or three axes, as desired, for prolonged periods using low power consumption.
	1	Set Pwr Sw		
AC		LOGIC 2/3 PWR - on (up)	7	
		ELEC PWR - ECA		If total attitude display desired, select GDC/ECA.
CP		BMAG TEMP lt (2) - out	2	
AC		FDAI/GPI PWR - OFF	7	If FDAIs powered when BMAGs come up to speed, rate needles will oscillate full scale.
		SIG CONDR/DR BIAS PWR (both) - AC1 or AC2		6.1.2, note 5.
		BMAG PWR (both) - ON		
		FDAI/GPI PWR - 1		Provides power for display electronics.
	2	Establish SCS Att Hold/Rate Cmd, 7.1.4		
		MAN ATT (3 or 2) - RATE CMD	1	Selection by axis using these switches will determine axes in which attitude hold is enabled.
		LIM CYCLE - on (up)		
		DBD/RATE - MAX/LO		
		ATT DBD - MAX		
		RATE - LO		
		SC CONT - SCS		
		BMAG MODE (3) - RATE 2		
		AUTO RCS - MNA or MNB	8	Single jet control in each axis preferred to allow fuel conservation.
		BMAG MODE (3 or 2) - ATT 1/RATE 2	1	
	3	Sel Disp, 7.2.1 & 2		
		FDAI - 1/GDC		
		FDAI SEL - 1		
		FDAI SOURCE - GDC		
		.05 G sw - OFF (verify)		

MINIMUM POWER SCS ATTITUDE HOLD

STA/T	STEP	PROCEDURE	PANEL	REMARKS
AC	4	Monitor FDAI 1 att err during limit cycling		
		8.4.5 SCS Attitude Maneuver		Provides options for performing SCS attitude maneuver during normal orbital operations or to satisfy specific mission requirements. Permits easy correlation to G&C Reference Modes, sec 7, and other G&C General Procedures, sec 8.
	1	The following are req ISS - on & orient known (for step 3a), 8.1.3 & sec 13 SCS - on, 8.4.2 CMC ATT - IMU (verify) .05 G sw - OFF (verify)	1	
	2	Obtain mnvr data from STDN		
		a. Fnl mnvr angles R___°, P___°, Y___°		
or		b. External ref cues		
	3	Maneuver		Select FDAI display as required. Also refer to 6.1.2, note 6.
		a. To specified mnvr angles If ISS avail Perform GDC align to IMU gmbl angles, 8.4.6 If ISS not avail Perform alternate SC Inertial Att Determination, 13.2.1		

STA/T STEP	PROCEDURE	PANEL	REMARKS
AC	Set ATT SET tw - to desired values (step 2)	1	
	Sel att cont mode, 7.1		Mode should be compatible with magnitude of maneuver - e.g., rate command, acceleration command or minimum impulse, and desired rates.
	RHC - mnvr		Use total attitude and/or attitude error displays as required to obtain final gimbal angles.
or	b. To external ref Sel att cont mode, 7.1 RHC - mnvr		Null rates at desired orientation.
	8.4.6 GDC Alignment to IMU Gimbal Angles		Provides two methods for aligning GDC to IMU.
1	The following are req CMC - (on for step 3b), 8.1.3 ISS - on & orient known, 8.1.3 & sec 13 SCS - on, 8.4.2 CMC ATT - IMU (verify) .05 G sw - OFF (verify) FDAI 1 sw - INRTL (desired)	13	Provides easy comparison between FDAI and ATT SET values.
2	Establish Att Cont, 7.1 Damp veh rates		Selected to prevent drift error during alignment process.
3	Perform Att Err Disp - ISS Att Set Source, 7.2.4		6.1.1, note 6.
	a. FDAI - 1/ATT SET/IMU FDAI SEL - 1	1	

GDC ALIGNMENT TO IMU GIMBAL ANGLES

STA/T	STEP	PROCEDURE	PANEL	REMARKS
AC		FDAI SOURCE - ATT SET	1	
		ATT SET - IMU		
		ATT SET tw - null FDAI 1 errors		Verify that ATT SET tw and FDAI 1 indicate same total attitude because false nulling of error needles could occur 180° from desired attitude.
CP	or b.	V16 N20E	2,140	
AC		ATT SET tw - adj to IMU gmbl angles on DSKY	1	
	or c.	ATT SET tw - adj to IMU gmbl angles as ind on FDAI		
	4	Align GDC, 7.3		
		ATT SET - GDC		
		GDC ALIGN pb - push, hold		
		FDAI SEL - 1/2		Verify both FDAIs indicate same total attitude.
		8.4.7 Attitude Reference System Comparison		
	1	The following are req		
		CMC - on, 8.1.3		
		ISS - on and orient known, 8.1.3 & sec 13		
		SCS - on, 8.4.2		
		CMC ATT - IMU (verify)		
		.05 G sw - OFF (verify)		
SPT	2	Key V37E 00E	2,140	
	3	Establish Att Cont, 7.1		
		Damp veh rates		

NORMAL/BACKUP

STA/T	STEP	PROCEDURE	PANEL	REMARKS
CP	4	Key V06 N20E (ICDU angles) R, P, Y XXX.XX DEG	2,140	Required to allow rough ATT SET adjustment to IMU gimbal angles prior to nulling operation. Monitor V16 may be used in lieu of display V06.
	5	Att ref comparison Select Att Err Disp, Att Set Source, 7.2.4		
AC		FDAI - 1/ATT SET/IMU FDAI SEL - 1 FDAI SOURCE - ATT SET ATT SET - IMU	1	6.1.1, note 6.
		ATT SET tw (3) - set approx to DSKY values, null FDAI 1 att errors		
CP		ENTR (when nulled)	2,140	ENTR updates display. If monitor V16 used in step 4, key VERB to freeze display.
		Record DSKY values R___°, P___°, Y___°		If ATT SET/GDC comparison made, error needle bias, if any, determined and may be subtracted (postflight) from GDC drift determined in ATT SET/GDC comparison.
		Record ATT SET values R___°, P___°, Y___°	1	
	or	ATT SET/GDC comparison		
AC		ATT SET - GDC ATT SET tw (3) - null FDAI 1 att errors		
CP		ENTR (when nulled)	2,140	ENTR updates display. If monitor V16 used in step 4, key VERB to freeze display.
		Record DSKY values R___°, P___°, Y___°		
		Record ATT SET values R___°, P___°, Y___°	1	

ATTITUDE REFERENCE SYSTEM COMPARISON

STA/T	STEP	PROCEDURE	PANEL	REMARKS
		8.4.8 ORDEAL Initialization		Aligns one or both FDAIs to local vertical coordinates.
	1	The following are req CMC - on (for steps 4a & 7a), 8.1.3 ISS - on & aligned, nom option (for step 7a), 8.1.3 & sec 13 SCS - on, 8.4.2		IMU and/or SCS attitude reference system must be aligned with +Y axis of reference along (V x R), where V is velocity vector and R is position vector from center of earth.
AC		CMC ATT - IMU (verify) .05 G sw - OFF (verify)	1	
	2	Sel Tot Att Disp, 7.2.5		
	3	Set ORDEAL cont, 7.2.6 FDAI 2 or 1 sw - ORB RATE EARTH/LUNAR - EARTH MODE - HOLD/FAST	13	Either or both FDAIs may be driven by ORDEAL.
	4	Obtain alt setting		
		a. (R30) orb param disp routine		
CP		Key V82E Record Ha and Hp Calculate ave	2,140	
	or	b. (P21) ground track determination prog Key V37E 21E Record alt for 10-min intervals of present orb Calculate ave		

NORMAL/BACKUP

STA/T	STEP	PROCEDURE	PANEL	REMARKS
	or	c. STDN If CMC in STBY, obtain alt setting from STDN		
AC	5	ALT SET - adj to proper alt	13	
	6	Sel att cont mode, 7.1, & mnvr to place +Xsc in orb plane (0° yaw)		
	7	Obtain θ - pitch angle to lcl horiz		θ is the angle included between +Xsc and local horizontal. Angle in range 0° to 180° indicates +Xsc above local horizontal plane. Total range 0° to 360°.
CP		a. (R31) rndz param disp routine Key V83E	2,140	
AC	or	b. STDN If CMC in STBY, obtain θ from STDN based on +Xsc pointed at horiz Mnvr to point +Xsc at horiz, 8.4.5	13	θ based on +Xsc pointed at horizon dependent on present altitude.
	8	Slew FDAI to θ		The CMC display of θ is from 0° to 360°.
	9	MODE - OPR/SLOW Slew/adj FDAI precisely		FDAI may be more accurately adjusted using 1° marks if yaw angle is 0° and roll angle 0° or 180°. When momentary SLEW switch released, ORDEAL is in operate mode.
	10	Repeat 7 thru 9 as req		FDAI sw (both) must be at INRTL (pwr OFF or not) to display pitch inertial attitude.

ORDEAL INITIALIZATION

STA/T STEP	PROCEDURE	PANEL	REMARKS
	8.4.9 SCS Passive Thermal Control Using Wobble Mode		For G&N Passive Thermal Control Procedure, refer to 8.1.13.
	1 Set up pwr sw		
AC	LOGIC 2/3 PWR - on (up)	7	
	ELEC PWR - ECA		If total attitude display desired, select GDC/ECA.
CP	BMAG TEMP lt (2) - out	2	
AC	FDAI/GPI PWR - OFF	7	If FDAIs powered when BMAGs come up to speed, rate needles will oscillate full scale.
	BMAG PWR (both) - ON		
	FDAI/GPI PWR - 1		
	SIG CONDR/DR BIAS PWR (both) - AC1 or AC2		6.1.2, note 5.
	RHC PWR NORM (both) - AC/DC	1	
	2 Establish SCS att hold/rate cmd		
	MAN ATT (3) - RATE CMD		
	LIM CYCLE - on (up)		
	DBD/RATE - MIN/LO		This switching assumes RCS not enabled or attitude error needles are nulled before this switching performed.
	ATT DBD - MIN		
	RATE - LO		
	SC CONT - SCS		
	BMAG MODE (3) - RATE 2		
	AUTO RCS A/C ROLL or B/D ROLL (4) - MNA or MNB	8	Only one pair of roll quads should be enabled.
	AUTO RCS PITCH & YAW - set for single jet oper		Single jet control in PITCH and YAW provides reduced RCS authority for attainment of minimum rates.
	BMAG MODE (3) - ATT 1/RATE 2	1	

NORMAL/BACKUP

STA/T	STEP	PROCEDURE	PANEL	REMARKS
	3	Select Disp		
CDR		FDAI - 1/GDC	1	
		FDAI SEL - 1		
		FDAI SOURCE - GDC		
		.05 G sw - OFF (verify)		
	4	Mnvr SC to desired att		Maneuver should place desired wobble axis in CSM -Z+Y quadrant, _____° from X axis.
	5	Achieve pitch up & yaw right rates of 0.01-0.02°/sec		Allow CSM to deadband to these rates. Rate may be obtained manually if minimum impulse control used.
	6	MAN ATT ROLL - ACCEL CMD		
		LIM CYCLE - OFF		
		DBD/RATE - MAX/HI		
		ATT DBD - MAX		
		RATE - HI		
		BMAG MODE (3) - RATE 2		
		AUTO RCS ROLL (8) - MNA or MNB	8	
		Init _____°/sec roll rate		Full roll authority can be used to establish this rate with one RHC action.
		AUTO RCS (16) - OFF		
	8.4.10	SCS Passive Thermal Control Using BAR-B-Q Minimum Power Mode		For G&N Passive Thermal Control Procedure, refer to 8.1.13
	1	Set up pwr sw		
		LOGIC 2/3 PWR - on (up)	7	
		SCS ELEC PWR - ECA		If total attitude display desired, select GDC/ECA.
SPT		BMAG TEMP lt (2) - out	2	

SCS PASSIVE THERMAL CONTROL USING BAR-B-Q MINIMUM POWER MODE

STA/T	STEP	PROCEDURE	PANEL	REMARKS
AC		FDAI/GPI PWR - OFF	7	If FDAIs powered when BMAGs come up to speed, rate needles will oscillate full scale.
		BMAG PWR (both) - ON FDAI/GPI PWR - 1 SIG CONDR/DR BIAS PWR (both) - AC1 or AC2		6.1.2, note 5.
		RHC PWR NORM (both) - AC/DC	1	
	2	Sel Disp FDAI - 1/GDC FDAI SEL - 1 FDAI SOURCE - GDC .05 G sw - OFF (verify)		
	3	Mnvr SC to desired att		
	4	Establish 2 axis SCS att hold/rate cmd MAN ATT P&Y (2) - RATE CMD MAN ATT ROLL - ACCEL CMD LIM CYCLE - on (up) or MIN IMP DBD/RATE - MAX/HI ATT DBD - MAX RATE - HI SC CONT - SCS		
		AUTO RCS PITCH & YAW - set for single jet oper	8	Engine combinations available for single jet control are:

SINGLE JET CONTROL				
PITCH	A3-A4	C3-C4	A3-C4	C3-A4
YAW	B3-B4	D3-D4	B3-D4	D3-B4

STA/T	STEP	PROCEDURE	PANEL	REMARKS
AC		AUTO RCS A/C ROLL or B/D ROLL (4) - MNA or MNB	8	
		BMAG MODE (3) - ATT 1/RATE 2	1	
	5	Init 0.1°/sec roll rate		
	6	Mon FDAI 1 att err during limit cycling		

SCS PASSIVE THERMAL CONTROL USING BAR-B-Q MINIMUM POWER MODE

STA/T STEP	PROCEDURE	PANEL	REMARKS
	9.0 RENDEZVOUS		
	Rendezvous is accomplished by systematic performance of various navigation, alignment, targeting and thrusting programs. Manual-sequenced rendezvous is performed by manual selection of each program as it is required in the rendezvous sequence. For the MINKEY sequence, the MINKEY program automatically selects and sequences the various programs. Refer to 9.1 for manual-sequenced rendezvous and 4.9.2 for the MINKEY sequence.		
	9.1 MANUAL RENDEZVOUS SEQUENCE		
	CMC - on (req), 8.1.3 ISS - on & orient known (req), 8.1.3 & sec 13 SCS - on (req), 8.4.2 Opt pwr up (req), 8.1.4		Required for target acquisition and SXT tracking during rendezvous phase.
	RCS DAP - load & activate (req), 8.2.1 Set up for VHF rng, 4.5.3		
1	Verify/confirm with STDN, oper status of Soyuz &/or CSM sys		
2	Select desired att cont, 7.1		
3	Select desired disp, 7.2		
4	Perform rndz nav, 10.2		
5	Perform targeting, 11.2		
6	Perform thrusting, sec 12		

NORMAL/BACKUP

9.2 MINKEY RENDEZVOUS SEQUENCE

The MINKEY controller routine (R07) monitors and executes in proper sequence, all programs required for effecting rendezvous. P20, however, operates in the background and, unlike P31 through P38, is not displayed in the PROG lt, except for the P20 call during the NPC (P38) sequence.

MINKEY sequence is initiated by selecting the appropriate targeting program for a given point in the sequence. The sequence begins at any one of seven entry points which is determined by the targeting program selected. The seven entry points are defined as follows:

P31 (NC1)
P32 (NC2)
P33 (NCC)
P34 (NSR)
P35 (TPI)
P36 (TPM)
P37 (TPF)

To enter the MINKEY sequence before NC1 (Normal Corrective Mnvr #1), P31 is selected; to enter before NC2, P32 is selected, etc. The MINKEY controller will, from entry point selected, automatically sequence the required programs. As with other CMC programs, the operator must accept or reject data, or provide desired data to the CMC to have the programs sequence properly.

9.2.1 MINKEY Operating Notes

The MINKEY process minimizes a number of calculations, loading of data, and certain operator decision requirements. Some of these features and other data pertinent to MINKEY are defined in the following MINKEY operating notes.

1. An erasable quantity designating desired attitude for performing rendezvous is preloaded. According to this value, the CMC computes and executes the appropriate attitude maneuvers.

2. Calculations for out-of-plane corrections are automatically performed, displayed, and scheduled for the appropriate maneuver.

3. The CMC reinitializes the W-matrix according to predetermined data requiring no operator consideration.

4. VHF range data are automatically collected and processed continuously in R22 when enabled by V87E (terminated by V88E), and in R22 (via R27) when enabled by V76E (terminated by V77E). When called by R22, VHF measured range is extended beyond 327.67 NM if indicated by the range computed in R61 using on-board state vector estimates.

5. SXT data (marks) can be taken at any flashing display when P20 is running (extended verb not required).

6. P52 provides option for gyro torquing ($\pm 45°$ depending on state of TCOMPFLG) prior to NPC maneuver and if torqued, returned to original alignment after burn. Provides more suitable platform orientation for the thrusting maneuver.

7. The NPC sequence (P38) can only be entered via V37E 38E. It is not automatically called, in line, by the MINKEY controller.

8. Providing REFSMFLG set, keying in any one of the targeting programs, P31 through P38, causes an immediate display of FL V50 N25, R1 = 00017 (request MINKEY). A PRO response initiates automatic sequencing. ENTR inhibits automatic and allows manual sequencing.

9. For both PRO and ENTR to FL V50 N25 (R1 = 00017), R61/R60 is selected to execute maneuver to tracking attitude via P20. By holding at any flashing display, optics (SXT) marks or COAS marks (V54E), can be taken anytime P20 is running (after maneuver to track attitude), or VHF ranging marks may be allowed to accumulate provided VHF ranging has been enabled (refer to note 4).

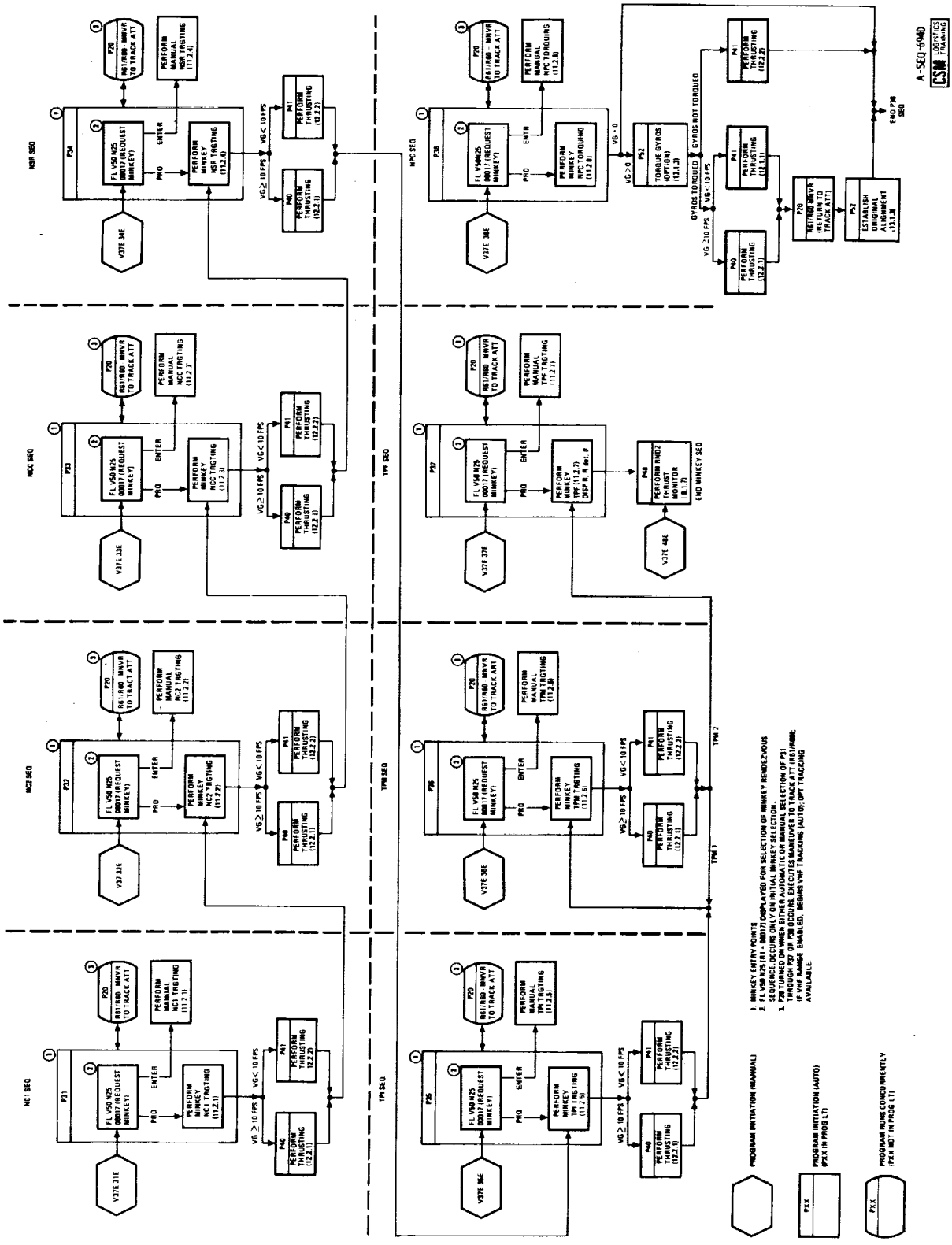
10. For P20 (options 0, 1, 4, 5), as applied to R61/R60 (maneuver to track attitude), the 10° criterion is pointing error measured as angle between the LOS and center of DAP deadband.

NORMAL/BACKUP

9.2.2 MINKEY Rendezvous Sequence (Flow)

Following is a simplified flow diagram of the MINKEY rendezvous sequence. The diagram summarizes the sequence of events as they would occur from any one of the entry points into the MINKEY sequence (i.e., selection of P31, P32, etc.). Each program, as it is called by the MINKEY controller, is completed in the usual manner, even though, as previously stated, certain additional functions are performed by the CMC, thus minimizing the need for operator actions otherwise needed for program completion.

MINKEY RENDEZVOUS SEQUENCE



MINKEY RENDEZVOUS SEQUENCE

9.2.2

STA/T	STEP	PROCEDURE	PANEL	REMARKS
		10.0 NAVIGATION		For general G&C operating data, refer to operating notes, 6.1.
		10.1 ORBITAL NAVIGATION		
		10.1.1 (P21) Ground Track Determination		Provides crew ground track data for either CSM or Soyuz, based on time loaded in 3.
		CMC - on (req), 8.1.3		
CP	1	Key V37E 21E	2,140	
	2	FL V04 N06		
		Option code 00002		
		CMC assumed option 00001 (00001 = CSM, 00002 = Soyuz)		CMC initializes R2 to 00001.
		Accept PRO		
		Reject V22E (load desired option)		
	3	FL V06 N34		Initial display will contain zeros (present time). If not changed by astronaut, P21 calculations will be based on present time.
		GET lat long 00XXX. HRS 000XX. MIN 0XX.XX SEC		GET at desired position of selected vehicle.
		Accept PRO		State vector integrated forward to desired time.
		Reject V25E (load desired T-lat long)		

NORMAL/BACKUP

STA/T	STEP	PROCEDURE		PANEL	REMARKS
CP	4	FL V06 N43		2,140	
		Lat (+N)	XXX.XX DEG		Selected vehicle latitude at T-lat long.
		Long (+E)	XXX.XX DEG		Selected vehicle longitude at T-lat long.
		Alt	XXXX.X NM		Selected vehicle altitude above launch pad radius at T-lat long.
		If desired			
		Key N73E			
		Alt/10	XXXXX. NM		
		VI	XXXXX. FPS		
		Gamma	XXX.XX DEG		
		To increment T-lat long by 10 min			
		Key V32E			For V32E, program keeps previous state vector for use in starting next iteration without, however, ensuring that subsequent integrations are precision. If times reasonably close, V32E should be used; if far apart, would be quicker to reselect P21.
		Return to 3			
	5	PRO (term P21)			ROO.
		FL V37			
		Key XXE			

STA/T	STEP	PROCEDURE		PANEL	REMARKS
		10.1.2 (P29) Time of Longitude			Provides time of (CSM or Soyuz) first crossing of a specified longitude after a specified time.
		CMC - on (req), 8.1.3			
CP	1	Key V37E 29E		2,140	
	2	FL V04 N06			
		Option code	00002		
		CMC assumed option (00001 = CSM, 00002 = Soyuz)	00001		CMC initializes R2 to 00001.
		Accept PRO			
		Reject V22E (load desired option)			
	3	FL V06 N34			Initial display will contain zeros (present time). If not changed by astronaut, P29 calculations will be based on present time.
		GET base time	00XXX. HRS 000XX. MIN 0XX.XX SEC		Base time from which next crossing of desired longitude is computed.
		Accept PRO			State vector integrated forward to desired base time.
		Reject V25E (load desired base time)			
	4	FL V06 N43			
		R2 Long (desired)	XXX.XX DEG		

NORMAL/BACKUP

STA/T STEP	PROCEDURE		PANEL	REMARKS
CP	Accept PRO Reject V22E (load long)		2,140	CMC computes time of next crossing of desired longitude after base time.
5	FL V06 N34			
	GET long	OOXXX. HRS OOOXX. MIN OXX.XX SEC		Time of longitude crossing.
	Accept PRO Reject V32E, return to 4			To re-specify longitude using original base time.
6	FL V06 N43			Latitude, longitude, altitude at crossing.
	Lat (+N) Long (+E) Alt	XXX.XX DEG XXX.XX DEG XXXX.X NM		
	Accept PRO (Term P29) Reject V32E, return to 2			To re-specify input data.
7	FL V37 Key XXE			

(P29) TIME OF LONGITUDE

STA/T	STEP	PROCEDURE	PANEL	REMARKS
		10.1.3 (V82) Orbit Parameter Display (R30)		Provides crew with CMC computed orbital parameters. Time from perigee (TF perigee) available via N32 if Hp >49.4 NM (300,000 feet). If P00 or P11 running, ΔR (miss distance) available via N50.
		CMC - on (req), 8.1.3		
CP	1	Key V82E If ave G routine on, go to 4	2,140	
	2	FL V04 N12 Option code 00002 CMC assumed option 0000X (1 = CSM 2 = Soyuz) Accept PRO Reject V22E (load desired option)		
	3	FL V06 N16 GET event 00XXX. HRS 000XX. MIN 0XX.XX SEC Accept PRO Reject Key V25E Load desired time		Time for state vector integration. TFF (N50) and time from perigee (N32) continue to be measured from present time rather than N16 input time. CMC sets time option initially to zero, meaning present time.

NORMAL/BACKUP

STA/T	STEP	PROCEDURE		PANEL	REMARKS
CP	4	FL V16 N44		2,140	If average G on, display updates every 2 seconds.
		Ha	XXXX.X NM		Above launch pad radius. Calculations are subject to limitations of two-body approximation and yield reasonable results if vehicle close to earth.
		Hp	XXXX.X NM		
		TFF	XXBXX MIN-SEC		Time of free fall to 49.4 NM (300,000 feet). TFF reads -59B59 if Hp >49.4 NM; under these conditions, time from perigee available by keying N32. If average G off and Hp <49.4 NM, TFF counts down. For N32, if average G off and Hp >49.4 NM, time from perigee counts down.
		Accept	PRO		Recalculates orbital parameters. (Valid only if average G off.)
		Reject	V32E		
			Recycle to 3		

(V82) ORBIT PARAMETER DISPLAY (R30)

STA/T STEP	PROCEDURE	PANEL	REMARKS
	10.2 RENDEZVOUS NAVIGATION		
	10.2.1 (P20) Universal Tracking & Rendezvous Navigation		Purpose: • Rendezvous - Performs normal rendezvous navigation, attitude control, and optics pointing. • Rotation - To produce a rotation about a specified SC body vector. • Universal tracking - To point (and maintain) a specified SC vector at a specified celestial body. Crew may exercise control of P20 functions via response to N06, N78, N79 and through use of the following extended verbs. V76E - Enables R27 in R22. V77E - Disables R27 in R22. V80E - Selects Soyuz state vector update. V81E - Selects CSM state vector update. V87E - Allow R22 to accept VHF range data. V88E - Inhibit acceptance of VHF range data. Program can be selected manually (V37E 20E), or automatically by MINKEY controller. Refer to 9.2 for additional data on MINKEY rendezvous sequence.
	CMC - on (req), 8.1.3 ISS - on & orient known (req), 8.1.3 & sec 13 SCS - on (desired), 8.4.2 Opt pwr up (req), 8.1.4		Provides total attitude and rate monitoring. Not required for VHF update.

NORMAL/BACKUP

STA/T	STEP	PROCEDURE	PANEL	REMARKS
		VHF AM ranging mode sel (req), 5.6.3		Not required for optical update.
AC		CMC ATT - IMU (verify)	1	
		LOGIC 2/3 PWR - on (up) (if no SCS)	7	Required for control and display functions.

Programs Allowing P20 in Background	P20 Option 0	1	2	4	5
21**	X	X	X	X	X
27*		X	X		X
29**	X	X	X	X	X
30	X	X	X	X	X
31	X			X	
32	X			X	
33	X			X	
34	X			X	
35	X			X	
36	X			X	
37	X			X	
38	X			X	
52*			X		
54*			X		

*UTFLAG set
**Tracking only (no navigation)

CP		Key V93E (if necessary)	2,140	If one hour or more has elapsed since W-matrix initialization or if state vector has not been updated via P27.
		Sel Tot Att disp, 7.2.5		
		Sel Att Cont mode, 7.1		

STA/T	STEP	PROCEDURE	PANEL	REMARKS
CP	1	Key V37E 20E	2,140	Manual selection of P20 (option zero automatically set). Other options available in step 2.
	or	If P31 through P38 sel P20 - on (auto) (P20 functions defined in each trgting prog)		MINKEY selection. If IMU on and aligned, P20 turned on automatically if programs P31 through P38 selected. This occurs whether or not rendezvous to be accomplished by MINKEY sequencing. P20 called to accomplish maneuver to tracking attitude, and various navigation tasks including VHF and optics tracking. No P20 displays are provided except FL V50 N18 in R60.
		Poss PROG alarm (4.8.1.16)		R02. (8.1.15)
	2	FL V04 N06 00024 (P20 option) 0000X		R2 initialized zero. If option zero desired, there is no choice but to use manual rendezvous sequence. If option 4 desired, either manual or MINKEY sequencing may be used. MINKEY, however, can only be performed using option 4. When a targeting program, P31 through P38 is called, option zero is automatically set. If not previously selected, P20 (option 4) will be automatically selected when MINKEY first initiated (PRO on FL V50 N25, R1 = 17).
		(X = 0, 1, 2, 4, 5)		P20 options defined as follows: 0 - Soyuz tracking (VECPOINT). Point specified SC vector at Soyuz (no attitude constraint about pointing vector). After initial selection, new SC vector can be chosen without reselecting P20. P20 initializes N78 to preferred track attitude (0°, -35°, 0°).

STA/T STEP		PROCEDURE	PANEL	REMARKS
CP	Accept Reject	PRO Key V22E Load desired option	2,140	1 - Celestial body tracking (VECPOINT). Point specified SC vector at celestial body (no attitude constraint about pointing vector). After initial selection, new SC vector can be chosen without reselecting P20. However, P20 must be reselected to change target (celestial body) code (N70/N88). If P20 in foreground (PROG lt = 20), P00 type integration will occur and P27 may be selected. 2 - Rotation. Rotate about a specified SC vector. Current contents of N78 and N79 used only when rotation begins by P20 initiation, by V58E after RHC deflection, or by V37 to a tracking program following a program not allowing rotation. If P20 in foreground (PROG lt = 20), P00 type integration will occur and P27 may be selected. Refer to 8.2.5 and 8.2.6 for PTC and orb rate procedures using option 2. 4 - Soyuz tracking (3 axis). Point specified SC vector at Soyuz (hold attitude about pointing vector). After initial selection, new SC vector or azimuth constraint can be chosen without reselecting P20. P20 initializes N78 to preferred track attitude (0°, -35°, 0°). 5 - Celestial body tracking (3-axis). Point specified SC vector at celestial body (hold attitude about pointing vector). After initial selection, ...continued

STA/T	STEP	PROCEDURE	PANEL	REMARKS
				new SC vector or azimuth constraint can be chosen without reselecting P20. However, P20 must be reselected to change target (celestial body) code (N70/N88). If P20 in foreground (PROG lt = 20), P00 type integration will occur and P27 may be selected. For R2, a value of X = 3, 6 or 7 will be treated as X = 2. (Options 0, 1, 4, 5) If CMC/FREE or SCS control modes selected during these P20 options, desired attitude is computed but test for R60 is never made and, therefore, neither UPLINK ACTY lt nor FL V50 N18 will appear if attitude deviation unacceptable. Monitor mode II (V62E) FDAI attitude error needles when in SCS or CMC/FREE modes.
CP	3	FL V06 N78 (SC vctr angles)	2,140	All options.
		Y, P, az XXX.XX DEG Accept PRO Reject Key V25E Load desired data If presently rotating & new N78 contents to be used RHC - move from detent Key V58E If P47 previously sel during P20 Reload N78		Program initializes N78 with values of preferred tracking attitude (0°, -35°, 0°) only if options 0 or 4 chosen. R1 & R2 (Y & P) are used to specify desired SC body vector to be pointed. The combination of P = 0° and Y = ±90° is a constraint upon options 4 and 5 and should not be specified. Azimuth (R3) used only by options 4 and 5 to hold attitude about a specified SC vector. When MINKEY first initiated R3 automatically loaded to 000.00° if HDSUPFLG set, or +180.00° if HDSUPFLG reset. Selection of P47 during P20 destroys least significant half of N78 (R1); will cause incorrect N78 (R1 data) and may cause bad tracking or rotation.

STA/T	STEP	PROCEDURE	PANEL	REMARKS
CP	4	FL V06 N79	2,140	All options.
		Rate X.XXXX DEG/SEC DBD XXX.XX DEG		If option 2, R1 & R2 displayed; for options 0, 1, 4 & 5, R2 only displayed. R2 initialized to current DAP deadband. Zero input causes 0.5° deadband to be employed. Maneuver rates for other than option 2 will be those computed as necessary to track the target.
		Reject Key V21E, V22E, V24E Load desired data Accept PRO Options 0 & 4, go to 8 1 & 5, go to 5 2, go to 7		
		If presently rotating & new N79 contents to be used RHC - move from detent		Stops rotation, allows initialization to new N79 values.
AC		or SC cont - CMC/HOLD	1	
		SC CONT - CMC CMC MODE - HOLD		
		CMC MODE - FREE (verify)		Prevents collapsing desired deadband.
		Load new data		
CP		Key V58E	2,140	
AC		CMC MODE - AUTO	1	Resumes rotation with new N79 values.
CP	5	FL V01 N70	2,140	Options 1 & 5. Celestial body to be pointed at. No specific values preloaded.

STA/T	STEP	PROCEDURE		PANEL	REMARKS
CP		Trgt code	00CDE	2,140	Target codes: [In P20, source code (C) must be zero. Any non-zero digit turns on OPR ERR lt] 00 - Planet (any planet except earth) 01 to 45 - Star 46 - Sun 47 - Earth
		Reject Key V21E Load trgt code			
		Accept PRO R1 = 00, go to 6 R1 >00 & ≤47, go to 8			
		Poss OPR ERR Recycles disp			Target code negative or >47.
	6	FL V06 N88 (planet only)		2,140	Options 1 & 5 (if N70 = 00). No specific values preloaded.
		X, Y, Z	.XXXXX		Components of planet unit position vector at present time.
		Accept PRO, go to 8 Reject Key V25E Load desired data			Use on-board tables to determine planet position vector at present time.
	7	FL V06 N34			Option 2. Time to begin rotation. No specific time preloaded.
		Time of event	00XXX. HRS 000XX. MIN 0XX.XX SEC		
AC		Accept SC cont - CMC/AUTO SC CONT - CMC CMC MODE - AUTO		1	Schedules rotation about specified SC vector to begin at specified time (immediately if time in past).
CP		PRO		2,140	

STA/T	STEP	PROCEDURE	PANEL	REMARKS
CP		(R67, Rotation Maneuver Routine)		Option 2 - Provides capability of having DAP maintain a controlled rotational rate about a specified SC vector. Refer to 8.2.4 & 5 for orb rate/PTC (P20 option 2) procedures. Remaining P20 procedure does not apply to option 2.
		Begin rotation (PRO on N34)		
		To stop rotation RHC - move from detent		Establishes attitude hold.
AC		or SC cont - CMC/HOLD SC CONT - CMC CMC MODE - HOLD	1	
		To re-initiate rotation		
CP		Key V58E	2,140	Re-establishes rotation to N78/N79 data (original or new data loaded).
		To terminate mnvr Key V56E		Terminates P20 and all options.
		or Key V37E 00E		
		(R61, Tracking Attitude Routine)		Computes required gimbal angles at tracking attitude with present IMU orientation, extrapolates (periodically) CSM and Soyuz state vectors to present time and calculates LOS from CSM to Soyuz. Maneuver is performed so as to yield a minimum attitude maneuver.
	8	Maneuver		9.2.1, note 10.
		If mnvr <10° SC cont - CMC/AUTO SC CONT - CMC CMC MODE - AUTO Options 0 or 4, go to 10 Option 1 or 5, exit (R61 maintains track att)		If maneuver <10°, R61 performs maneuver to tracking attitude. R61 will continue to compute and maintain selected attitude (option) as long as SC cont - CMC/AUTO and RHC not moved out of detent. For maneuver <10°, remainder of P20 procedure does not apply to options 1 and 5.
AC			1	

STA/T STEP	PROCEDURE	PANEL	REMARKS
AC	If mnvr ≥10°, go to 9		If maneuver ≥10° and V50N18 flag set, calls R60 (R60 performs maneuver). V50N18 flag set by V37 processing (except P00) and on initial entry to P20. If maneuver ≥10° and V50N18 flag not set, lights UPLINK ACTY lt.
CP	Poss PROG alarm Key V05 N09E (to verify alarm) 00401 (MGA excessive) Key V23 N78E Change N78 (R3) KEY REL		Options 4 and 5. Load value in R3 to reduce MGA to acceptable limit.
	If MGA >75° CMC goes to att hold RHC - manually mnvr to sel track att Key V58E		Prevents maneuver into gimbal lock. Sets V50N18 flag.
	If mnvr <10° Option 0 or 4, go to 10 Option 1 or 5, exit (R61 maintains track att)		
	If mnvr ≥10°, go to 9		
	or Align IMU to acceptable orient, sec 13		

NORMAL/BACKUP

STA/T	STEP	PROCEDURE	PANEL	REMARKS
		(R60, Attitude Maneuver Routine)		Maneuvers (auto or manual) to attitude specified by option selected and N78 data. R60 called only if maneuver $\geq 10°$ as determined by R61. Otherwise maneuver performed by R61.
CP		(If UPLINK ACTY lt on Key V58E)	2,140	Must key V58E in order to get R60 (V50 N18). R61 resets V50N18 flag at completion of first R61 cycle; therefore, V58E required to set flag to allow R60 if subsequent auto maneuver $\geq 10°$ required.
	9	Poss FL V50 N18 (auto mnvr request) (2 sec priority) If req angle change $\geq 10°$		DAP will point specified SC vector in direction of LOS to specified target.
		R, P, Y XXX.XX DEG		Required gimbal angles.
AC		Accept SC cont - CMC/AUTO SC CONT - CMC CMC MODE - AUTO	1	
CP		PRO	2,140	This may be performed second time as attitude trim.
		V06 N18 R, P, Y XXX.XX DEG Monitor auto mnvr on FDAI		Priority display. At completion of maneuver, display will revert to FL V50 N18 (non-MINKEY only).
		Reject Key V62E RHC - null FDAI err needles Recycle 9		Provides reference for manual maneuver.
AC		or SC CONT - SCS (or CMC mode ≠ auto)	1	To update display without performing maneuver.

STA/T STEP	PROCEDURE	PANEL	REMARKS
CP	PRO Recycle 9	2,140	
	When att satisfactory ENTR		Terminates Attitude Maneuver Routine, R60. (Routine R61 will continue to compute and maintain selected attitude (option) as long as SC control CMC/AUTO and RHC not moved out of detent.) UPLINK ACTY light will be lit if V50N18 flag not set and tracking error, as determined by R61, ≥10 degrees. At this point, SXT marks can be taken. If VHF ranging enabled (V87E), VHF marks automatic. Navigation automatic until final computation requested, and optimized VHF range and range rate may be obtained by enabling R27 (step 16).
	Options 0 or 4 a. If opt sighting mrks desired, go to 10 or b. If BU opt (COAS) sighting mrks desired, go to 12 or c. If VHF ranging update desired, Key V87E, go to 15		Remainder of procedure applies to options 0 and 4 only.
	(R52, Automatic Optics Positioning)		(Options 0 or 4). Points star LOS of optics at Soyuz during rendezvous tracking operations. Cycles R61 approximately every 2 seconds during rendezvous tracking operations (maintains tracking attitude).

NORMAL/BACKUP

STA/T	STEP	PROCEDURE	PANEL	REMARKS
CP	10	OPT ZERO - ZERO OPT MODE - CMC	122	6.1.3, note 4g.
		If TA >50° (options 0 & 4)		Trunnion driven to upper limit (≈49.7754°) and held at this angle.
AC		RHC - mnvr to reduce TA		Key V16 N22E for desired gimbal angles.
	or	SC cont - CMC/AUTO SC CONT - CMC CMC MODE - AUTO If RHC moved from detent	1	
CP		Key V58E	2,140	
	11	OPT MODE - MAN OHC - ctr trgt in SXT MARK pb - push	122	Required for centering target using OHC.
		Accept Repeat mrk proced		If more marks desired. If any mark results in excessive update, priority display FL V06 N49, step 15, will interrupt program and display magnitude of excessive update.
		or OPT MODE - CMC Go to 15		If sufficient marks have been made.
		Reject MARK REJ pb - push Repeat mrk proced		Should be done promptly (within 7 seconds) to ensure mark has not been processed.

STA/T STEP	PROCEDURE	PANEL	REMARKS
CP	Poss PROG alarm Key V05 N09E (to verify alarm) 00121 (att rate >two-thirds deg/sec)	2,140	Sighting marks automatically rejected.
	(R23, Backup Rendezvous Tracking Sighting Mark Routine)		(Options 0 & 4). To perform sighting marks on Soyuz using backup optics (COAS).
12	Key V54E		
13	FL V06 N94 SA XXX.XX DEG TA XX.XXX DEG Accept PRO Reject Key V24E Load desired data		Values obtained from COAS calibration, 13.1.8 Nominal SA and TA for COAS sightings are: SA - 000.00 DEG TA - 57.470 DEG
14	FL V53 N45 (request alt LOS mrk) Mrks (VHF/opt) XXBXX MKS		Number of marks processed by R22. Two most significant digits display VHF ranging marks. Two least significant digits display optics marks [either SXT or backup optics (COAS) marks]. (If V87E, VHF marks accumulated automatically.) Optics marks may be taken any time P20 operating (after maneuver to sighting attitude).

NORMAL/BACKUP

STA/T	STEP	PROCEDURE	PANEL	REMARKS
CP		TF GETI (next burn) XXBXX MIN-SEC	2,140	Contents dependent on external programs. If P20 only, display static. Constraint - R2 cannot be >59B59 at this point. If TF GETI >59 min 59 sec, display is limited. N35 may be used to get full time to ignition.
		MGA (next burn) XXX.XX DEG		Contents dependent on external programs. If P20 only, display static.
		RHC - align Soyuz in COAS ENTR		Alternate LOS mark.
	Accept	Repeat mrk proced		If more marks desired.
	or	Wait 15 sec		To allow processing of final mark.
		PRO		If sufficient marks have been made. To ensure processing of last mark, wait 15 seconds before proceeding. This allows for previous marks to be processed. If PRO done too soon, last mark may be treated as a prime rather than a backup mark.
	Reject	V86E Repeat mrk proced		Rejects previous mark. Should be done promptly (within 7 seconds) to ensure mark has not been processed.

STA/T	STEP	PROCEDURE	PANEL	REMARKS
		(R22, Rendezvous Tracking Data Processing Routine)		(Options 0 & 4). Processes optics and VHF ranging data in accordance with status of FULTKFLG and integrates CSM and Soyuz state vectors to present time. Nominally, CSM state vector is automatically selected for incorporation by initial entry to P20. V80 and V81, however, are also available for selecting Soyuz and CSM state vector update respectively. For FULTKFLG status, or change, refer to 8.3.5.
CP	15	Poss FL V06 N49 (2 sec priority) ΔR XXX.XX NM ΔV XXXX.X FPS	2,140	Excessive update parameters. To change ΔR and ΔV threshold values, refer to 8.1.10.
		Source code 0000X.		00001 = Optics (CMC does not differentiate between SXT and COAS marks). 00002 = VHF ranging. For this option, refer to 5.6.3.
		Wait 2 sec		Priority display. Will not respond to DSKY input until after 2 seconds.
		Accept PRO Reject Key V32E		Incorporates update data. Does not incorporate update data.
		(R27, VHF Range/Range Rate)		Provides method of obtaining optimized measurements of VHF range and range rate, and ϕ, either for present time or for a desired time specified via N72. The time interval for optimizing range rate should be chosen so as not to conflict with final computations for a targeting solution. Targeting solutions should be obtained after recording optimized results in N77.

NORMAL/BACKUP

STA/T	STEP	PROCEDURE	PANEL	REMARKS
CP	16	Key V76E	2,140	Enables R27 in R22.
		Poss OPR ERR Exit		If another extended verb active.
	17	FL V06 N72		
		T (R27 optimized) 00XXX. HRS 000XX. MIN 0XX.XX SEC		
		Accept PRO Reject Key V25E Load GET for optimization		
	18	Obtain current R & R dot Key V16 N76E		
		R XXX.XX NM		Range.
		R dot XXXX.X FPS		Range rate.
		TFO (- closing) XXBXX MIN-SEC		Time from R27 optimization(counting to N72 time).
	19	Monitor R3 → 0 Center Soyuz in opt FOV With Soyuz centered and R3 = 0 MARK		

STA/T	STEP	PROCEDURE	PANEL	REMARKS
CP	20	Obtain optimized values of R, R dot & ϕ		
		Key N77E	2,140	Displays latest optimized range and range rate.
		R XXX.XX NM		
		R dot (- closing) XXXX.X FPS		
		ϕ XXX.XX DEG		ϕ computed for last N72 time.
		Record N77 data		
		V77E		Disables R27 in R22.
		Go to trgting prog		
	21	To term P20 & all other prog running		6.1.3, note 3r.
		Key V37E 00E		
	or	To term P20 only		
		Key V56E		If V56E keyed in during computation in P35/P36, these computations will be restarted from beginning.
		Poss FL V37		FL V37 only if no other program active.
		Key XXE		
	22	Set opt cont		
		OPT ZERO - ZERO	122	
		OPT PWR - OFF	100	
		RETCL BRT tw - DIM	122	

NORMAL/BACKUP

STA/T	STEP	PROCEDURE	PANEL	REMARKS
		10.2.2 (P25) Contingency VHF Range Rate		Displays range and range rate from a source independent of vehicle state vectors. Allows selection of a time at which range rate will be optimized.
		CMC - on (req), 8.1.3 VHF AM ranging mode sel (req), 5.6.3		
CP	1	Key V37E 25E	2,140	
	2	FL V06 N72 T (R27 optimized) 00XXX. HRS 000XX. MIN 0XX.XX SEC		
		Accept PRO Reject Key V25E Load desired data		No R27 optimization if zeros loaded in N72.
		If N72 = 0, go to 4		
	3	FL V16 N76 R XXX.XX NM R dot (-closing) XXXX.X FPS		Range (updated at a 2-second interval). Range rate. Updated at 2-second interval.
		TFO XXBXX MIN SEC		Time from R27 optimization updated at 1-second interval (59B59 = no R27 optimization).
		Accept PRO Reject Key V32E Return to 2		To respecify additional optimization time.

(P25) CONTINGENCY VHF RANGE RATE

STA/T	STEP	PROCEDURE		PANEL	REMARKS
CP	4	FL V16 N77		2,140	If N72 = 0 R, R dot = current values If N72 ≠ 0 TFO < -01B35, R, R dot = current values -01B35 < TFO < +00B02, R, R dot fixed at last current value +00B02 < TFO < +01B35, R, R dot = optimizing values. TFO > +01B35, R, R dot = optimized values New optimization is done every 4 minutes.
		R	XXX.XX NM		
		R dot (-closing)	XXXX.X FPS		
		θ/φ	-00001 code		
		Accept	PRO		
		Reject	Key V32E Return to 2		To optimize R dot for new N72 time.
	5	FL V37 Key XXE			

NORMAL/BACKUP

STA/T	STEP	PROCEDURE	PANEL	REMARKS
		10.2.3 (V83) Rendezvous Parameter Display #1 (R31)		Displays CMC calculated rendezvous parameters (range, range rate, and theta).
		CMC - on (req), 8.1.3 ISS - on & orient known (req), 8.1.3 & sec 13		Required for meaningful display of theta.
CP	1	Key V83E	2,140	V83 automatically executed for P37 (Final Rendezvous Parameters) during MINKEY sequence. (Refer to 11.2.7.)
		Poss OPR ERR		If another extended verb active.
	2	FL V16 N54		Display updated at 2-second intervals.
		Range XXX.XX NM		Range and range rate based on stored state vectors. Range and range rate displays may degrade considerably at ranges below ≈0.3 to 0.5 NM depending on marking schedules and resultant CMC navigation accuracy. Once this routine has started, changes to state vector caused by optics mark or VHF sample will not be reflected in displayed parameters.
		Range rate XXXX.X FPS		(-) range rate indicates closing. This calculation not sufficiently accurate for reliable terminal closing values. It should not be utilized without good visual cues.
		Theta (lcl horiz/ CSM +X) XXX.XX DEG		Theta - Angle included between +Xsc axis and local horizontal. Angle in range 0° to 180° indicates +Xsc axis is above local horizontal plane. Total range: 0° to 360°.
		PRO Return to prog in progress		

STA/T	STEP	PROCEDURE	PANEL	REMARKS
		10.2.4 (V85) Rendezvous Parameter Display #2 (R34)		Displays CMC calculated rendezvous parameters (range, range rate, and phi).
		CMC - on (req), 8.1.3		
		ISS - on & orient known (req), 8.1.3 & sec 13		Required for meaningful display of phi.
		Opt pwr up (req), 8.1.4		Required for meaningful display of phi.
CP	1	Key V85E	2,140	
		Poss OPR ERR		If another extended verb active.
	2	FL V16 N53		Display updated at 2-second intervals.
		Range XXX.XX NM Range rate XXXX.X FPS		Range and range rate computed based on stored Soyuz and CSM state vectors. (-) range rate indicates closing. Range and range rate displays may degrade considerably at ranges below ≈0.3 to 0.5 NM depending on marking schedules and resultant CMC navigation accuracy. Once this routine has started, changes to state vector caused by optics mark or VHF sample will not be reflected in displayed parameters.
		Phi (lcl horiz/ SLOS) XXX.XX DEG		Phi - Angle included between optics star line-of-sight and local horizontal. Angle in range 0° to 180° indicates SLOS is above local horizontal plane. Total range: 0° to 360°.
		PRO Return to prog in progress		

NORMAL/BACKUP

STA/T	STEP	PROCEDURE	PANEL	REMARKS
		10.2.5 (V90) Rendezvous Out of Plane Display (R36)		Displays CMC calculated rendezvous out-of-plane parameters.
		CMC - on (req), 8.1.3		
CP	1	Key V90E	2,140	
		Poss OPR ERR		If another extended verb active.
	2	FL V06 N16		
		GET event 00XXX. HRS		GET for which out-of-plane parameters desired. N16 initialized to TIG(N33) before this display. (Present time indicated by all zeros.)
		000XX. MIN		
		0XX.XX SEC		
		Accept PRO		
		Reject Key V25E		
		Load desired GET event		
	3	FL V06 N96 (rndz out of plane param)		
		Y (CSM) XXX.XX NM		
		Y dot (CSM) XXXX.X FPS		
		Y dot (Soyuz) XXXX.X FPS		
		Accept PRO		
		Exit R36		
		Reject Key V32E		To obtain additional data point.
		Return to 2 (adjust GET event)		

STA/T	STEP	PROCEDURE	PANEL	REMARKS
		10.2.6 (V89) Rendezvous Final Attitude (R63)		Calculates final gimbal angles required to point either CSM +X axis or preferred tracking axis at SWS. Provides auto maneuver to selected attitude by calling R60.
		CMC - on (req), 8.1.3 ISS - on & orient known (req), 8.1.3 & sec 13 SCS - on (desired), 8.4.2 RCS DAP - load & activate (req), 8.2.1		
CP	1	Key V37E 00E	2,140	R63 may be selected from P00 only.
	2	Sel ISS Tot Att Disp, 7.2.5		Both FDAIs recommended so that either reference system (IMU or GDC) may be monitored. (CMC attitude error and rate display available.)
	3	Key V89E Poss PROG alarm		R02. (8.1.15)
	4	FL V06 N78 (SC vctr angles) Y, P XXX.XX DEG Accept PRO Reject Key V24E Load desired data		R1 and R2 initialized zero, R3 blanked.
	5	FL V06 N18 (computed GMBL angles) R, P, Y XXX.XX DEG		Computed required gimbal angles at selected tracking attitude as determined by N78 inputs if present IMU orientation maintained.

STA/T	STEP	PROCEDURE	PANEL	REMARKS
CP		Accept PRO Reject Key V32E (to update disp)	2,140	
		or Key V34E (to term routine)		
		(R60, Attitude Maneuver Routine)		Provides maneuver (automatic or manual) to attitude selected in 4.
	6	FL V50 N18 (auto mnvr request) R, P, Y XXX.XX DEG		Required gimbal angles.
AC		Accept SC cont - CMC/AUTO SC CONT - CMC CMC MODE - AUTO	1	
CP		PRO Go to 7	2,140	
		Reject Key V62E RHC - null FDAI err needles		Provides reference for manual maneuver.
AC		or SC CONT - SCS (or CMC MODE ≠ AUTO)	1	Recomputes desired attitude without performing auto maneuver.
CP		PRO (to update disp) **Recycle 6**	2,140	
		or ENTR Exit R60/R63		Terminates R60.
	7	V06 N18 (auto mnvr) R, P, Y XXX.XX DEG		Non-flashing display until completion of auto maneuver, then returns to FL V50 N18. Maneuver rates will be as specified by last DAP data load (R03).
		Mon auto mnvr on FDAI Return to 6		When maneuver complete.

STA/T	STEP	PROCEDURE	PANEL	REMARKS
		10.2.7 (P77) Target Delta V		P77 provides CSM maneuver parameters for updating CMC knowledge of CSM state vector. Keying V34E terminates P77 at any flashing display.
		CMC - on (req), 8.1.3		
CP	1	Key V37E 77E	2,140	
	2	FL V06 N33 GETI 00XXX. HRS 000XX. MIN 0XX.XX SEC Accept PRO Reject Key V25E Load desired GETI		
	3	FL V06 N81 ΔVX, Y, Z (CSM lcl vert) XXXX.X FPS Accept PRO Reject Key V25E Load desired data		CMC updates CSM state vector.
	4	FL V37 Key XXE		

NORMAL/BACKUP

STA/T	STEP	PROCEDURE	PANEL	REMARKS
	11.0	PRETHRUSTING		For general G&C operating data, refer to operating notes, 6.1.
	11.1	ORBIT CHANGE PRETHRUSTING		
	11.1.1	(P30) External Delta V Prethrusting		Accepts targeting parameters from sources external to CMC and computes, therefrom, required velocity and other initial conditions required by CMC for execution of ΔV maneuver. Targeting parameters include time of ignition (TIG) and impulsive ΔV along CSM local vertical axes at TIG. P30 displays, to flight crew and STDN, certain specific dependent variables associated with desired maneuver for approval by flight crew/ STDN.
		CMC - on (req), 8.1.3 ISS - on & orient known (desired), 8.1.3 & sec 13		ISS must be on and its orientation known to obtain middle gimbal display (step 5).
CP	1	Key V37E 30E	2,140	At this point, P30 sets TRACK and UPDATE flags.
	2	FL V06 N33 GETI, stored OOXXX. HRS OOOXX. MIN OXX.XX SEC Accept Rcd GETI PRO Reject V25E, load desired GETI		
	3	FL V06 N81 (VG compnts) VGX, Y, Z (lcl vert at GETI) XXXX.X FPS		Stored VG components along local vertical axes at GETI.

NORMAL/BACKUP

STA/T	STEP	PROCEDURE		PANEL	REMARKS
CP		Accept PRO Reject V25E, load desired data		2,140	PRO option resets UPDATE flag and sets external ΔV flag.
	4	FL V06 N42 (calculated thrust parameters)			
		Ha	XXXX.X NM		Altitudes above launch pad radius. Measurements are limited to 9999.9 NM. Calculated Ha and Hp in P30 are considerably in error for long burns and should be ignored because parameters are computed (assuming an impulsive ΔV) at time of ignition along CSM local vertical axis. ΔV is magnitude of the impulsive ΔV vector at GETI.
		Hp	XXXX.X NM		
		ΔV (req)	XXXX.X FPS		
		Coord parameters with STDN (if available)			
		Accept PRO Reject Reselect P30 or P27, load new parameters			
	5	FL V16 N45			
		Mrks (VHF/opt)	XXBXX MKS		Number of marks processed by R22. Two most significant digits display VHF ranging marks. Two least significant digits display optics marks [either SXT or backup optics (COAS) marks]. Optics mark counter does not distinguish between backup and primary marks.
-59:59		TF GETI (next burn)	XXBXX MIN-SEC		Constraint - R2 cannot be >59B59 at this point. If TF GETI >59 min 59 sec, display limited. For full time to ignition display, use N35.
		MGA (next burn)	XXX.XX DEG		MGA is displayed as -00002 at this point if IMU not on and orientation known (REFSMFLG reset). Otherwise, MGA at GETI displayed if CSM +X axis aligned with initial thrust direction.
		Rcd values PRO Align GDC to IMU, 8.4.6			

STA/T	STEP	PROCEDURE	PANEL	REMARKS
CP	6	FL V37 Key XXE	2,140	If average G on, R00 turns off average G. It also sets or resets RNDVZFLG, TRACK, and UPDATE flags, depending on which programs in progress or called, and may recycle into P20 under certain conditions.
		Go to (P40) G&N/SPS Thrusting, 12.2.1		
		or (P41) G&N/SM RCS Thrusting, 12.2.2		
		or SCS Thrusting, 12.3		
		or (P52) IMU Realign, 13.1.3		IMU realign should be selected if MGA unsatisfactory in step 5.

NORMAL/BACKUP

STA/T	STEP	PROCEDURE	PANEL	REMARKS
		11.2 RENDEZVOUS PRETHRUSTING		
		11.2.1 (P31) Normal Corrective Maneuver #1 (NC1)		Calculates and displays parameters associated with NC1 maneuver and ΔV burn. Keying V34E terminates P31 at any flashing display. Based on stored target parameters, the following parameters are computed and stored: TIG(NC2) in N28 — ΔV(NC2) in N84 TIG(NCC) in N11 — ΔH(NC2) in N84 TIG(NSR) in N13 — ΔV(NCC) in N84 ΔV(NC1-LV) in N81 — ΔV(NSR-LV) in N82 Refer to 9.2 for additional data on the MINKEY rendezvous sequence.
		CMC - on (req), 8.1.3 ISS - on & orient known (desired), 8.1.3 & sec 13		Required for MINKEY and for meaningful MGA display during final N45 display (step 8).
		DAP - load & activate (desired), 8.2.1		Required for auto maneuver to tracking attitude.
CP	1	Key V37E 31E	2,140	If IMU on and aligned, P20 automatically turned on when P31 selected. P31 however, can be selected without P20 in background.
	2	FL V50 N25 00017 (request MINKEY)		Displayed for selection of MINKEY rendezvous sequence. Will occur here only if P31 selected as entry point to MINKEY sequence via V37E. If PRO, will not occur in subsequent programs.
		PRO (MINKEY) ENTR (manual) Go to 3		PRO initiates MINKEY rendezvous sequence. ENTR allows manual sequencing. If not previously selected, P20 (option 4) would now be automatically selected and N78 (R3) in P20 would be loaded as determined by state of EDSUPFLG. Also refer to 9.2.1, note 9.

STA/T	STEP	PROCEDURE	PANEL	REMARKS
		(R61, Tracking Attitude Routine)		Computes specified tracking attitude [computes required gimbal angles at tracking attitude (specified by N78) with present IMU orientation]. The CMC will compute and execute appropriate maneuver (R61/R60).
	3	Maneuver		9.2.1, note 10.
		If mnvr <10°		
CP		SC cont - CMC/AUTO	2,140	If maneuver <10°, R61 performs maneuver to tracking attitude.
		SC CONT - CMC		
		CMC MODE - AUTO		
		Go to 5		
		If mnvr ≥10°, go to 4		If maneuver ≥10° and V50N18 flag set, calls R60 (R60 performs maneuver). V50N18 flag set by V37 processing (except P00) and on initial entry to P20.
				If maneuver ≥10° and V50N18 flag not set, lights UPLINK ACTY light.
		Poss PROG alarm		P20 (option 4).
		Key V05 N09E (to verify alarm)		
		00401 (MGA excessive)		
		If MGA >75°		
		CMC goes to att hold		Prevents maneuver into gimbal lock.
		RHC - manually mnvr to sel track att		
		Key V58E		Sets V50N18 flag.
		If mnvr <10°, go to 5		
		If mnvr ≥10°, go to 4		
		or Align IMU to acceptable orient, sec 13		

STA/T	STEP	PROCEDURE	PANEL	REMARKS
		(R60, Attitude Maneuver Routine)		Controller selects P20. Provides for maneuver (auto or manual) to attitude specified by option selected and N78 data. R60 called only if maneuver ≥10° as determined by R61. Otherwise maneuver performed by R61.
		(If UPLINK ACTY lt on Key V58E)		Must key V58E in order to get R60 (V50 N18). R61 resets V50N18 flag at completion of first R61 cycle; therefore, V58E required to set flag to allow R60 if subsequent auto maneuver ≥10° required.
CP	4	Poss FL V50 N18 (auto mnvr request) (2 sec priority) If req angle change ≥10°	2,140	DAP will point specified (N78) axis at Soyuz.
		R, P, Y XXX.XX DEG		Required gimbal angles.
AC		Accept SC cont - CMC/AUTO SC CONT - CMC CMC MODE - AUTO	1	
CP		PRO	2,140	This may be performed second time as attitude trim.
		V06 N18 R, P, Y XXX.XX DEG Monitor auto mnvr on FDAI		Priority display. At completion of maneuver, display will revert to FL V50 N18 (non-MINKEY only).
		Reject Key V62E RHC - null FDAI error needles Recycle 4		Provides reference for manual maneuver.
AC		or SC CONT - SCS (or CMC mode ≠ auto)	1	To update display without performing maneuver.
CP		PRO Recycle 4	2,140	

STA/T STEP	PROCEDURE	PANEL	REMARKS
CP	When att satisfactory ENTR, go to 5	2,140	Terminates Attitude Maneuver Routine, R60. (Routine R61 will continue to compute and maintain selected attitude (option) as long as SC control CMC/AUTO and RHC not moved out of detent.) UPLINK ACTY light will be lit if V50N18 flag not set and tracking error, as determined by R61, ≥10 degrees. At this point, SXT marks can be taken. [For mark procedure, refer to (P20) 10.2.1, step 11.] If VHF ranging enabled (V87E), VHF marks automatic. Navigation automatic until final computation request.
5	FL V06 N95 GETI (NC1) OOXXX. HRS OOOXX. MIN OXX.XX SEC Accept Rcd GETI (NC1) PRO Reject Key V25E Load desired GETI (NC1)		If P31 first program called in MINKEY sequence, GETI (NC1) must be loaded.
6	FL V06 N57 1/2 revs XXXXX. ΔH (NCC) XXXX.X NM ΔH (NSR) XXXX.X NM Accept Rcd data PRO Reject Key V25E Load desired data		Number of 1/2 revs between NC1 and NC2.

NORMAL/BACKUP

STA/T	STEP	PROCEDURE		PANEL	REMARKS
CP	7	FL V06 N37		2,140	
		GETI (TPI)	00XXX. HRS 000XX. MIN 0XX.XX SEC		
		Accept Rcd GETI (TPI) PRO			
		Reject Key V25E Load desired GETI (TPI)			
	8	FL V16 N45 (mnvr data)			
		Marks	XXBXX MKS		Number of marks processed by R22. Two most significant digits display VHF ranging marks. Two least significant digits display optics marks [either SXT or backup optics (COAS) marks]. (If V87E, VHF marks accumulated automatically.) Optics marks may be taken any time P20 operating.
		TF GETI (NC1)	XXBXX MIN-SEC		Time from NC1 ignition. Maximum reading 59B59. -, before; +, after.
		MGA	-0000X		-00001 for other than final pass. -00002 final pass, IMU not aligned.
		or IMU aligned	+XXX.XX DEG		Middle gimbal angle (yaw): +XXX.XX DEG for final pass and IMU aligned (if +X axis aligned to initial thrust direction).
		To continue mark process Key V32E, go to 9			CMC computes NCC and NSR parameters.

STA/T	STEP	PROCEDURE	PANEL	REMARKS
		or To terminate mark process & do final pass Wait 15 sec		Allows processing of final mark.
CP		PRO, go to 9	2,140	CMC computes NCC and NSR parameters.
		Poss FL V05 N09 00600 failure in phase match iterations 00601 failure in either NC2 or NCC height mnvr iterations 00602 failure in outer (phase) loop iterations 00603 failure in QRDTPI iterations		
		Key V32E Return to 5		To adjust input parameters.
		or PRO If 00600, 00601, or 00603 Go to 10		Continue program without recycle.
		or After final pass PRO, go to 11		
		9 FL V06 N84 ΔV (NC2) XXXX.X FPS ΔH (NC2) XXXX.X NM ΔV (NCC) XXXX.X FPS Rcd data PRO		

STA/T	STEP	PROCEDURE	PANEL	REMARKS
CP	10	FL V06 N81 VGX, Y, Z (NC1) XXXX.X FPS	2,140	CMC calculated components of VG (in local vertical coordinates) for NC1. N81 values will be zero if PRO after alarms 00600, 00601, or 00603 (step 8).
		Rcd data PRO, return to 8		
	11	FL V37 Key XXE		
	or	If MINKEY, go to 12.2.1/12.2.2		For MINKEY, W-matrix reinitialization values are changed to 2K ft and 2 fps. If VG computed to be $\geq$10 fps, controller proceeds to P40 sequence. If VG <10 fps, controller proceeds to P41.

(P31) NORMAL CORRECTIVE MANEUVER #1 (NC1)

STA/T	STEP	PROCEDURE	PANEL	REMARKS
	11.2.2	(P32) Normal Corrective Maneuver #2 (NC2)		Calculates and displays parameters associated with NC2 maneuver and ΔV burn. Successful completion dependent upon assumptions: a. Prescribed angle (E) exists at selected GETI (TPI). b. Computed variables may be stored for later STDN verification. P32 can be selected manually (manual rendezvous sequence) or automatically by MINKEY controller (MINKEY rendezvous sequence). Keying V34E terminates P32 at any flashing display. Based on stored target parameters, the following parameters are computed and stored: TIG(NCC) in N11 — ΔV(NCC) in N84 TIG(NSR) in N13 — ΔV(NSR) in N84 ΔV(NC2-LV) in N81 — ΔV(NSR-LV) in N82 Refer to 9.2 for additional data on the MINKEY rendezvous sequence.
		CMC - on (req), 8.1.3 ISS - on & orient known (desired), 8.1.3 & sec 13		Required for MINKEY and for meaningful MGA display during final N45 display (step 8).
		DAP - load & activate (desired), 8.2.1		Required for auto maneuver to tracking attitude.
	1	If MINKEY auto call Go to 3		If MINKEY selected in P31, P32 automatically called by MINKEY controller at completion of NC1 sequence.
CP	or	Key V37E 32E	2,140	If IMU on and aligned, P20 automatically turned on. P32 however, can be selected without P20 in background.

NORMAL/BACKUP

STA/T	STEP	PROCEDURE	PANEL	REMARKS
CP	2	FL V50 N25 00017 (request MINKEY) PRO (MINKEY) ENTR (manual) Go to 3 (R61, Tracking Attitude Routine) 3 Maneuver If mnvr <10° SC cont - CMC/AUTO SC CONT - CMC CMC MODE - AUTO Go to 5 If mnvr ≥10°, go to 4 Poss PROG alarm Key V05 N09E (to verify alarm) 00401 (MGA excessive)	2,140	Occurs only if MINKEY sequence initiated at this point. PRO initiates MINKEY rendezvous sequence. ENTR allows manual sequencing. If not previously selected, P20 (option 4) would now be automatically selected and N78 (R3) in P20 would be loaded as determined by state of HDSUPFLG. Also refer to 9.2.1, note 9. Computes specified tracking attitude [computes required gimbal angles at tracking attitude (specified by N78) with present IMU orientation]. The CMC will compute and execute appropriate maneuver (R61/R60). 9.2.1, note 10. If maneuver <10°, R61 performs maneuver to tracking attitude. If maneuver ≥10° and V50N18 flag set, calls R60 (R60 performs maneuver). V50N18 flag set by V37 processing (except P00) and on initial entry to P20. If maneuver ≥10° and V50N18 flag not set, lights UPLINK ACTY light. P20 (option 4).

(P32) NORMAL CORRECTIVE MANEUVER #2 (NC2)

STA/T	STEP	PROCEDURE	PANEL	REMARKS
CP		If MGA >75° CMC goes to att hold RHC - manually mnvr to sel track att Key V58E If mnvr <10°, go to 5 If mnvr ≥10°, go to 4	2,140	Prevents maneuver into gimbal lock. Sets V50N18 flag.
		or Align IMU to acceptable orient, sec 13		
		(R60, Attitude Maneuver Routine)		Controller selects P20. Provides for maneuver (auto or manual) to attitude specified by option selected and N78 data. R60 called only if maneuver ≥10° as determined by R61. Otherwise maneuver performed by R61.
		(If UPLINK ACTY lt on Key V58E)		Must key V58E in order to get R60 (V50 N18). R61 resets V50N18 flag at completion of first R61 cycle; therefore, V58E required to set flag to allow R60 if subsequent auto maneuver ≥10° required.
	4	Poss FL V50 N18 (auto mnvr request) (2 sec priority) If req angle change ≥10°		DAP will point specified (N78) axis at Soyuz.
		R, P, Y XXX.XX DEG		Required gimbal angles.
AC		Accept SC cont - CMC/AUTO SC CONT - CMC CMC MODE - AUTO	1	
CP		PRO	2,140	This may be performed second time as attitude trim.
		V06 N18 R, P, Y XXX.XX DEG Monitor auto mnvr on FDAI		Priority display. At completion of maneuver, display will revert to FL V50 N18 (non-MINKEY only).

NORMAL/BACKUP

STA/T	STEP	PROCEDURE	PANEL	REMARKS
CP		Reject Key V62E	2,140	Provides reference for manual maneuver.
		RHC - null FDAI error needles		
		Recycle 4		
AC		or SC CONT - SCS (or CMC mode ≠ auto)	1	To update display without performing maneuver.
CP		PRO	2,140	
		Recycle 4		
		When att satisfactory ENTR, go to 5		Terminates Attitude Maneuver Routine, R60. (Routine R61 will continue to compute and maintain selected attitude (option) as long as SC control CMC/AUTO and RHC not moved out of detent.) UPLINK ACTY light will be lit if V50N18 flag not set and tracking error, as determined by R61, ≥10 degrees. At this point, SXT marks can be taken. [For mark procedure, refer to (P20) 10.2.1, step 11]. If VHF ranging enabled (V87E), VHF marks automatic. Navigation automatic until final computation request.
	5	FL V06 N28		
		GETI (NC2)	OOXXX. HRS OOOXX. MIN OXX.XX SEC	
		Accept Rcd GETI (NC2)		
		PRO		
		Reject Key V25E		
		Load desired GETI (NC2)		
	6	FL V06 N57		
		R2 ΔH (NCC)	XXXX.X NM	
		R3 ΔH (NSR)	XXXX.X NM	

(P32) NORMAL CORRECTIVE MANEUVER #2 (NC2)

STA/T STEP	PROCEDURE	PANEL	REMARKS
CP	Accept Rcd data PRO Reject Key V22E, or V23E Load desired data	2,140	
7	FL V06 N37 GETI (TPI) OOXXX. HRS OOOXX. MIN OXX.XX SEC Accept Rcd GETI (TPI) PRO Reject Key V25E Load desired GETI (TPI)		
8	FL V16 N45 (mnvr data) Marks XXBXX MKS		Number of marks processed by R22. Two most significant digits display VHF ranging marks. Two least significant digits display optics marks [either SXT or backup optics (COAS) marks]. (If V87E, VHF marks accumulated automatically.) Optics marks may be taken anytime P20 operating.
	TF GETI (NC2) XXBXX MIN-SEC		Time from NC2 ignition. Maximum reading 59B59. -, before; +, after.
	MGA -0000X		-00001 for other than final pass. -00002 for final pass (and IMU not aligned).
	or IMU aligned +XXX.XX DEG		Middle gimbal angle (yaw): +XXX.XX DEG for final pass and IMU aligned (if +X axis aligned to initial thrust direction).

STA/T STEP	PROCEDURE	PANEL	REMARKS
CP	To continue mark process Key V32E, go to 9	2,140	
	or To terminate mark process & do final pass PRO, go to 9		
	Poss FL V05 N09 00600 failure in phase match iterations 00601 failure in NCC height mnvr iterations 00602 failure in outer (phase) loop iterations 00603 failure in QRDTPI iterations		
	Key V32E Return to 5		
	or PRO If 00600, 00601, or 00603 Go to 10		
	or After final pass PRO, go to 11		

STA/T	STEP	PROCEDURE		PANEL	REMARKS
CP	9	FL V06 N84		2,140	
		ΔV (NCC)	XXXX.X FPS		
		ΔH (NCC)	XXXX.X NM		
		ΔV (NSR)	XXXX.X FPS		
		Rcd data			
		PRO			
	10	FL V06 N81			CMC calculated components of VG (in local vertical coordinates) for NC2. N81 values will be zero if PRO after alarms 00600, 00601, or 00603 (step 8).
		VGX, Y, Z (NC2)	XXXX.X FPS		
		Accept Rcd data			
		PRO, return to 8			
		Reject Key V25E			
		Load desired data			
	11	FL V37			
		Key XXE			
	or	If MINKEY, go to 12.2.1/12.2.2			For MINKEY, W-matrix reinitialization values are changed to 2K ft and 2 fps. If VG computed to be ≥10 fps, controller proceeds to P40 sequence. If VG <10 fps, controller proceeds to P41.

STA/T	STEP	PROCEDURE	PANEL	REMARKS
	11.2.3	(P33) Normal Corrective Combination Maneuver (NCC)		Calculates and displays parameters associated with NCC maneuver and ΔV burn. Successful completion dependent on prior completion of P32 or ΔH(NSR) stored (pad load). P33 can be selected manually (manual rendezvous sequence) or automatically by MINKEY controller (MINKEY rendezvous sequence). Keying V34E terminates P33 at any flashing display. Based on stored target parameters, the following parameters are computed and stored: ΔV(NCC) in N81 ΔV(NSR) in N82 Computations include out-of-plane component at NSR. -Y dot (CSM) is written into R2 of N82. Refer to 9.2 for additional data on the MINKEY rendezvous sequence.
		CMC - on (req), 8.1.3 ISS - on & orient known (desired), 8.1.3 & sec 13		Required for MINKEY and for meaningful MGA display during final N45 display (step 8).
		DAP - load & activate (desired), 8.2.1		Required for auto maneuver to tracking attitude.
	1	If MINKEY auto call Go to 3		If MINKEY initiated prior to P33, P33 automatically called by MINKEY controller at completion of NC2 sequence.
CP	or	Key V37E 33E	2,140	If IMU on and aligned, P20 automatically turned on. P33, however, can be selected without P20 in background.
	2	FL V50 N25 00017 (request MINKEY)		Occurs only if MINKEY sequence initiated at this point.

STA/T STEP	PROCEDURE	PANEL	REMARKS
CP	PRO (MINKEY) ENTR (manual) Go to 3	2,140	PRO initiates MINKEY rendezvous sequence. ENTR allows manual sequencing. If not previously selected, P20 (option 4) would now be automatically selected and N78 (R3) would be loaded as determined by state of HDSUPFLG. Also refer to 9.2.1, note 9.
	(R61, Tracking Attitude Routine)		Computes specified tracking attitude [computes required gimbal angles at tracking attitude (specified by N78) with present IMU orientation]. The CMC will compute and execute the appropriate maneuver (R61/R60).
3	Maneuver		9.2.1, note 10.
	If mnvr <10° SC cont - CMC/AUTO SC CONT - CMC CMC MODE - AUTO Go to 5		If maneuver <10°, R61 performs maneuver to tracking attitude.
	If mnvr ≥10°, go to 4		If maneuver ≥10° and V50N18 flag set, calls R60 (R60 performs maneuver). V50N18 flag set by V37 processing (except P00) and on initial entry to P20. If maneuver ≥10° and V50N18 flag not set, lights UPLINK ACTY light.
	Poss PROG alarm Key V05 N09E (to verify alarm) 00401 (MGA excessive)		P20 (option 4).

STA/T	STEP	PROCEDURE	PANEL	REMARKS
		If MGA >75° CMC goes to att hold RHC - manually mnvr to sel track att		Prevents maneuver into gimbal lock.
CP		Key V58E	2,140	Sets V50N18 flag.
		If mnvr <10°, to to 5 If mnvr ≥10°, go to 4		
		or Align IMU to acceptable orient, sec 13		
		(R60, Attitude Maneuver Routine)		Controller selects P20. Provides for maneuver (auto or manual) to attitude specified by option selected and N78 data. R60 called only if maneuver ≥10° as determined by R61. Otherwise maneuver performed by R61.
		(If UPLINK ACTY lt on Key V58E)		Must key V58E in order to get R60 (V50 N18). R61 resets V50N18 flag at completion of first R61 cycle; therefore, V58E required to set flag to allow R60 if subsequent auto maneuver ≥10° required.
	4	Poss FL V50 N18 (auto mnvr request) (2 sec priority) If req angle change ≥10°		DAP will point specified (N78) axis at Soyuz.
		R, P, Y XXX.XX DEG		Required gimbal angles.
AC		Accept SC cont - CMC/AUTO	1	
		SC CONT - CMC CMC MODE - AUTO		
CP		PRO	2,140	This may be performed second time as attitude trim.
		V06 N18 R, P, Y XXX.XX DEG Monitor auto mnvr on FDAI		Priority display. At completion of maneuver, display will revert to FL V50 N18 (non-MINKEY only).

(P33) NORMAL CORRECTIVE COMBINATION MANEUVER (NCC)

STA/T	STEP	PROCEDURE	PANEL	REMARKS
CP	Reject	Key V62E RHC - null FDAI error needles Recycle 4	2,140	Provides reference for manual maneuver.
AC	or	SC CONT - SCS (or CMC mode ≠ auto)	1	To update display without performing maneuver.
CP		PRO Recycle 4	2,140	
		When att satisfactory ENTR, go to 5		Terminates Attitude Maneuver Routine, R60. (Routine R61 will continue to compute and maintain selected attitude (option) as long as SC control CMC/AUTO and RHC not moved out of detent.) UPLINK ACTY light will be lit if V50N18 flag not set and tracking error, as determined by R61, ≥10 degrees. At this point, SXT marks can be taken. [For mark procedure, refer to (P20) 10.2.1, step 11]. If VHF ranging enabled (V87E), VHF marks automatic. Navigation automatic until final computation request.
	5	FL V06 N11 GETI (NCC)	OOXXX. HRS OOOXX. MIN OXX.XX SEC	
		Accept Rcd GETI (NCC) PRO		
		Reject Key V25E Load desired GETI (NCC)		
	6	FL V06 N13 GETI (NSR)	OOXXX. HRS OOOXX. MIN OXX.XX SEC	

STA/T STEP	PROCEDURE		PANEL	REMARKS
CP	Accept Rcd GETI (NSR) PRO		2,140	
	Reject Key V25E Load desired GETI (NSR)			
7	FL V06 N37			
	GETI (TPI)	00XXX. HRS 000XX. MIN 0XX.XX SEC		
	Accept Rcd GETI (TPI) PRO			
	Reject Key V25E Load desired GETI (TPI)			
8	FL V16 N45			
	Marks	XXBXX MKS		Number of marks processed by R22. Two most significant digits display VHF ranging marks. Two least significant digits display optics marks [either SXT or backup optics (COAS) marks]. (if V87E, VHF marks accumulated automatically.) Optics marks may be taken anytime P20 operating.
	TF GETI (NCC)	XXBXX MIN-SEC		Time from NCC ignition. Maximum reading 59B59. -, before; +, after.
	MGA	-0000X		-00001 for other than final pass. -00002 for final pass (and IMU not aligned).
	or IMU aligned	+XXX.XX DEG		Middle gimbal angle (yaw): +XXX.XX DEG for final pass and IMU aligned (if +X axis aligned to initial thrust direction).

(P33) NORMAL CORRECTIVE COMBINATION MANEUVER (NCC)

STA/T STEP	PROCEDURE	PANEL	REMARKS
	To continue mark process		
CP	Key V32E, go to 9	2,140	
	or To terminate mark process & do final pass PRO, go to 9		
	Poss FL V05 N09 00603 failure in QRDTPI iterations PRO, go to 10		
	or Key V32E, return to 5		To adjust input parameters.
	or After final pass PRO, go to 11		
9	FL V06 N82 ΔVX, Y, Z (NSR) XXXX.X FPS Rcd data PRO		CMC calculated components of VG (in local vertical coordinates) for NSR. CMC automatically incorporates the negative of the computed Y dot (CSM) into R2 of N82. Used for nulling out-of-plane component (Y dot) at appropriate time.
10	FL V06 N81 VGX, Y, Z (NCC) XXXX.X FPS Accept Rcd data PRO, return to 8 Reject Key V25E Load desired data		

NORMAL/BACKUP

STA/T	STEP	PROCEDURE	PANEL	REMARKS
CP	11	FL V37 Key XXE	2,140	
		or If MINKEY, go to 12.2.1/12.2.2		For MINKEY, W-matrix reinitialization values are changed to 2K ft and 2 fps. If VG computed to be ≥10 fps, controller proceeds to P40 sequence. If VG <10 fps, controller proceeds to P41.

(P33) NORMAL CORRECTIVE COMBINATION MANEUVER (NCC)

STA/T STEP	PROCEDURE	PANEL	REMARKS
	11.2.4 (P34) Normal Slow Rate Maneuver (NSR)		Calculates and displays parameters associated with NSR maneuver and ΔV burn. Successful completion dependent on prior completion of P33 (NCC). P34 can be selected manually (manual rendezvous sequence) or automatically by MINKEY controller (MINKEY rendezvous sequence). Keying V34E terminates P34 at any flashing display. Refer to 9.2 for additional data on the MINKEY rendezvous sequence.
	CMC - on (req), 8.1.3 ISS - on & orient known (desired), 8.1.3 & sec 13		Required for MINKEY and for meaningful MGA display during final N45 display (step 6).
	DAP - load & activate (desired), 8.2.1		Required for auto maneuver to tracking attitude.
1	If MINKEY auto call Go to 3		If MINKEY initiated prior to P34, P34 automatically called by MINKEY controller at completion of last burn sequence.
CP or	Key V37E 34E	2,140	If IMU on and aligned, P20 automatically turned on. P34, however, can be selected without P20 in background.
2	FL V50 N25 00017 (request MINKEY)		Occurs only if MINKEY sequence initiated at this point.
	PRO (MINKEY) ENTR (manual) Go to 3		PRO initiates MINKEY rendezvous sequence. ENTR allows manual sequencing. If not previously selected, P20 (option 4) would now be automatically selected and N78 (R3) would be loaded as determined by state of HDSUPFLG. Also refer to 9.2.1, note 9.

STA/T	STEP	PROCEDURE	PANEL	REMARKS
		(R61, Tracking Attitude Routine)		Computes specified tracking attitude [computes required gimbal angles at tracking attitude (specified by N78) with present IMU orientation]. The CMC will compute and execute the appropriate maneuver (R61/R60).
	3	Maneuver		9.2.1, note 10.
CP		If mnvr <10° SC cont - CMC/AUTO SC CONT - CMC CMC MODE - AUTO Go to 5	2,140	If maneuver <10°, R61 performs maneuver to tracking attitude.
		If mnvr ≥10°, go to 4		If maneuver ≥10° and V50N18 flag set, calls R60 (R60 performs maneuver). V50N18 flag set by V37 processing (except P00) and on initial entry to P20. If maneuver ≥10° and V50N18 flag not set, lights UPLINK ACTY light.
		Poss PROG alarm Key V05 N09E (to verify alarm) 00401 (MGA excessive)		P20 (option 4).
		If MGA >75° CMC goes to att hold RHC - manually mnvr to sel track att Key V58E If mnvr <10°, go to 5 If mnvr ≥10°, go to 4		Prevents maneuver into gimbal lock. Sets V50N18 flag.
		or Align IMU to acceptable orient, sec 13		

STA/T	STEP	PROCEDURE	PANEL	REMARKS
		(R60, Attitude Maneuver Routine)		Controller selects P20. Provides for maneuver (auto or manual) to attitude specified by option selected and N78 data. R60 called only if maneuver ≥10° as determined by R61. Otherwise maneuver performed by R61.
CP		(If UPLINK ACTY lt on Key V58E)	2,140	Must key V58E in order to get R60 (V50 N18). R61 resets V50N18 flag at completion of first R61 cycle; therefore, V58E required to set flag to allow R60 if subsequent auto maneuver ≥10° required.
	4	Poss FL V50 N18 (auto mnvr request) (2 sec priority) If req angle change ≥10°		DAP will point specified (N78) axis at Soyuz.
		R, P, Y XXX.XX DEG		Required gimbal angles.
AC		Accept SC cont - CMC/AUTO SC CONT - CMC CMC MODE - AUTO	1	
CP		PRO	2,140	This may be performed second time as attitude trim.
		V06 N18 R, P, Y XXX.XX DEG Monitor auto mnvr on FDAI		Priority display. At completion of maneuver, display will revert to FL V50 N18 (non-MINKEY only).

NORMAL/BACKUP

STA/T	STEP	PROCEDURE	PANEL	REMARKS
CP		Reject Key V62E RHC - null FDAI error needles Recycle 4	2,140	Provides reference for manual maneuver.
AC		or SC CONT - SCS (or CMC mode ≠ auto)	1	To update display without performing maneuver.
CP		PRO Recycle 4	2,140	
		When att satisfactory ENTR, go to 5		Terminates Attitude Maneuver Routine, R60. (Routine R61 will continue to compute and maintain selected attitude (option) as long as SC control CMC/AUTO and RHC not moved out of detent.) UPLINK ACTY light will be lit if V50N18 flag not set and tracking error, as determined by R61 ≥10 degrees. At this point, SXT marks can be taken. [For mark procedure, refer to (P20) 10.2.1, step 11]. If VHF ranging enabled (V87E) VHF marks automatic. Navigation automatic until final computation request.
	5	FL V06 N13 GETI (NSR) 00XXX. HRS 00XX. MIN 0XX.XX SEC		
		Accept Rcd GETI (NSR) PRO		
		Reject Key V25E Load desired GETI (NSR)		

STA/T	STEP	PROCEDURE	PANEL	REMARKS
CP	6	FL V16 N45	2,140	
		Marks XXBXX MKS		Number of marks processed by R22. Two most significant digits display VHF ranging marks. Two least significant digits display optics marks [either SXT or backup optics (COAS) marks]. (If V87E, VHF marks accumulated automatically.) Optics marks may be taken anytime P20 operating.
		TF GETI (NSR) XXBXX MIN-SEC		Time from NSR ignition. Maximum reading 59B59. -, before; +, after.
		MGA -0000X		-00001 for other than final pass. -00002 for final pass (and IMU not aligned).
		or IMU aligned +XXX.XX DEG		Middle gimbal angle (yaw): +XXX.XX DEG for final pass and IMU aligned (if +X axis aligned to initial thrust direction).
		To continue mark process Key V32E, go 7		
		or To terminate mark process & do final pass PRO, go to 7		
		Poss FL V05 N09 00611 No GETI for given E PRO, go to 7		
		or Key V32E, return to 5		
		or After final pass PRO, go to 9		

STA/T	STEP	PROCEDURE		PANEL	REMARKS
CP	7	FL V06 N75		2,140	Maximum reading (displayed) in R2 and R3 is 59B59. Only minutes and seconds displayed although time computation done in hours, minutes, and seconds.
		Δ alt (NSR)	XXXX.X NM		
		ΔT (TPI -NSR)	XXBXX MIN-SEC		
		ΔT (TPI -nom TPI)	XXBXX MIN-SEC		TPI computed minus input TPI time (N37). GETI (TPI) available via V06 N37E.
		Rcd values PRO			
	8	FL V06 N81			CMC calculated components of VG (in local vertical coordinates) for NSR. CMC automatically incorporates the negative of the computed Y dot (CSM) out-of-plane component (Y dot) at appropriate time.
		VGX, Y, Z (NSR)	XXXX.X FPS		
		Accept Rcd data PRO, return to 6 Reject Key V25E Load desired data			
		If desired Key N90E FL V06 N90			
		Y (CSM)	XXX.XX NM		
		Y dot (CSM)	XXXX.X FPS		
		Y dot (Soyuz)	XXXX.X FPS		
		Rcd data KEY REL			

STA/T	STEP	PROCEDURE	PANEL	REMARKS
CP	9	FL V37 Key XXE	2,140	
	or	If MINKEY, to to 12.2.1/12.2.2		For MINKEY, W-matrix reinitialization values are changed to 2K ft and 2 fps. If VG computed to be ≥10 fps, controller proceeds to P40 sequence. If VG <10 fps, controller proceeds to P41.

STA/T	STEP	PROCEDURE	PANEL	REMARKS
		11.2.5 (P35) Transfer Phase Initiation (TPI)		P35 Transfer Phase Initiation calculates required ΔV and other initial conditions required by CMC for CSM execution of TPI maneuver, given: a. Time of ignition, nominal GETI (TPI), or elevation angle (E) of CSM-to-Soyuz LOS at GETI (TPI). b. Central angle of transfer (CENTANG) of passive vehicle from GETI (TPI) to time of intercept. CENTANG = 130° (fixed memory). c. Calculates GETI (TPI) given E, or E given nominal GETI (TPI). P35 can be selected manually (manual rendezvous sequence) or automatically by MINKEY controller (MINKEY rendezvous sequence). Keying V34E terminates P35 at any flashing display. Refer to 9.2 for additional data on the MINKEY rendezvous sequence.
		CMC - on (req), 8.1.3 ISS - on & orient known (desired), 8.1.3 & sec 13		Required for MINKEY and for meaningful MGA display during final N45 display (step 7).
		DAP - load & activate (desired), 8.2.1		Required for auto maneuver to tracking attitude.
	1	If MINKEY auto call Go to 3		If MINKEY initiated prior to P35, P35 automatically called by MINKEY controller at completion of NSR sequence.
CP	or	Key V37E 35E	2,140	If IMU on and aligned, P20 automatically turned on. P35, however, can be selected without P20 in background.

STA/T	STEP	PROCEDURE	PANEL	REMARKS
CP	2	FL V50 N25 00017 (request MINKEY) PRO (MINKEY) ENTR (manual) (R61, Tracking Attitude Routine)	2,140	Occurs only if MINKEY sequence initiated at this point. PRO initiates MINKEY rendezvous sequence. ENTR allows manual sequencing. If not previously selected, P20 (option 4) would now be automatically selected and N78 (R3) would be loaded as determined by state of HDSUPFLG. Also refer to 9.2.1, note 9. Computes specified tracking attitude [computes required gimbal angles at tracking attitude (specified by N78) with present IMU orientation]. The CMC will compute and execute the appropriate maneuver (R61/R60).
	3	Maneuver If mnvr <10° SC cont - CMC/AUTO SC CONT - CMC CMC MODE - AUTO Go to 5 If mnvr ≥10°, go to 4 Poss PROG alarm Key V05 N09E (to verify alarm) 00401 (MGA excessive)		9.2.1, note 10. If maneuver <10°, R61 performs maneuver to tracking attitude. If maneuver ≥10° and V50N18 flag set, calls R60 (R60 performs maneuver). V50N18 flag set by V37 processing (except P00) and on initial entry to P20. If maneuver ≥10° and V50N18 flag not set, lights UPLINK ACTY light. P20 (option 4).

NORMAL/BACKUP

STA/T	STEP	PROCEDURE	PANEL	REMARKS
CP		If MGA >75° CMC goes to att hold RHC - manually mnvr to sel track att Key V58E If mnvr <10°, go to 5 If mnvr ≥10°, go to 4	2,140	Prevents maneuver into gimbal lock. Sets V50N18 flag.
		or Align IMU to acceptable orient, sec 13		
		(R60, Attitude Maneuver Routine)		Controller selects P20. Provides for maneuver (auto or manual) to attitude specified by option selected and N78 data. R60 called only if maneuver ≥10° as determined by R61. Otherwise maneuver performed by R61.
		(If UPLINK ACTY lt on) Key V58E		Must key V58E in order to get R60 (V50 N18). R61 resets V50N18 flag at completion of first R61 cycle; therefore, V58E required to set flag to allow R60 if subsequent auto maneuver ≥10° required.
	4	Poss FL V50 N18 (auto mnvr request) (2 sec priority) If req angle change ≥10°		DAP will point specified (N78) axis at Soyuz.
		R, P, Y XXX.XX DEG		Required gimbal angles.
AC		Accept SC cont - CMC/AUTO SC CONT - CMC CMC MODE - AUTO	1	
CP		PRO	2,140	This may be performed second time as attitude trim.
		V06 N18 R, P, Y XXX.XX DEG Monitor auto mnvr on FDAI		Priority display. At completion of maneuver, display will revert to FL V50 N18 (non-MINKEY only).

STA/T STEP	PROCEDURE	PANEL	REMARKS
CP	Reject Key V62E RHC - null FDAI error needles Recycle 4	2,140	Provides reference for manual maneuver.
	or SC CONT - SCS (or CMC mode ≠ auto)	1	To update display without performing maneuver.
	PRO Recycle 4	2,140	
	When att satisfactory ENTR, go to 5		Terminate Attitude Maneuver Routine, R60. (Routine R61 will continue to compute and maintain selected attitude (option) as long as SC control CMC/AUTO and RHC not moved out of detent.) UPLINK ACTY light will be lit if V50N18 flag not set and tracking error, as determined by R61, ≥10 degrees. At this point, SXT marks can be taken. [For mark procedure, refer to (P20) 10.2.1, step 11]. If VHF ranging enabled (V87E), VHF marks automatic. Navigation automatic until final computation request.
5	FL V06 N37 GETI (TPI) 00XXX. HRS 000XX. MIN 0XX.XX SEC		
	Accept Rcd GETI (TPI) PRO		
	Reject Key V25E Load desired GETI (TPI)		Load desired GETI (TPI) if CMC computation of E desired. For a specified value of E and CMC computation of GETI (TPI), load an initial value of GETI (TPI). Loaded value should be within 30 minutes of actual.

NORMAL/BACKUP

STA/T	STEP	PROCEDURE		PANEL	REMARKS
CP	6	FL V06 N55		2,140	
		NN	0000X.		Integration method and number of precision offset computations desired. NN initially +00000.
		E	XXX.XX DEG		Elevation angle (pad loaded erasable).
		Accept Rcd E PRO			
		Reject Key V24E Load desired data			Load desired NN in R1: 0, conic integration; X, precision integration with (X) target offsets. Desired E in R2, CMC computes GETI (TPI). +00000 in R2, CMC computes E.
	7	FL V16 N45			After recycle from step 11, V06 N59 may be keyed for required impulsive ΔV components in an orthogonal coordinate system oriented along CSM to Soyuz LOS. (For complete definition, refer to GSOP section 5.4.6 of R693.)
		Marks	XXBXX MKS		Number of marks processed by R22. Two most significant digits display VHF ranging marks. Two least significant digits display optics marks [either SXT or backup optics (COAS) marks]. (If V87E, VHF marks accumulated automatically.) Optics marks may be taken anytime P20 operating.
		TF GETI (TPI)	XXBXX MIN-SEC		Time from TPI ignition. Maximum reading 59B59. -, before; +, after.
		MGA	-0000X		-00001 for other than final pass. -00002 for final pass (and IMU not aligned).
	or	IMU aligned	+XXX.XX DEG		Middle gimbal angle (yaw): +XXX.XX DEG for final pass and IMU aligned (if +X axis aligned to initial thrust direction).

(P35) TRANSFER PHASE INITIATION (TPI)

STA/T STEP	PROCEDURE	PANEL	REMARKS
	To continue mark process		
CP	Key V32E	2,140	
	If E = 0, go to 8		
	If E ≠ 0, go to 9		
	or To terminate mark process & do final pass		
	PRO		
	If E = 0, go to 8		
	If E ≠ 0, go to 9		
	or After final pass		
	PRO, go to 12		
8	If +00000 specified for E (CMC computes E)		
	FL V06 N55		
	NN 0000X.		Integration method and number of precision offset computations desired.
	E XXX.XX DEG		CMC computed E based on N37 GETI (TPI).
	Rcd E		
	PRO, go to 10		
9	If E specified (CMC computes GETI)		
	Poss FL V05 N09		
	00611 (no GETI for given E)		
	PRO, return to 5		
	(adj input parameters)		

NORMAL/BACKUP

STA/T	STEP	PROCEDURE		PANEL	REMARKS
CP		FL V06 N37		2,140	
		GETI (TPI)	OOXXX. HRS OOOXX. MIN OXX.XX SEC		
		Rcd GETI (TPI)			
		PRO, go to 10			To accept computed GETI (TPI).
		or Key V25E Load desired GETI (TPI)			Reject computed GETI (TPI), specify GETI (TPI) and allow CMC to compute E.
		or PRO, go to 10 If MINKEY & final pass PRO, return to 8			
	10	FL V06 N58			
		ΔV (TPI)	XXXX.X FPS		
		ΔV (TPF)	XXXX.X FPS		
		ΔT (TPI -nom TPI)	XXBXX MIN-SEC		TPI computed minus input TPI time (N37).
		Rcd data			
		PRO			

STA/T	STEP	PROCEDURE	PANEL	REMARKS
CP	11	FL V06 N81 VGX, Y, Z (TPI) XXXX.X FPS Accept Rcd data PRO, return to 7 Reject Key V25E Load desired data	2,140	CMC calculated components of VG (in local vertical coordinates) for TPI. To modify VG (lcl vert) to correct for out of planeness, key V90E (R36). Use data obtained from R36 to determine desired VG (lcl vert).
	12	FL V37 Key XXE		
	or	If MINKEY, go to 12.2.1/12.2.2		For MINKEY, W-matrix reinitialization values are changed to 2K ft and 2 fps. If VG computed to be $\geq$10 fps, controller proceeds to P40 sequence. If VG <10 fps, controller proceeds to P41.

STA/T	STEP	PROCEDURE	PANEL	REMARKS
		11.2.6 (P36) Transfer Phase Midcourse (TPM)		P36 Transfer Phase Midcourse calculates required ΔV and other initial conditions required by CMC for execution of next midcourse correction of transfer phase. Successful completion dependent on prior completion of P35 (TPI). P36 can be selected manually (manual rendezvous sequence) or automatically by MINKEY controller (MINKEY rendezvous sequence). Keying V34E terminates P36 at any flashing display. Refer to 9.2 for additional data on the MINKEY rendezvous sequence.
		CMC - on (req), 8.1.3 ISS - on & orient known (desired), 8.1.3 & sec 13		Required for MINKEY and for meaningful MGA display during final N45 display (step 5).
		DAP - load & activate (desired), 8.2.1		Required for auto maneuver to tracking attitude.
	1	If MINKEY auto call Go to 3		If MINKEY initiated prior to P36, P36 automatically called by MINKEY controller at completion of TPI sequence, and again after completion of first midcourse (TPM) burn.
SPT	or	Key V37E 36E	2,140	If IMU on and aligned, P20 automatically turned on. P36, however, can be selected without P20 in background.
	2	FL V50 N25 00017 (request MINKEY)		Occurs only if MINKEY sequence initiated at this point.

STA/T	STEP	PROCEDURE	PANEL	REMARKS
CP		PRO (MINKEY) ENTR (manual) Go to 3	2,140	PRO initiates MINKEY rendezvous sequence. ENTR allows manual sequencing. If not previously selected, P20 (option 4) would now be automatically selected and N78 (R3) would be loaded as determined by status of HDSUPFLG. Also refer to 9.2.1, note 9.
		(R61, Tracking Attitude Routine)		Computes specified tracking attitude [computes required gimbal angles at tracking attitude (specified by N78) with present IMU orientation]. The CMC will compute and execute the appropriate maneuver (R61/R60).
	3	Maneuver		9.2.1, note 10.
		If mnvr <10° SC cont - CMC/AUTO SC CONT - CMC CMC MODE - AUTO Go to 5		If maneuver <10°, R61 performs maneuver to tracking attitude.
		If mnvr ≥10°, go to 4		If maneuver ≥10° and V50N18 flag set, calls R60 (R60 performs maneuver). V50N18 flag set by V37 processing (except P00) and on initial entry to P20. If maneuver ≥10° and V50N18 flag not set, lights UPLINK ACTY light.
		Poss PROG alarm Key V05 N09E (to verify alarm) 00401 (MGA excessive)		P20 (option 4).

NORMAL/BACKUP

STA/T STEP	PROCEDURE	PANEL	REMARKS
	If MGA >75° CMC goes to att hold RHC - manually mnvr to sel track att		Prevents maneuver into gimbal lock.
CP	Key V58E	2,140	Sets V50N18 flag.
	If mnvr <10°, go to 5 If mnvr ≥10°, go to 4		
	or Align IMU to acceptable orient, sec 13		
	(R60, Attitude Maneuver Routine)		Controller selects P20. Provides for maneuver (auto or manual) to attitude specified by option selected and N78 data. R60 called only if maneuver ≥10° as determined by R61. Otherwise maneuver performed by R61.
	(If UPLINK ACTY lt on Key V58E)		Must key V58E in order to get R60 (V50 N18). R61 resets V50N18 flag at completion of first R61 cycle; therefore, V58E required to set flag to allow R60 if subsequent auto maneuver ≥10° required.
	4 Poss FL V50 N18 (auto mnvr request) (2 sec priority) If req angle change ≥10°		DAP will point specified (N78) axis at Soyuz.
	R, P, Y XXX.XX DEG		Required gimbal angles.

STA/T STEP		PROCEDURE	PANEL	REMARKS
AC	Accept	SC cont - CMC/AUTO SC CONT - CMC CMC MODE - AUTO	1	
CP		PRO	2,140	This may be performed second time as attitude trim.
		V06 N18 R, P, Y XXX.XX DEG Monitor auto mnvr on FDAI		Priority display. At completion of maneuver, display will revert to FL V50 N18 (non-MINKEY only).
	Reject	Key V62E RHC - null FDAI error needles Recycle 4		Provides reference for manual maneuver.
AC	or	SC CONT - SCS (or CMC mode ≠ auto)	1	To update display without performing maneuver.
CP		PRO Recycle 4	2,140	
		When att satisfactory ENTR, go to 5		Terminates Attitude Maneuver Routine, R60. (Routine R61 will continue to compute and maintain selected attitude (option) as long as SC control CMC/AUTO and RHC not moved out of detent.) UPLINK ACTY light will be lit if V50N18 flag not set and tracking error, as determined by R61, ≥10 degrees. At this point, SXT marks can be taken. [For mark procedure, refer to (P20) 10.2.1, step 11]. If VHF ranging enabled (V87E) VHF marks automatic. Navigation automatic until final computation request.

NORMAL/BACKUP

STA/T	STEP	PROCEDURE		PANEL	REMARKS
CP	5	FL V16 N45		2,140	
		Marks	XXBXX MKS		Number of marks processed by R22. Two most significant digits display VHF ranging marks. Two least significant digits display optics marks [either SXT or backup (COAS) marks]. (If V87E, VHF marks accumulated automatically.) Optics marks may be taken anytime P20 operating.
		TF GETI (TPM)	XXBXX MIN-SEC		(-): Time from previous burn (TPI or TPM 1) before final pass. (+): Time from TPM ignition after final pass. Maximum reading 59B59.
		MGA	-0000X		-00001 for other than final pass. -00002 for final pass (and IMU not aligned).
		or IMU aligned	+XXX.XX DEG		Middle gimbal angle (yaw): +XXX.XX DEG for final pass and IMU aligned (if +X axis aligned to initial thrust direction).
		To continue mark process Key V32E, go to 6			
		or To terminate mark process & do final pass PRO, go to 6			
		or After final pass PRO, go to 7			

STA/T	STEP	PROCEDURE	PANEL	REMARKS
CP	6	FL V06 N59 ΔVX, Y, Z (LOS) XXXX.X FPS Accept Rcd data PRO, return to 5 Reject Key V25E Load desired data	2,140	CMC calculated components of ΔV for TPM oriented along CSM to Soyuz LOS.
	7	FL V37 Key XXE		
	or	If MINKEY, go to 12.2.1/12.2.2		For MINKEY, W-matrix reinitialization values are changed to 2K ft and 2 fps. If VG computed to be ≥10 fps, controller proceeds to P40 sequence. If VG <10 fps, controller proceeds to P41.

STA/T	STEP	PROCEDURE	PANEL	REMARKS
		11.2.7 (P37) Transfer Phase Final (TPF)		Displays CMC calculated rendezvous parameters (range, range rate, and theta). Initiates automatic maneuver to X-axis tracking attitude. P37 can be selected manually (manual rendezvous sequence) or automatically by MINKEY controller (MINKEY rendezvous sequence). Keying V34E terminates P37 at any flashing display. Refer to 9.2 for additional data on the MINKEY rendezvous sequence.
		CMC - on (req), 8.1.3 ISS - on & orient known (req), 8.1.3 & sec 13 DAP - load & activate (desired), 8.2.1		Required for auto maneuver to X-axis tracking attitude.
	1	MINKEY auto call		CMC executes V83 (R31). R1 and R2 of N78 (P20) set to zero prior to initiating R31.
CP	or	Key V37E 37E	2,140	If IMU on and aligned, P20 automatically turned on. P37, however, can be selected without P20 in background.
	2	FL V50 N25 00017 (request MINKEY)		Occurs only if MINKEY sequence initiated at this point.
		PRO (MINKEY) ENTR (manual)		PRO initiates MINKEY rendezvous sequence. ENTR allows manual sequencing. If not previously selected, P20 (option 4) would now be automatically selected and N78 (R3) would be loaded as determined by state of HDSUPFLG. Also refer to 9.2.1, note 9.

STA/T	STEP	PROCEDURE	PANEL	REMARKS
CP		(R61, Tracking Attitude Routine)	2,140	Computes specified tracking attitude [computes required gimbal angles at tracking attitude (specified by N78) with present IMU orientation]. The CMC will compute and execute the appropriate maneuver (R61/R60).
	3	Maneuver		9.2.1, note 10.
		If mnvr <10°		If maneuver <10°, R61 performs maneuver to specified (N78) tracking attitude.
AC		SC cont - CMC/AUTO	1	
		SC CONT - CMC		
		CMC MODE - AUTO		
		Go to 5		
		If mnvr ≥10°, go to 4		If maneuver ≥10° and V50N18 flag set, calls R60 (R60 performs maneuver to specified (N78) tracking attitude). V50N18 flag set by V37 processing (except P00) and on initial entry to P20.
				If maneuver ≥10° and V50N18 flag not set, lights UPLINK ACTY light.
				P20 (option 4).
CP		Poss PROG alarm Key V05 N09E (to verify alarm) 00401 (MGA excessive)	2,140	
		If MGA >75°		Prevents maneuver into gimbal lock.
		CMC goes to att hold		
AC		RHC - manually mnvr to sel track att		
CP		Key V58E		
		If mnvr <10°, go to 5		
		If mnvr ≥10°, go to 4		

STA/T	STEP	PROCEDURE	PANEL	REMARKS
CP	or	Align IMU to acceptable orient, sec 13		
		(R60, Attitude Maneuver Routine)		Controller selects P20. Provides for maneuver (auto or manual) to attitude specified by option selected and N78 data. R60 called only if maneuver ≥10° as determined by R61. Otherwise maneuver performed by R61.
		(If UPLINK ACTY lt on Key V58E)		Must key V58E in order to get R60 (V50 N18). R61 resets V50N18 flag at completion of first R61 cycle; therefore, V58E required to set flag to allow R60 if subsequent auto maneuver ≥10° required.
	4	Poss FL V50 N18 (auto mnvr request) (2 sec priority) If req pointing angle change ≥10°	2,140	DAP will point specified (N78) axis at Soyuz.
		R, P, Y XXX.XX DEG		Required gimbal angles.
AC		Accept SC cont - CMC/AUTO SC CONT - CMC CMC MODE - AUTO	1	
CP		PRO V06 N18 R, P, Y XXX.XX DEG Monitor auto mnvr on FDAI	2,140	This may be performed second time as attitude trim. Priority display.
		Reject Key V62E RHC - null FDAI error needles Recycle 4		Provides reference for manual maneuver.
AC		or SC CONT - SCS (or CMC mode ≠ auto)	1	To update display without performing maneuver.
CP		PRO Recycle 4	2,140	

STA/T	STEP	PROCEDURE		PANEL	REMARKS
CP		When att satisfactory ENTR, go to 5		2,140	Terminates Attitude Maneuver Routine, R60. (Routine R61 will continue to compute and maintain selected attitude (option) as long as SC control CMC/AUTO and RHC not moved out of detent.) UPLINK ACTY light will be lit if V50N18 flag not set and gimbal angle error, as determined by R61, ≥10 degrees.
		Poss OPR ERR			If another extended verb active. (Not expected on P37 call by MINKEY.)
	5	FL V16 N54			Display updated at 2-second intervals.
		R	XXX.XX NM		Range and range rate based on stored state vectors. Range and range rate may degrade considerably at ranges below ≈0.3 to 0.5 NM depending on marking schedules and resultant navigation accuracy.
		R dot	XXXX.X FPS		(-) range rate indicates closing. This calculation not sufficiently accurate for reliable terminal closing values. It should not be utilized without good visual cues.
		Theta (lcl horiz/ CSM +X)	XXX.XX DEG		Theta - Angle included between +Xsc axis and local horizontal. Angle in range 0° to 180° indicates +Xsc axis is above local horizontal plane. Total range: 0° to 360°.
		PRO			(P48) Rendezvous Thrust Monitor (final phase).
		If MINKEY, go to 8.1.7 Manual FL V37 Key XXE			

NORMAL/BACKUP

STA/T	STEP	PROCEDURE	PANEL	REMARKS
	11.2.8	(P38) Normal Plane Change Targeting (NPC)		Computes and displays out-of-plane parameters required for execution of plane change maneuver, e.g., for one case of a non-coplanar condition, an antinode is established as a function of the NCC maneuver (P33). P38 then, targets a second nulling maneuver to be performed 90° later (at the node at the appropriate time), resulting in desired CSM, Soyuz. coplanar orbits. P38 is called by manual selection only (V37E 38E). It is not called automatically by the MINKEY controller as part of the normal MINKEY rendezvous sequence. PRO on FL V50 N25 (00017) however, does provide MINKEY controller functions (P20, P52 call for gyro torquing, etc.) within the NPC sequence. Keying V34E terminates P38 at any flashing display. Refer to 9.2 for additional data on the MINKEY rendezvous sequence.
		CMC - on (req), 8.1.3 ISS - on & orient known (desired), 8.1.3 & sec 13		Required for P38 MINKEY and for meaningful MGA display during final N45 display (step 7).
		DAP - load & activate (desired), 8.2.1		Required for auto maneuver to tracking attitude.
CP	1	Key V37E 38E	2,140	If IMU on and aligned, P20 automatically turned on. P38, however, may be selected without P20 in background.

(P38) NORMAL PLANE CHANGE TARGETING (NPC)

STA/T	STEP	PROCEDURE	PANEL	REMARKS
CP	2	FL V50 N25 00017 (request MINKEY)	2,140	
		PRO (MINKEY) ENTR (manual) Go to 3		PRO initiates NPC MINKEY sequence. ENTR allows manual sequencing. If not previously selected, P20 (option 4) would now be automatically selected and N78 (R3) would be loaded as determined by state of HDSUPFLG. Also refer to 9.2.1, note 9.
		(R61, Tracking Attitude Routine)		Computes specified tracking attitude [computes required gimbal angles at tracking attitude (specified by N78) with present IMU orientation]. The CMC will compute and execute appropriate maneuver (R61/R60).
	3	Maneuver		9.2.1, note 10.
		If mnvr <10°		If maneuver <10°, R61 performs maneuver to tracking attitude.
AC		SC cont - CMC/AUTO SC CONT - CMC CMC MODE - AUTO Go to 5	1	
		If mnvr ≥10°, go to 4		If maneuver ≥10° and V50N18 flag set, calls R60 (R60 performs maneuver). V50N18 flag set by V37 processing (except P00) and on initial entry to P20. If maneuver ≥10° and V50N18 flag not set, lights UPLINK ACTY light.
CP		Poss PROG alarm Key V05 N09E (to verify alarm) 00401 (MGA excessive)	2,140	P20 (option 4).

NORMAL/BACKUP

STA/T	STEP	PROCEDURE	PANEL	REMARKS
		If MGA >75°		
CP		CMC goes to att hold		Prevents maneuver into gimbal lock.
		RHC - manually mnvr to sel track att		
		Key V58E	2,140	Sets V50N18 flag.
		If mnvr <10°, go to 5		
		If mnvr ≥10°, go to 4		
		or Align IMU to acceptable orient, sec 13		
		(R60, Attitude Maneuver Routine)		Controller selects P20. Provides for maneuver (auto or manual) to attitude specified by option selected and N78 data. R60 called only if maneuver ≥10° as determined by R61. Otherwise maneuver performed by R61.
		(If UPLINK ACTY lt on Key V58E)		Must key V58E in order to get R60 (V50 N18). R61 resets V50N18 flag at completion of first R61 cycle; therefore, V58E required to set flag to allow R60 if subsequent auto maneuver ≥10° required.
	4	Poss FL V50 N18 (auto mnvr request) (2 sec priority) If req angle change ≥10°		DAP will point specified (N78) axis at Soyuz.
		R, P, Y XXX.XX DEG		Required gimbal angles.
AC		Accept SC cont - CMC/AUTO	1	
		SC CONT - CMC		
		CMC MODE - AUTO		
CP		PRO	2,140	This may be performed second time as attitude trim.
		V06 N18		Priority display. At completion of maneuver, display will revert to FL V50 N18 (non-MINKEY only).
		R, P, Y XXX.XX DEG		
		Monitor auto mnvr on FDAI		

(P38) NORMAL PLANE CHANGE TARGETING (NPC)

STA/T	STEP	PROCEDURE	PANEL	REMARKS
CP	Reject	Key V62E RHC - null FDAI error needles Recycle 4	2,140	Provides reference for manual maneuver.
AC	or	SC CONT - SCS (or CMC mode ≠ auto)	1	To update display without performing maneuver.
CP		PRO Recycle 4	2,140	
		When att satisfactory ENTR, go to 5		Terminates Attitude Maneuver Routine, R60, (Routine R61 will continue to compute and maintain selected attitude (option) as long as SC control CMC/AUTO and RHC not moved out of detent.) UPLINK ACTY light will be lit if V50N18 flag not set and tracking error, as determined by R61, ≥10 degrees. At this point, SXT marks can be taken. [For mark procedure, refer to (P20) 10.2.1, step 11]. If VHF ranging enabled (V87E), VHF marks automatic. Navigation automatic until final computation request.
	5	FL V06 N39 GETI (last mnvr) 00XXX. HRS 000XX. MIN 0XX.XX SEC		
		Accept Rcd GETI (last mnvr) PRO		
		Reject Key V25E Load desired GETI (last mnvr)		

NORMAL/BACKUP

STA/T	STEP	PROCEDURE		PANEL	REMARKS
CP	6	FL V06 N33		2,140	
		GETI (NPC)	00XXX. HRS 000XX. MIN 0XX.XX SEC		Time 1/4 rev after time specified in N39.
		Rcd data PRO			
	7	FL V16 N45 (mnvr data)			
		Marks	XXBXX MKS		Number of marks processed by R22. Two most significant digits display VHF ranging marks. Two least significant digits display optics marks [either SXT or backup optics (COAS) marks]. (If V87E, VHF marks accumulated automatically). Optics marks may be taken anytime P20 operating.
		TF GETI (NPC)	XXBXX MIN-SEC		Time from NPC ignition. Maximum reading 59B59. -, before; +, after.
		MGA	-0000X		-00001 for other than final pass. -00002 final pass, IMU not aligned.
	or	IMU aligned	+XXX.XX DEG		Middle gimbal angle (yaw): +XXX.XX DEG for final pass and IMU aligned (if +X axis aligned to initial thrust direction).
		To continue mark process Key V32E, go to 8			
	or	To terminate mark process & do final pass PRO, go to 8			
	or	After final pass PRO, go to 9			

(P38) NORMAL PLANE CHANGE TARGETING (NPC)

STA/T	STEP	PROCEDURE	PANEL	REMARKS
CP		or If MINKEY and If VG = 0 (bypass gyro torquing) If VG >0, go to 13.1.3		Bypass gyro torquing option in P52. Controller selects P52 for gyro torquing option. If gyros not torqued, P41 automatically selected. If gyros torqued, and VG computed to be ≥10 fps, controller proceeds to P40 sequence; if VG <10 fps, controller proceeds to P41.
	8	FL V06 N81 VGX, Y, Z (lcl vert) XXXX.X FPS Accept Rcd data PRO, return to 7 Reject Key V22E Load desired data If desired Key N90E FL V06 N90 (rndz out of plane param) Y (CSM) XXX.XX NM Y dot (CSM) XXXX.X FPS Y dot (Soyuz) XXXX.X FPS Rcd data KEY REL	2,140	CMC calculated components of VG (in local vertical coordinates) for NPC. CMC automatically incorporates the negative of the computed Y dot (CSM) into R2 of N81 (R1 and R3 = 0). Used for nulling out-of-plane component (Y dot) at appropriate time.
	9	FL V37 Key XXE		

STA/T	STEP	PROCEDURE	PANEL	REMARKS
		12.0 THRUSTING		For general G&C operating data, refer to operating notes, 6.1.
		12.1 VEHICLE PREPARATION		
		(Proced not designated as "req" are optional		
	1	For orb change		
		Obtain update from STDN		
CP		Gas Separator Cartridge Prep (req)		
		Remove separator from water pistol & stow temporarily in LEB stowage bag		
		Assure separator on food prep unit secured with bayonet locks		
		Install outlet cap on food prep unit separator		
		SPS and SM RCS Checks, 5.2.1 & 5.2.2		
		EPS DC & AC Checks, 5.3.2 & 5.3.3		
		Pres Suit Ckt & PGA Check at 5.0 psia, 5.4.9 (if req)		
		C&WS Oper Check, 5.5.1		
		CMC Self Check, 8.1.8		
		DSKY Condition Light Check, 8.3.1		
		Dry tunnel		If necessary, absorb water with towel. Condensed moisture in tunnel rains on crew during thrusting.
		ΔV Test & Null Bias Check, 7.6.1		In-flight verification of X-axis accelerometer output, ΔV indicator, SPS THRUST light, and thrust cutoff relay in EMS.
		If preparing for NC2 rndz mnvr		
AC		DIRECT O2 vlv - close (CW)	7	DIRECT O2 valve closed after minimum of 3 hours total operation from launch.

NORMAL/BACKUP

STA/T	STEP	PROCEDURE	PANEL	REMARKS
		For PSM activation		Nominal mission requires that PSM be activated after 50 lbs primary (quad) propellant has been expended. Provides adequate contingency blowdown capabilities and ensures sufficient RCS quad propellant for hybrid deorbit.
AC		SM RCS PSM He - OPEN	2	
		SM RCS PSM He tb - gray		
		SM RCS PRPLNT (4) - CLOSE	2	
		SM RCS PSM PRPLNT (4) - OPEN		
		SM RCS PRPLNT tb (8) - bp		
		SM RCS PSM PRPLNT tb (4) - gray		
		SM RCS QUAD He (4) - CLOSE		
		SM RCS QUAD He tb (4) - bp		
	2	For deorbit		
		Deorbit & Entry Veh Prep, 14.1 (req)		

STA/T STEP	PROCEDURE	PANEL	REMARKS
	12.2 G&N THRUSTING		
	12.2.1 (P40) G&N/SPS Thrusting		Computes preferred CSM attitude and IMU orientation for SPS thrusting maneuver. Calculates and displays gimbal angles which would result if present IMU orientation used for thrusting in preferred vehicle attitude (function of R60 computations). Crew then decides whether to thrust at present IMU orientation or to reorient IMU using P52/P54. Maneuvers CSM to thrusting attitude (R60). Controls GNCS during SPS thrust countdown, ignition, thrust, and thrust termination; and allows residual steering error trimming. P40 should not be performed in CSM-Soyuz docked configuration.
	CMC - on (req), 8.1.3 ISS - on & orient known (req), 8.1.3 & sec 13 SCS - on (req), 8.4.2		G&C circuit breakers on all panels should be closed except as defined in Limited Use Controls, 6.1.1, figure 6-7.
	Test C/W lamps DAP - load & activate, including ull sel, 8.2.1		SPS trim values should be reviewed now for use at beginning of P40 for computing preferred IMU orientation and final vehicle attitude. SPS trim values are updated during CMC-controlled burn. If a roll jet fails on during SPS thrust, an appreciable roll excursion ≈30° may occur. PITCH-YAW DAP will continue to function properly.

NORMAL/BACKUP

STA/T STEP	PROCEDURE	PANEL	REMARKS
	Prethrust prog (req), sec 11		P31 through P38 may have been performed during MINKEY sequence.
	Veh Prep (req), 12.1		
1	ΔV Setup, 7.6.2		
2	Key V37E 00E (non-MINKEY)	2	P00 updates state vector periodically. State vector automatically updated during MINKEY.
3	Key V37E 40E		
or	MINKEY auto call		During MINKEY rendezvous sequence, if VG is computed to be ≥10 fps, MINKEY controller (R07) automatically calls P40 at completion of targeting sequence (P31 through P37) or in case of NPC sequence (P38), P40 called at completion of gyro torquing (P52) if VG ≥10 fps.
	Poss PROG alarm (8.1.15)		R02. If no alarm at this point (after R02 exited), CMC computes initial thrust direction and initial value of VG (local vertical), computes preferred IMU orientation, and sets PFRATFLG (preferred attitude flag) and stores desired attitude for use in R60. Final attitude computed in R60, gimbals trimmed for initial thrust, and 0.5-degree deadband set in RCS DAP.
4	If VG display desired Key V06 N81E VGX, Y & Z XXXX.X FPS (lcl vert at GETI) KEY REL		Display available until average G turned on (GETI minus 30 seconds).

STA/T	STEP	PROCEDURE	PANEL	REMARKS
		(R60 - Attitude Maneuver)		Maneuvers CSM to attitude stored in P40. Maneuver performed automatically by G&N, or manually with an optional final automatic G&N-controlled trim maneuver.
	5	FL V50 N18 (sel CMC - auto) R, P, Y XXX.XX DEG		Desired final gimbal angles.
		Establish Total Att disp, 7.2.5		Both FDAIs should be selected to provide redundant displays.
AC		Accept BMAG MODE (3) - RATE 2 CMC Att Cont - Auto, 7.1.6	1	Prevents BMAGs from hitting stops during maneuvers.
CP		PRO	2	PRO initiates auto maneuver without reviewing final gimbal angles. If review desired prior to auto maneuver, reject option should be selected. If desired, attitude set control panel can then be set to final gimbal angles to provide attitude error information for completion of maneuver manually if G&N fails.
		Reject Sel desired Att Cont, 7.1 Mnvr to thrust att ENTR - Go to 7		
	6	Auto mnvr V06 N18 (final att) R, P, Y XXX.XX DEG		Angles obtained from a VECPOINT calculation. Maneuver rate is as last defined by DAP load.
AC,CP		Mon FDAIs If RHC used or SCS sel, go to 7	1,2	CSM began maneuver to final attitude when PRO keyed in step 5. Refer to 6.1.3, notes 1b and 1c.
CP	7	FL V50 N18 (att trim enbl) R, P, Y XXX.XX DEG	2	Final trim maneuver should be considered essential to SPS ΔV attitudes. Display of final gimbal angles remains in registers. Final attitude trim maneuver performed after gimbal drive and trim check.

NORMAL/BACKUP

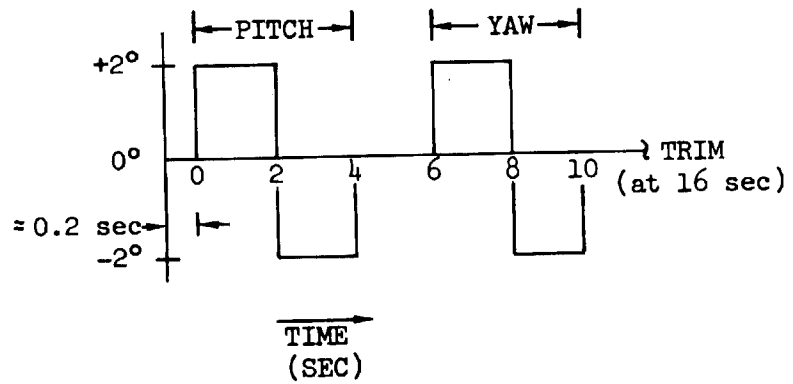
STA/T	STEP	PROCEDURE	PANEL	REMARKS
	8	Ign prep		Sets up nontime-critical switching required for thrusting. If necessary for deorbit, STDN dumps and rewinds tape recorder, and changes to HBR.
		CAUTION If either bat bus A(B) current fails to incr after cycling respective MN BUS TIE sw, configure bats to main buses using cb BAT C TO BAT BUS A(B) & 250 cb MNA(B) BAT C as necessary. 275		Assumes reconfiguration BAT C to MNA(B) for orbit change; BAT A(B) and BAT C to MNA(B) for deorbit.
-06:00		MN BUS TIE BAT A/C - on (up)	5	
DP		Verify bat bus A current incr &/or bat volt decr	3	Verification of current increase for appropriate bat bus via DC AMPS indicator (panel 3) confirms successful operation of main bus tie motor switches. MN BUS TIE BAT A/C and B/C switches at on provide two batteries on line for orbit change if cb MNA & B BAT C (2) - open, or three batteries on line for deorbit burn and entry if cbs closed (panel 275).
		MN BUS TIE BAT B/C - on (up)	5	
		Verify bat bus B current incr &/or bat volt decr	3	
		SPS He VLV tb (both) - bp SPS He VLV (both) - AUTO		Barber pole indicates helium isolation valves closed.
AC		RHC PWR DIR (both) - OFF	1	
		SC cont - CMC/AUTO SC CONT - CMC CMC MODE - AUTO		
		SCS TVC (2) - RATE CMD		Provides rate damped manual TVC as backup to G&N, if THC - CW. SCS auto or MTVC acceleration command optional, but less desirable backup modes.

STA/T	STEP	PROCEDURE	PANEL	REMARKS
AC		BMAG MODE (3) - ATT 1/RATE 2	1	
		DBD/RATE - MIN/LO		
		ATT DBD - MIN		
		RATE - LO		
		LV IND/GPI sw - GPI (verify)		
		TVC GMBL DR (2) - AUTO		
	9	Gmbl drive & trim check		PITCH and YAW GMBL caution/warning lights (panel 2) indicate overcurrent to actuator motors.
		TVC SERVO PWR 1 - AC1/MNA	7	
		TVC SERVO PWR 2 - AC2/MNB		
		THC PWR - on (up)	1	
		RHC PWR NORM 2 - AC		Opens RHC 2 (commander's) breakout switch (dc circuits) to prevent attitude maneuvers through CMC during MTVC checks. During burn, RCS DAP disabled at SPS engine ignition (TFI = 0).
		RHC 2 - ARMED		
-05:00		GMBL MOT P1 & Y1 - START		START position is momentary. Also refer to 6.1.1, note 12.
		Auto switchover check		
		THC - CW		Enables MTVC and switches TVC to channel 2.
		RHC - verify no MTVC control		
		GMBL POS ind (4) - no motion		Verifies TVC switches from channel 1 to channel 2 (which is off) when THC CW selected.
		Sec TVC check		
		GMBL MOT P2 & Y2 - START		START position is momentary.
		Confirm & set trim cont		Verifies secondary gimbal trim control.

NORMAL/BACKUP

STA/T	STEP	PROCEDURE	PANEL	REMARKS
AC		SPS GMBL tw (2) - + & - Set to c.g. trim values	1	Trim values obtained from DAP Data Load (8.2.1), or STDN.
		RHC 2 - Verify MTVC		Gimbals drive in response to RHC movement and return to set-in values when RHC neutral. Verifies control of secondary MTVC loops through RHC. Gimbals move proportional to RHC deflection since MTVC integrator not enabled until engine ignition.
		THC - neut RHC PWR NORM 2 - AC/DC		
	Accept	Complete auto att trim		Accept and reject options refer to attitude trim enable flash V50 N18 in step 7.
		BMAG MODE (3) - RATE 2 Align CSM in roll CMC Att Cont - Auto, 7.1.6		
CP		PRO	2	
		Returns to V06 N18 disp of step 6		Does not imply that any previous checks need be repeated for each trim enable.
	Reject	Sel desired Att Cont, 7.1 Verify/mnvr to thrust att (V62E for tot att err disp)		
AC		RHC PWR DIR (both) - MNA/MNB MAN ATT (3) - RATE CMD	1	Enables manual direct RCS for overriding an auto RCS roll failure during thrusting.
		RATE - HI		If MTVC required, RATE - HI bypasses noise problem in SCS gyro assemblies because of thrusting vibration levels, which can cause spurious RCS roll jet firings.
		BMAG MODE (3) - ATT 1/RATE 2		

STA/T STEP	PROCEDURE	PANEL	REMARKS
AC	or If RATE 1 ΔV planned BMAG MODE PITCH - RATE 1 BMAG MODE YAW - RATE 1	1	RATE 1 ΔV should be used for burns where angular change >15° or if gyro assembly 2 failed.
	or BMAG MODE (in axis) - RATE 1		
	Align GDC to IMU if necessary, 8.4.6		DSKY display option recommended because of its availability - only need to set ATT SET thumbwheels to DSKY values and defer alignment until just prior to thrust.
CP	Check boresight star ENTR (exit R60)	2	
	10 FL V50 N25 00204 (CMC GMBL drive test)		Manual drive, trim and MTVC check accomplished before CMC gimbal drive test enabled (PRO keyed).
	Accept PRO Mon GMBL drive seq		



NORMAL/BACKUP

STA/T	STEP	PROCEDURE	PANEL	REMARKS
CP		Reject ENTR GMBLs drive to trim position (after 4 sec)	2	If gimbal test sequence not desired, gimbals drive to trim 4 seconds after ENTR keyed.
	11	V06 N40 TF GETI XXBXX MIN-SEC VG XXXX.X FPS ΔV (accum) XXXX.X FPS		TF GETI max reading is 59B59. Sign minus before nominal GETI, plus after. Event Timer will not agree with R1 if GETI was slipped.
AC	12	1-min countdown		
-01:00		Report TF GETI = 1 min FDAI SCALE - 5/5 ΔV THRUST A(B) - NORM THC - ARMED	1	Guarded.
AC,CP		RHC (both) - ARMED		
		(R41 - State Vector Integration)		
-00:40 CP		Poss PROG Alarm Key V05 N09E 01703 (TIG slipped) KEY REL R1 of N40 continues count to former TIG DSKY clears at new TIG -35 sec	2	May illuminate between TIG -42.5 and -35 seconds. TIG slipped delta amount as required by CMC to complete state vector integration
		COMP ACTY lt - out (exit R41)		
-00:35		DSKY clears		
-00:30		V06 N40 (ave G on)		Dynamic, nonflashing display, with COMP ACTY lt flash every 2 seconds.

STA/T	STEP	PROCEDURE		PANEL	REMARKS
CP		Check ΔV (accum) for PIPA bias R3 ≤0002.0 FPS		2	G&N controlled burns unreliable if R3 >0002.0 FPS.
DP		UP TLM CMD - RSET then NORM PCM BIT RATE - HI		3	
AC		TAPE RCDR FWD - FWD EMS MODE - NORM		1	6.1.1, note 10.
-00:29 to -00:06		Perform ull			2 or 4 jet ullage times defined in MSC-07765-VOL I, Part I. Retain ullage for ≈1 second after ignition. Exact velocity change not critical - only a steady ullage to settle SPS propellants.
		xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx			
		No ull DIR ULL pb - push, hold RHC - control att			Direct ullage inhibits pitch and yaw auto RCS. Maintain attitude within deadband limits.
		xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx			
-00:05 CP	13	FL V99 N40 (eng enbl) TF GETI VG ΔV (accum)	 XXBXX MIN-SEC XXXX.X FPS XXXX.X FPS	2	CMC changes V06 to V99, but retains previous display in registers. Do not exercise extended verb or monitor displays for extended periods during TVC; these displays can override a FL V97 N40 (low thrust) display which indicates CMC thinks engine off, steering stopped (including cutoff computations), and attitude hold established.

NORMAL/BACKUP

STA/T STEP	PROCEDURE	PANEL	REMARKS
CP	Accept PRO Go to 14	2	
	Reject ENTR, go to 18 as req & 19 Man trim with RCS		If ENTR option selected, post SPS burn switching in step 18 must be accomplished.
	or V34E FL V37		If average G on, R00 turns off average G. It also sets or resets RNDVZFLG, TRACK, and UPDATE flags, depending on which programs in progress or called, and may also recycle into P20.
AC 14 Ign 00:00	SPS THRUST lt - on	1	If N46 (digit A) configured for DM off, CMC will not accept V46E or V48E during TVC. Although not expected, if N46 (digit A) configured for DM on, CMC will accept V46E for low bandwidth mode (decreases control required response because of off-nominal bending moments).
CP	V06 N40 TFC XXBXX MIN-SEC	2	Time from engine cutoff. Sign (-) before cutoff, (+) thereafter. TFC display discontinuous for 4 to 5 seconds after ignition.
	VG (decr) XXXX.X FPS ΔV accum (incr) XXXX.X FPS		
AC	ΔV ind - decr	1	
CP	Poss PROG alarm Key V05 N09E (to verify alarm) 01407 (VG incr)	2	
IGN+1 sec AC	Discontinue ull		RCS X-axis translation discontinued by program 2 seconds after engine-on command. RCS DAP disabled at ignition.

(P40) G&N SPS THRUSTING

STA/T STEP	PROCEDURE	PANEL	REMARKS
IGN+2 to 5 sec AC	ΔV THRUST (2) - NORM (if desired)	1	Guarded. For dual bank operation.
	xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx		
	If no ign or premature shutdown		Engine restart should not be attempted within 5 seconds from initial ignition - avoids undesirable helium pressure excursions.
	Continue ull ΔV THRUST (2) - NORM Recycle 14		Guarded.
CP	or If FL V97 N40 (R40) PRO - If thrust back on	2	Thrust failure routine (R40) called if CMC detects thrust failure during non-impulsive thrusting period. If thrust decreases to some low level, VG and ΔV displays continue changing. If thrust actually terminates prematurely, VG and ΔV displays become static. For Lambert burns, VG may not become static.
CDR	or ΔV THRUST (2) - NORM Reorient to thrust att	1	
CP	ENTR - Recycle to 13	2	If ENTR response to FL V97 N40, R1 (TFC) set to 59B59. A slight delay (≈3 sec) occurs before FL V99 N40 appears.
	or Key V34E FL V37 Key XXE		Terminates P40 and R40.
	or Sel SCS option		

STA/T STEP	PROCEDURE	PANEL	REMARKS
AC	or Discontinue ull SC CONT - SCS ΔV THRUST (2) - NORM SCS TVC (2) - AUTO	1	SCS ΔV option selected to bypass as many failure modes as possible and provide minimum engine delay. Depending on duration of burn prior to failure, a motion transient could result if c.g. shifted significantly from GMBL thumbwheel values.
	Initiate ull THRUST ON pb - push		Ullage and THRUST ON pushbutton required to satisfy SCS logic if SPS THRUST switch not at DIR ON.
	or SPS THRUST - DIR ON		Lever lock.
IGN+1 sec	Discontinue ull		
	or Term mnvr		
	xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx		
15	Orb change SPS monitor Pc ind - 95-105 psia		65 to 125% green range on indicator corresponds to psia. Normal Pc range 95-105 psia.
CP	SPS INJ VLV ind (2 or 4) - OPEN SPS He VLV tb (both) - gray SPS FUEL & OXID PRESS ind (2) - 170-195 psia SPS OXID UNBAL ind - 0 psi	3	All four injector valves open for dual-bank operation. Gray indicates helium isolation valves open. PUGS deactivated.
	CAUTION		
AC	If noncritical burn & ΔP >20 psi ΔV THRUST (2) - OFF	1	ΔP between fuel and oxidizer should not exceed 20 psi during burn or degraded performance; rough combustion, and/or engine failure may result.

STA/T	STEP	PROCEDURE	PANEL	REMARKS
AC	16	Deorbit SPS monitor Pc ind - 95-105 psia	1	65 to 125% green range on indicator corresponds to psia. Normal Pc range 95-100 psia.
DP		SPS INJ VLV ind (4) - OPEN SPS He VLV tb (both) - gray SPS FUEL & OXID PRESS ind (2) - 170-195 psia	3	All four injector valves open for dual-bank operation. Gray indicates helium isolation valves open.
AC or CP	17	FDAI - monitor err & rates	1,2	Monitoring for possibly required MTVC takeover.
		xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx		
AC		MTVC takeover THC - CW Maintain att cont man		
		or ΔV THRUST (2) - OFF Damp rates to IMU ball or out window Reorient & hold thrust att RHC - CW ΔV THRUST A(B) - NORM	1	Guarded. Guarded.
		Initiate ull THRUST ON pb - push		Ullage and THRUST ON pushbutton required to satisfy SCS logic if SPS THRUST switch not at DIR ON.
		or SPS THRUST - DIR ON		Lever lock.
		Fly MTVC (RATE CMD)		

STA/T	STEP	PROCEDURE	PANEL	REMARKS
IGN+2 to 5 sec AC		ΔV THRUST B(A) - NORM (if desired)	1	Guarded. For dual bank operation.
		Initiate ull THRUST ON pb - push		Ullage and THRUST ON pushbutton required to satisfy SCS logic for second bank operation if SPS THRUST switch not at DIR ON.
		or SPS THRUST - DIR ON		Lever lock.
		or Term mnvr		
		XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX		
		XXXXXXXXXXXXXXXXXXXXXXXXXXXXXX		
		Roll att cont failure MAN ATT ROLL - ACCEL CMD		ACCEL CMD position inhibits CMC roll commands and allows acceleration control of RCS auto coils with RHC.
		or AUTO RCS ROLL (8) - OFF Use direct cont	8	
		XXXXXXXXXXXXXXXXXXXXXXXXXXXXXX		
	18	Mon SPS eng cutoff		
		SPS THRUST lt - out	1	
CP		FL V16 N40 (eng cutoff)	2	
		TFC (static at 2.5 sec from cutoff) XXBXX MIN-SEC		Time from cutoff. At cutoff +2.5 seconds, CMC sets wide deadband in RCS DAP. Then CMC switches from TVC DAP to RCS DAP at cutoff +3.1 seconds.
		VG XXXX.X FPS		
		ΔV (accum) XXXX.X FPS		

(P40) G&N SPS THRUSTING

STA/T	STEP	PROCEDURE	PANEL	REMARKS
AC		EVNT TMR ind - 59:59 (-) thrust duration	1	Timer normally counts down from 59:59.
C/O+1 sec		ΔV THRUST (2) - OFF		Guarded.
		SPS THRUST - NORM (verify)		Lever lock.
		Report eng off		
		Pc = 0		
CP		SPS INJ VLV ind (4) - CLOSE	3	
		SPS He VLV tb (both) - bp		Barber pole indicates helium isolation valves closed.
C/O +2.5 sec				
AC		GMBL POS ind (4) - servo null	1	CMC removes TVC enable discrete (C/O indicated by TFC sign change and VG → 0).
		For postorbit change free drift		
		EMAG MODE (3) - RATE 2		
		CMC MODE - FREE		
DP		DC IND sel - FC 3	3	
		DC AMPS ind - mon for amps decr		Decrease verifies gimbal motor shutdown.
		after each No. 2 gmbl mot shutdown		
AC		GMBL MOT P2 & Y2 - OFF	1	6.1.1, note 12.
DP		DC IND sel - FC 1 (2)	3	
		DC AMPS ind - mon for amps decr		Decrease verifies gimbal motor shutdown.
		after each No. 1 gmbl mot shutdown		
AC		GMBL MOT P1 & Y1 - OFF	1	
DP		DC IND sel - MNA	3	
		If MTVC		
		THC - neut		To prevent possible reignition (if G&N thrust-on command still present), ΔV THRUST switches must be OFF prior to THC - neutral.
AC		TVC SERVO PWR (both) - OFF	7	

STA/T	STEP	PROCEDURE	PANEL	REMARKS
AC		If deorbit cb SPS PITCH (both) - open cb SPS YAW (both) - open EMS MODE - STBY	1	6.1.1, note 10.
DP		PCM BIT RATE - LO	3	
AC		Record ΔV ind	1	
CP		PRO	2	CMC sets minimum deadband in RCS DAP.
	19	FL V16 N85 (VG vctr compnt) VGX, Y, Z (cont) XXXX.X FPS		Velocity to be gained resolved along CSM X, Y, and Z control axes (updated each computation cycle).
AC		If VG compnt to be nulled CMC MODE - AUTO or HOLD RHC/THC - null out VG compnt THC - neut, LOCKED	1	Optional. All AUTO RCS switches must be on for nulling residuals in 3 axis.
		If orb change RHC - LOCKED		
DP		If deorbit TAPE RCDR FWD - off (ctr)	3	
CP		If R30 desired Key V82E Go to 20	2	
		To term P40 PRO Go to 21		CMC sets last specified R03 deadband in RCS DAP.

STA/T	STEP	PROCEDURE		PANEL	REMARKS
		(R30 - Orbital Parameter Display)			
	20	FL V16 N44			
		Ha	XXXX.X NM		Altitudes above launch pad radius. Parameter calculations yield reasonable results if vehicle close to earth.
		Hp	XXXX.X NM		
		TFF	XXBXX MIN-SEC		Time of free fall to 49.4 NM (300,000 ft) above launch pad radius.
		If Hp >49.4 NM R3 = -59B59 PRO (exit R30) Return to 19			If TFF = -59B59, time from perigee available via N32E.
	21	FL V37 (non-MINKEY)			If average G on, R00 turns off average G. R00 also sets or resets RNDVZFLG, TRACK, and UPDATE flags, depending on which programs in progress or called, and may also recycle into P20.
		If orb change Key XXE (non-MINKEY) Set controls after tailoff			
DP		MN BUS TIE (2) - OFF		5	Monitor main bus voltage for maximum allowable (31 vdc) during power down sequence.
		If MN BUS TIE fail prior to thrust Leave MN BUS TIE BAT B/C(A/C) - on (up) Go to EPS Malf, Pwr Distr, SSR-2 reconfig for subsequent main bus ties			Circuit breakers used to reconfigure for subsequent bat bus operation and battery charging procedures in place of opening (known) good main bus tie motor switches. Malfunction procedures are in Flight Data File (FDF).

NORMAL/BACKUP

STA/T	STEP	PROCEDURE	PANEL	REMARKS
CP		Rcd burn data	2	Recorded burn data should include ΔV accomplished and SPS propellant quantity remaining.
AC		EMS FUNC - OFF THC PWR - OFF RHC PWR DIR (both) - OFF	1	
		Charge bats, 5.3.5		
		If MINKEY, go to next MINKEY seq		MINKEY controller proceeds to next targeting program in MINKEY sequence.
	or	If deorbit		
CP		Rcd burn data Key 61E Go to CM/SM Sep, 14.2	2	Recorded burn data should include ΔV accomplished.

STA/T	STEP	PROCEDURE	PANEL	REMARKS
		12.2.2 (P41) G&N/SM-RCS Thrusting		Computes preferred CSM attitude and preferred IMU orientation for RCS thrust, and maneuvers CSM to thrust attitude (R60).
		CMC - on (req), 8.1.3 ISS - on & orient known (req), 8.1.3 & sec 13 SCS - on (req), 8.4.2		G&C circuit breakers on all panels should be closed except as defined in Limited Use Controls, 6.1.1, figure 6-7.
		Test C/W lamps Prethrust prog (req), sec 11		P31 through P38 may have been performed during MINKEY sequence.
				During MINKEY rendezvous sequence, if VG is computed to be <10 fps, controller automatically calls P41 at completion of targeting sequence (P31 through P37) or in case of NPC sequence (P38), P41 called at completion of P52 if gyros not torqued, or if gyros torqued and VG <10 fps.
		Veh Prep (req), 12.1 DAP - Load & Activate, (R03) 8.2.1, or (R04), 8.2.2		May be R03 and V46E if not docked, or R04 and V45E if CSM docked to Soyuz.
AC	1	Set EVNT TMR to read 00:00 at GETI	1	
CP	2	Key V37E 00E (non-MINKEY)	2	
	3	Key V37E 41E		TFI available (prior to step 11) via N35, N40, or N45.
	or	MINKEY auto call		

NORMAL/BACKUP

STA/T	STEP	PROCEDURE	PANEL	REMARKS
CP		Poss PROG alarm (8.1.16)	2	R02. If no alarms at this point (after R02 exited), CMC computes initial thrust direction and initial value of VG (local vertical), computes preferred IMU orientation, and sets PFRATFLG (preferred attitude flag) and stores desired attitude for use in R60. Final attitude computed in R60 and 0.5-degree deadband set in RCS DAP.
	4	If VG disp desired Key V06 N81E VGX, Y, Z XXXX.X FPS (Lcl vert at GETI) KEY REL		Display available until average G turned on (GETI -30 seconds).
		(R60 - Attitude Maneuver)		Maneuvers CSM to attitude stored in P41. Maneuver performed automatically by G&N, or manually with optional final automatic G&N controlled trim maneuver.
	5	FL V50 N18 (select CMC - auto) R, P, Y XXX.XX DEG		Desired final gimbal angles.
		Establish Tot Att disp, 7.2.5		Both FDAIs should be selected to provide redundant displays.
AC		Accept BMAG MODE (3) - RATE 2 CMC Att Cont - auto, 7.1.6	1	Prevents BMAGs from hitting stops during maneuvers.
CP		PRO	2	Initiates auto maneuver without review of final gimbal angles.
AC		Reject Sel desired Att Cont, 7.1 Mnvr to thrust att		
CP		ENTR, go to 8		

STA/T	STEP	PROCEDURE	PANEL	REMARKS
CP	6	Auto mnvr V06 N18 (fnl att) R, P, Y XXX.XX DEG	2	
AC, CP		Mon FDAIs If RHC used or SCS sel, go to 7	1,2	CSM began maneuver to final attitude when PRO keyed in step 5. ICDU drives to achieve final gimbal angles. Refer to 6.1.3, notes 1b and 1c.
	7	FL V50 N18 (att trim enbl) R, P, Y XXX.XX DEG		Step should be completed prior to TIG -2 minutes. Display of final gimbal angles in registers.
AC		Accept BMAG MODE (3) - RATE 2 CMC Att Cont - Auto, 7.1.6	1	
CP		PRO Return to V06 N18 display of 6	2	Does not imply that any previous checks need be repeated for each trim enable.
AC		Reject Sel desired Att Cont, 7.1 Verify/mnvr to thrust att		All RCS channels required for 3-axis translation.
CP		(V62E for total att err disp)		
AC		MAN ATT (3) - RATE CMD BMAG MODE (3) - ATT 1/RATE 2 Align GDC to IMU if necessary, 8.4.6	1	DSKY display option recommended because of its availability - only need to set ATT SET thumbwheels to DSKY values and defer alignment until just prior to thrust.
CP		ENTR (exit R60)	2	
	8	Mon VG disp V06 N85 (VG vctr compnts) VGX, Y, Z (cont) XXXX.X FPS		Components resolved along CSM axes, and updated at 1-second intervals.

STA/T STEP	PROCEDURE	PANEL	REMARKS
-05:00			
9	Ign prep		Sets up nontime-critical switching required for thrust.
AC	Check boresight star	1	
	For X axis thrust		
	THC PWR - on (up)		
	If orb change		
	ΔV Test and Null Bias Check, 7.6.1		For deorbit thrust, check accomplished during EMS Entry Test, 14.1.3, if desired.
	ΔV Setup, 7.6.2		Set to ΔV obtained from charts, P30, and/or STDN.
	(R41 - State Vector Integration)		
-00:40	Poss PROG alarm		May illuminate between TIG -42.5 and -35 seconds.
CP	Key V05 N09E	2	TIG slipped delta amount as required by CMC to complete state vector integration.
	01703 (TIG slipped)		
	KEY REL		
	R1 of N40 continues count to former TIG		
	DSKY clears at new TIG -35 sec		
10	COMP ACTY lt - out (exit R41)		
-00:35	DSKY clears		
-00:30			
11	V16 N85 (ave G on)		Dynamic, nonflashing display with COMP ACTY light flash every 2 seconds.

STA/T	STEP	PROCEDURE	PANEL	REMARKS
-00:25				
AC		THC - ARMED		
AC,CP		RHC (both) - ARMED		
AC		LIM CYCLE - OFF	1	For SCS translations.
DP		UP TLM CMD - RSET then NORM	3	
		PCM BIT RATE - HI		
		TAPE RCDR FWD - FWD		
AC		EMS MODE - NORM	1	6.1.1, note 10.
00:00				
	12	RCS thrust		
CP		FL V16 N85 (requests null VG)	2	Event Timer not valid if GETI slipped.
		VGX, Y, Z (cont) XXXX.X FPS		
AC		Man null VG		Command manual translations and rotations to null VG components.
CP		If R30 desired		
		Key V82E		
		Go to 13		
		To term P41		
		PRO		
		Go to 14		CMC sets last specified R03 deadband in RCS DAP.
		(R30 - Orbital Parameter Display)		R30 displays automatically updated at 2-second intervals if called because average G still on.
	13	FL V16 N44		
		Ha XXXX.X NM		Altitudes above launch pad radius.
		Hp XXXX.X NM		
		TFF XXBXX MIN-SEC		Time of free fall to 49.4 NM (300,000 ft) above launch pad radius.

STA/T	STEP	PROCEDURE	PANEL	REMARKS
CP		If Hp >49.4 NM R3 = -59B59 PRO (exit R30) Return to 12	2	If TFF = -59B59, time from perigee available via N32E.
	14	Thrust complete		
AC		EMS MODE - STBY	1	6.1.1, note 10.
DP		PCM BIT RATE - LO	3	
AC		Rcd ΔV ind	1	
		If orb change EMS FUNC - OFF THC PWR - OFF		
AC,CP		RHC (both) - LOCKED		
		If deorbit		
DP		TAPE RCDR FWD - off (ctr)	3	
AC		THC - neut, LOCKED		
CP	15	FL V37 (non-MINKEY)	2	If average G on, R00 turns off average G. It also sets or resets RNDVZFLG, TRACK, and UPDATE flags, depending on which programs in progress or called, and may also recycle into P20.
		If orb change Key XXE		
	or	If deorbit Key 61E (if desired) Go to CM/SM Sep, 14.2		P61 may be bypassed if hybrid or SCS deorbit.
		If MINKEY, go to next MINKEY seq		MINKEY controller proceeds to next targeting program in MINKEY sequence.

(P41) G&N SM RCS THRUSTING

STA/T	STEP	PROCEDURE	PANEL	REMARKS
		12.2.3 G&N/Hybrid Deorbit Thrusting		Computes preferred CSM attitude and preferred IMU orientation for RCS thrusting maneuver. Maneuvers CSM to thrusting attitude (R60), and provides sufficient displays for cutoff of both SM RCS burn followed by CM RCS deorbit burn.
		CMC - on (req), 8.1.3 ISS - on & orient known (req), 8.1.3 & sec 13 SCS - on (req), 8.4.2		G&C circuit breakers on all panels should be closed except as defined in Limited Use Controls, 6.1.1, figure 6-7.
		Test C/W lts Prethrust prog (req), sec 11 Veh Prep (req), 12.1 DAP - Load & Activate, 8.2.1		
AC	1	Set EVNT TMR to read 00:00 at GETI	1	
		Key V37E 00E	2	P00 updates state vector periodically.
CP	2	Key V37E 41E		TFI available via N35, N40, or N45.
		Poss PROG alarm (4.8.1.16)		R02. If no alarms at this point (after R02 exited), CMC computes initial thrust direction and initial value of VG (local vertical), computes preferred IMU orientation, sets PFRATFLG (preferred attitude flag), and stores desired attitude for use in R60. Final attitude computed in R60 and 0.5-degree deadband set in RCS DAP.

NORMAL/BACKUP

STA/T	STEP	PROCEDURE	PANEL	REMARKS
CP	3	If VG disp desired Key V06 N81E VGX, Y, Z XXXX.X FPS (Lcl vert at GETI)	2	Display available until average G turned on (GETI -30 seconds).
		(R60 - Attitude Maneuver)		Maneuvers CSM to attitude stored in P41. Maneuver performed automatically by G&N, or manually with an optional final automatic G&N controlled trim maneuver.
	4	FL V50 N18 (sel CMC - auto) R, P, Y XXX.XX DEG		
		Establish Tot Att disp, 7.2.5		Both FDAIs should be selected to provide redundant displays.
AC		Accept BMAG MODE (3) - RATE 2 CMC Att Cont - auto, 7.1.6	1	Prevents BMAGs from hitting stops during maneuvers.
CP		PRO	2	Initiates auto maneuver without review of final gimbal angles.
AC		Reject Sel desired Att Cont, 7.1		
CP		ENTR, go to 7		
	5	Auto mnvr V06 N18 (final att) R, P, Y XXX.XX DEG		
AC,CP		Monitor FDAIs	1,2	CSM began maneuver to final attitude when PRO keyed in step 4. ICDU drives to achieve final gimbal angles.
		If RHC used or SCS sel, go to 6		Refer to 6.1.3, note 1b.

STA/T	STEP	PROCEDURE	PANEL	REMARKS
CP	6	FL V50 N18 (att trim enbl) R, P, Y XXX.XX DEG	2	Step should be completed prior to TIG -2 minutes. Display of final gimbal angles in registers.
AC		Accept BMAG MODE (3) - RATE 2 CMC Att Cont - auto, 7.1.6	1	
CP		PRO, return to 5	2	
AC		Reject Sel desired Att Cont, 7.1 Verify/mnvr to thrust att (V62E for tot att err disp)		
AC		MAN ATT (3) - RATE CMD BMAG MODE (3) - ATT 1/RATE 2	1	DSKY display option recommended because of its availability - only need to set ATT SET thumbwheels to DSKY values and defer alignment until just prior to thrust.
CP		ENTR (exit R60)	2	
	7	Mon VG disp V06 N85 (VG vctr compnts) VGX, Y, Z (cont) XXXX.X FPS		Components resolved along CSM axes and updated at 1-second intervals.
DP	8	Configure & preload bats		Prepares for battery preloading prior to CM/SM separation and verifies batteries transferred to main buses.
		CAUTION If either bat bus A(B) current fails to incr after cycling MN BUS TIE sws, configure bats to main buses using cb BAT C TO BAT BUS A(B).	250	Assumes reconfiguration BAT A(B) and BAT C to MNA(B). cb MNA(B) BAT C closed in Deorbit and Entry Vehicle Preparation, 14.1.

NORMAL/BACKUP

STA/T STEP	PROCEDURE	PANEL	REMARKS
-06:00	MN BUS TIE BAT A/C - on (up)	5	
DP	Verify bat bus A current incr &/or bat volt decr	3	Verification of current increase for appropriate battery bus via DC AMPS indicator (panel 3) confirms successful operation of main bus tie motor switches.
	MN BUS TIE BAT B/C - on (up)	5	
	Verify bat bus B current incr &/or bat volt decr	3	MN BUS TIE BAT A/C and B/C switches at on provide two batteries on line if circuit breaker MNA & B BAT C (2) - open, or three batteries on line for deorbit and entry if circuit breakers closed (panel 275).
-05:00			
AC 9	Ign prep		
	THC PWR - on (up)	1	Sets up nontime-critical switching required for thrusting.
	ΔV Setup, 7.6.2		Set to ΔV obtained from charts, P30, and/or STDN.
	(R41 - State Vector Integration)		
-00:40	Poss PROG alarm		May illuminate between TIG -42.5 and -35 seconds.
CP	Key V05 N09E	2	TIG slipped delta amount as required by CMC to complete state vector integration.
	01703 (TIG slipped)		
	KEY REL		
	R1 of N40 continues count to former TIG		
	DSKY clears at new TIG -35 sec		
10	COMP ACTY lt - out (exit R41)		
-00:35	DSKY clears		
-00:30			
11	V16 N85 (ave G on)		Dynamic, nonflashing display with COMP ACTY light flash every 2 seconds.

STA/T	STEP	PROCEDURE	PANEL	REMARKS
-00:25				
AC,CP		RHC (both) - ARMED		
AC		THC - ARMED		
		LIM CYCLE - OFF	1	For SCS translations.
DP		UP TLM CMD - RSET then NORM	3	
		PCM BIT RATE - HI		
		TAPE RCDR FWD - FWD		
AC		EMS MODE - NORM	1	6.1.1, note 10.
00:00				
CP	12	SM RCS thrust		
		FL V16 N85 (request null VG)	2	Event Timer not valid if GETI slipped.
		VGX, Y, Z (cont) XXXX.X FPS		
AC		Man null VG		Command manual translation and rotation to null VG components.
		Mon DSKY, ΔV ind, & EVNT TMR	1,2	
CP		Crew options		
		V83 - R, R dot, θ	2	
		V82 - Ha, Hp, TFF		
	13	SM RCS thrust complete		
AC		EMS MODE - STBY	1	6.1.1, note 10.
DP		PCM BIT RATE - LO	3	
CP		Rcd DSKY, ΔV ind, & EVNT TMR values	1,2	
AC		Reset EVNT TMR	1	
		THC - neut, LOCKED		
	14	Sel SCS Att Cont mode, 7.1		Separation follows immediately, preventing proper G&N DAP operation until entry DAP selected in P62.
	15	Perform Sep proced, 14.2		Separation at SM deorbit attitude saves time. Only one minute allowed between burns.

STA/T	STEP	PROCEDURE	PANEL	REMARKS
AC	16	Verify/mnvr to CM RCS deorbit att R____°, P____°, Y____°		Both CM RCS systems should be enabled. CM RCS deorbit portion complete with +X axis ≈70° below velocity vector (apex down and forward); ≈110° +pitch maneuver from heads down, BEF, SM RCS portion of deorbit.
		MAN ATT YAW, ROLL - RATE CMD MAN ATT PITCH - ACCEL CMD DBD/RATE - MIN/HI ATT DBD - MIN RATE - HI	1	
AC,CP		RHC (both) - ARMED		
AC		FDAI SCALE - 5/5		
CP	17	Key V82E FL V16 N44 Ha XXXX.X NM Hp XXXX.X NM TFF XXBXX MIN-SEC	2	Altitudes above launch pad radius. Time of free fall to 49.4 NM (300,000 ft) above launch pad radius.
AC	18	EVNT TMR ind - SM RCS C/O +2 min EMS MODE - NORM	1	Two minutes after SM RCS cutoff, start CM RCS burn. 6.1.1, note 10.
CP		RHC 1 - contin -pitch		
AC		RHC 2 - pulse to maintain att in pitch axis Mon FDAI		Negative pitch engines have ≈25 to 30 percent less authority than positive engines because of engine location and thrust direction relative to CM c.g.
		xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx		
		If only 1 RHC		
AC,CP		Pulse RHC + & - in pitch from pitch retro att, maintaining rates <3°/sec		
		xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx		

G&N HYBRID DEORBIT THRUSTING

STA/T	STEP	PROCEDURE	PANEL	REMARKS
CP	19	Mon Hp & TFF on DSKY	2	Monitor Event Timer for duration of burn no greater than 02:10 for either single or dual system. Conserve CM RCS propellant reserves, 30 lb each system for entry. ΔV indicator cutoff cue must be adjusted to account for EMS sensing axis (along X) being reversed from SM RCS deorbit burn and biased off ≈70° from CM RCS velocity vector. (ΔVems = ΔVcm Cos 70°).
	20	PRO FL V16 N85 VGX, Y, Z (cont) XXXX.X FPS		
	21	Thrust complete, ΔV ind = _____ or EVNT TMR = _____	1	
		PRO	2	
AC		MAN ATT (3) - RATE CMD	1	
		Rcd ΔV ind, DSKY, EVNT TMR	1,2	
DP		TAPE RCDR FWD - off (ctr)	3	
AC		ATT DBD - MAX	1	
CP	22	FL V37	2	
AC		EMS MODE - STBY	1	6.1.1, note 10.
AC,CP		RHC (both) - LOCKED		
AC	23	Sel Att Cont mode, 7.1 Mnvr to entry att R____°, P____°, Y____°		
	24	Set up for CM RCS sys 1 AUTO RCS A/C ROLL (4) - OFF AUTO RCS CM 1 (6) - MNA or MNB AUTO RCS CM 2 (6) - OFF	8	Electrically isolates system 2 for entry. If problem develops in system 1, disable affected channel and use direct RCS control.
	25	Go to G&N Entry, 14.3		

STA/T	STEP	PROCEDURE	PANEL	REMARKS
		12.3 SCS THRUSTING		
		12.3.1 SCS/SPS Thrusting		
		CMC - on (desired), 8.1.3 ISS - on & orient known (desired), 8.1.3 & sec 13 SCS - on (req), 8.4.2		CMC and ISS on, and orientation known, necessary for P47 monitor. G&C circuit breakers on all panels should be closed except as defined in Limited Use Controls, 6.1.1, figure 6-7.
		Vehicle Prep (req), 12.1		
		For small impulse SPS/SCS burn Set ΔV ind - ΔVc		Initial counter setting (ΔVc) and counter reading for SPS ignition cue (ΔVf) will be provided by STDN or determined from on-board charts. (Ref CSM Data Book Vol I, Part I.)
	1	ΔV Setup, 7.6.2		
CP	2	Key V37E 00E	2	P00 updates state vector periodically.
	3	Establish Tot Att disp, 7.2.5		To obtain telemetry on BMAG attitude error, FDAI SEL switch must be in 1 or 2 position (with SCS displays).
	4	SCS Att Mnvr to thrust att, 8.4.5		
	5	Establish SCS Att Hold, 7.1.4 Check boresight star		Limit cycle, maximum deadband and low rate should be selected for propellant conservation.
	6	Ign prep		Sets up nontime-critical switching required for thrusting.

STA/T	STEP	PROCEDURE	PANEL	REMARKS
DP		SPS He VLV tb (both) - bp SPS He VLV (both) - AUTO	3	Barber pole indicates helium isolation valves closed.
		CAUTION		
		If either bat bus A(B) current fails to incr after cycling MN BUS TIE sws, configure bats to main buses using cb BAT C TO BAT BUS A(B) & cb MNA(B) BAT C as necessary.	250 275	Assumes reconfiguration BAT C to MNA(B) for orbit change; BAT A(B) and BAT C to MNA(B) for deorbit.
-06:00		MN BUS TIE BAT A/C - on (up) Verify bat bus A current incr &/or bat voltage decr MN BUS TIE BAT B/C - on (up) Verify bat bus B current incr &/or bat voltage decr	5	Verification of current increase for appropriate bat bus via DC AMPS indicator (panel 3) confirms successful operation of main bus tie motor switches. MN BUS TIE BAT A/C and B/C switches at on provide two batteries on line for orbit change if cb MNA & B BAT C (2) - open, or three batteries on line for deorbit burn and entry if cbs closed (panel 275).
		LV IND/GPI sw - GPI (verify)		
AC		RHC PWR DIR (both) - OFF SCS TVC (2) - AUTO TVC GMBL DR (2) - AUTO	1	
		ATVC GAIN - HI		LO position provides proper response for tw control of SPS gimbals.
		Establish U11 Sel, 6.1		
CP	7	If P47 for thrust monitor Key V37E 47E	2	G&N monitoring highly desirable but not required. Refer to 8.1.6 for P47 description.
		Poss PROG alarm (8.1.16)		R02.

STA/T	STEP	PROCEDURE	PANEL	REMARKS
CP		FL V16 N83	2	
		ΔVX, Y, Z (cont) XXXX.X FPS		
		If desired		
		KEY N62E		
		VI XXXXX. FPS		Inertial velocity.
		H dot XXXXX. FPS		Altitude rate.
		H pad XXXX.X NM		Altitude above launch pad radius.
		KEY REL (to return to N83)		
	8	Gmbl drive & trim check		PITCH and YAW GMBL caution/warning lights indicate overcurrent to actuator motors.
AC		TVC SERVO PWR 1 - AC1/MNA	7	
		TVC SERVO PWR 2 - AC2/MNB		
		cb SPS PITCH 1 BAT A - close (verify)		Remain closed from launch through first SPS thrust and closed again for each subsequent SPS thrusting.
		cb SPS YAW 1 BAT A - close (verify)		
		THC PWR - on (up)	1	
		RHC PWR NORM 2 - AC		Opens RHC 2 (commander's) breakout switch dc circuits to prevent loss of attitude reference. Prevents RCS jets from firing when RHC used for MTVC check. Normally, IGN 1 signal disables RCS pitch and yaw channels 1 second after SPS engine ignition.
		RHC 2 - ARMED		
		Primary TVC check		6.1.1, note 12.
-05:00		GMBL MOT P1 & Y1 - START		START position is momentary.
		Verify trim control on ind		Gimbals drive in response to thumbwheel movement. Verifies primary gimbal trim control.

STA/T	STEP	PROCEDURE	PANEL	REMARKS
AC		Auto switchover check	1	
		THC - CW		
		RHC 2 - verify no MTVC		
		GMBL POS ind (4) - no motion		Verifies TVC control switches from channel 1 to channel 2 (which is off) when THC - CW.
		Sec TVC check		
		GMBL MOT P2 & Y2 - START		START position is momentary.
		Verify trim control		Verifies secondary gimbal trim control.
		Verify MTVC		Gimbals drive in response to RHC movement, and return to set-in values when RHC neutral. Verifies control of secondary MTVC loops through RHC.
		THC - neut		
		SPS GMBL tw (2) - set & confirm fnl desired gmbl position		Gimbals trimmed in primary channel to thrusting values (SCS modes).
	9	RHC PWR DIR (both) - MNA/MNB		Enables manual direct RCS for overriding a roll auto RCS failure during thrusting.
		RHC 2 - null att err		Needles can be used as error null reference during MTVC contingency takeover from automatic ΔV mode.
		ATT DBD - MIN		Set to MIN as errors nulled.
		RHC PWR NORM (both) - AC/DC		
		Check boresight star		
CP	10	1-min countdown		
-01:00		Report TF GETI = 1 min	2	
AC		FDAI SCALE - 5/5	1	
		ΔV THRUST A(B) - NORM		Guarded.

NORMAL BACKUP

STA/T	STEP	PROCEDURE	PANEL	REMARKS
AC		THC - ARMED LIM CYCLE - OFF	1	
DP		UP TLM CMD - RSET, then NORM PCM BIT RATE - HI	3	
-00:30		TAPE RCDR FWD - FWD		
AC		EMS MODE - NORM	1	6.1.1, note 10.
-00:29 to -00:06		Perform ull		2 or 4 jet ullage times defined in MSC-07765-Vol I, Part I. Exact velocity change not critical - only steady ullage to settle SPS propellants.
		For small impulse SPS/SCS burn THC - +X Mon EMS counting down When EMS ind = ΔVf THRUST ON pb - push SPS THRUST lt - on Discontinue ull when SPS thrusting		
		xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx x x No ull DIR ULL pb - push, hold RHC 2 - control att x x xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx		Direct ullage inhibits pitch and yaw auto RCS control. Attitude should be maintained manually.
	11	Orb change ign		Engine restart should not be attempted within 5 seconds from initial ignition - avoids undesirable He pressure excursions.
00:00		If ull present THRUST ON pb - push		

STA/T STEP	PROCEDURE	PANEL	REMARKS
AC	If no ull present THC - +X, hold THRUST ON pb - push SPS THRUST lt - on	1	Provides ullage discrete to SCS.
IGN+1 sec	RATE - HI		Bypasses noise problem in SCS gyro assemblies because of thrusting vibration levels and provides backup to auto selection of high rate in pitch and yaw TVC.
	Discontinue ull		
IGN +2 to 5 sec	ΔV THRUST (2) - NORM (if desired)		For dual bank operation.
	Initiate ull THRUST ON pb - push		Ullage and THRUST ON pushbutton required to satisfy SCS logic for second bank operation.
	xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx		
	If no ign, or premature shutdown ΔV THRUST (2) - NORM Recycle ll		
	or SPS THRUST - DIR ON Recycle ll		Lever lock.
	or Term mnvr		
	xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx		
12 00:00	Deorbit ign SPS THRUST - DIR ON		Engine restart should not be attempted within 5 seconds from initial ignition to avoid undesirable He pressure excursions.
	SPS THRUST lt - on		

NORMAL/BACKUP

STA/T	STEP	PROCEDURE	PANEL	REMARKS
AC				
IGN	+1 sec	RATE - HI	1	Bypasses noise problem in SCS gyro assemblies because of thrusting vibration levels and provides backup to auto selection of high rate in pitch and yaw TVC.
		xxxxxxxxxxxxxxxxxxxxxxxxxxxxxx		
		If no ign ΔV THRUST (2) - NORM Recycle 12		Guarded.
		or Term mnvr		
		xxxxxxxxxxxxxxxxxxxxxxxxxxxxxx		
		Discontinue ull		
IGN	+2 to 5 sec	ΔV THRUST (2) - NORM		Guarded.
	13	Orb change SPS monitor Pc ind - 95-105 psia		65 to 125% green range on indicator corresponds to psia. Normal range 95-105 psia.
DP		SPS INJ VLV ind (2 or 4) - OPEN SPS He VLV tb (both) - gray SPS FUEL & OXID PRESS ind (2) - 170-195 psia SPS OXID UNBAL ind - 0 psi	3	All four injector valves open for dual-bank operation. Gray indicates helium isolation valves open. PUGS deactivated.
		CAUTION If noncritical burn & ΔP >20 psi.		ΔP between fuel and oxidizer should not exceed 20 psi during burn or degraded performance, rough combustion and/or engine failure may result.
AC		ΔV THRUST (2) - OFF	1	Guarded.

STA/T	STEP	PROCEDURE	PANEL	REMARKS
	14	Deorbit SPS Monitoring		
AC		Pc ind - 95-105 psia	1	
DP		SPS INJ VLV ind (4) - OPEN	3	
		SPS He VLV tb (both) - gray		Gray indicates helium isolation valves open.
		SPS FUEL & OXID PRESS ind (2) - 170-195 psia		
AC or CP	15	FDAI - mon att err & rates	1,2	
		xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx		
AC		Orb change MTVC takeover		
		If pitch & yaw err & rates abnormal		
		ΔV THRUST (2) - OFF	1	Backup procedure bypasses maximum possible failure modes, thereby providing alternate means of completing burn without troubleshooting.
		Damp rates to IMU ball or out window with RHC		
		If no response		
		Use dir RCS & disable affected chan		Since a failure causing abnormal TVC and RCS attitude control is not a failed-on jet, RCS disabling should be done with MAN ATT switch to ACCEL CMD rather than AUTO RCS switches OFF, thereby providing auto RCS control for reorientation.
		If rate needle(s) abnormal		
		BMAG MODE - RATE 1		
		Reorient to thrust att		
		THC - CW		
		ΔV THRUST A(B) - NORM		Guarded.
		Initiate ull		
		THRUST ON pb - push		
		or SPS THRUST - DIR ON		Lever lock

STA/T STEP	PROCEDURE	PANEL	REMARKS
AC	Fly MTVC (rate cmd)		
IGN+2 to 5 sec	ΔV THRUST B(A) - NORM (if desired)	1	For dual bank operation.
	Initiate ullage THRUST ON pb - push		Ullage and THRUST ON pushbutton required to satisfy SCS logic for second bank operation if SPS THRUST switch not at DIR ON.
	or SPS THRUST - DIR ON		Lever lock.
	or Term mnvr		
	xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx		
	Orb change roll err & rates abnormal & no roll att cont MAN ATT ROLL - ACCEL CMD RHC - cont roll rates		
	or AUTO RCS (16) - OFF Cont roll using dir RCS	8	
	xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx		
	Deorbit MTVC takeover If err & rates abnormal ΔV THRUST (2) - OFF Damp rates to IMU ball or out window with RHC SPS THRUST - NORM	1	Backup procedure bypasses maximum possible failure modes, thereby providing an alternate means of completing burn without troubleshooting. Lever lock.

STA/T STEP	PROCEDURE	PANEL	REMARKS
AC	If no response Use dir RCS & disable affected chan		Since a failure causing abnormal TVC and RCS attitude control is not a failed-on jet, RCS disabling should be done with MAN ATT switch to ACCEL CMD rather than AUTO RCS switches - OFF, thereby providing automatic RCS control for reorientation.
	If rate needle(s) abnormal BMAG MODE - RATE 1	1	
	Reorient to thrust att THC - CW ΔV THRUST A(B) - NORM Initiate ull SPS THRUST - DIR ON Fly MTVC (rate cmd)		 Guarded. Lever lock.
IGN+2 to 5 sec	ΔV THRUST (2) - NORM		Guarded.
	or Term mnvr		
	Deorbit no roll att cont MAN ATT ROLL - ACCEL CMD RHC - cont roll rates		
	or AUTO RCS (16) - OFF Cont roll using dir RCS	8	

STA/T	STEP	PROCEDURE	PANEL	REMARKS
AC	16	Mon for SPS eng cutoff cue ΔV ind - goes through -0.1 &/or EVNT TMR ind - 59:59 (-) thrust duration	1	For suspected ΔV indicator failures, utilize Event Timer to terminate SPS thrust manually. Timer normally counts down from 59:59.
		ΔV THRUST (2) - OFF		Guarded.
		SPS THRUST - NORM		Lever lock.
		SPS THRUST lt - out		
		For postorbit change free drift MAN ATT (3) - ACCEL CMD		
		Report eng cutoff Pc = 0		
DP		SPS INJ VLV ind (4) - CLOSE	3	
		SPS He VLV tb (both) - bp		Barber pole indicates helium isolation valves closed.
	17	Set controls after tailoff		
		DC IND sel - FC 3		
		DC AMPS ind - mon for amps decr after each No. 2 gmbl mot shutdown		Decrease verifies gimbal motor shutdown.
AC		GMBL MOT P2 & Y2 - OFF	1	6.1.1, note 12.
DP		DC IND sel - FC 1 (2)	3	
		DC AMPS ind - mon for amps decr after each No. 1 gmbl mot shutdown		Decrease verifies gimbal motor shutdown.
AC		GMBL MOT P1 & Y1 - OFF	1	
DP		DC IND sel - MNA	3	
AC		EMS MODE - STBY		6.1.1, note 10.
		If orb change		
DP		PCM BIT RATE - LO	3	
AC		Rcd ΔV ind	1	
		TVC SERVO PWR (both) - OFF	7	

STA/T	STEP	PROCEDURE	PANEL	REMARKS
		If orb change		
AC		cb SPS PITCH 1 BAT A - open	8	
		cb SPS YAW 1 BAT A - open		
		If deorbit		
		cb SPS PITCH (both) - open		
		cb SPS YAW (both) - open		
		ATT DBD - MAX	1	
		THC - LOCKED		
		If deorbit		
DP		TAPE RCDR FWD - off (ctr)	3	
		If orb change		
AC,CP		RHC (both) - LOCKED		
AC		RHC PWR DIR (both) - OFF		
CP		(To re-zero registers, V32E)	2	Provides capability to monitor another burn without going through ROO.
	18	PRO (exit P47)		When P47 termination desired.
	19	FL V37		
		Key XXE		
		If deorbit		
		Go to CM/SM Sep, 14.2		
	20	If orb change		
CP		MN BUS TIE (2) - OFF	5	

STA/T	STEP	PROCEDURE	PANEL	REMARKS
		xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx If MN BUS TIE fail prior to thrust		
CP		Leave MN BUS TIE BAT B/C(A/C)-on (up) Go to EPS Malf, Pwr Distr, SSR-2 reconfig for subsequent main bus ties xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx	5	Circuit breakers used to reconfigure for subsequent bat bus operation and battery charging procedures in place of opening (known) good main bus tie motor switches. Malfunction procedures are to be found in Flight Data File (FDF).
AC		EMS FUNC - OFF Charge bats, 5.3.5	1	

STA/T	STEP	PROCEDURE	PANEL	REMARKS
		12.3.2 SCS/SM RCS Thrusting		
		CMC - on (desired), 8.1.3 ISS - on & orient known (desired), 8.1.3 & sec 13 SCS - on (req), 8.4.2 Veh Prep (req), 12.1		CMC and ISS on, and orientation known, necessary for P47 monitor.
CP	1	Key V37E 00E	2	P00 updates state vector periodically.
	2	Establish Tot Att disp, 7.2.5		
	3	Sel desired Att Cont, 7.1 Mnvr to thrust att		All RCS channels required for 3-axis thrusting.
	4	Establish SCS Att Hold, 7.1.4		Limit cycle, max deadband and low rate should be selected for propellant conservation until prior to thrusting.
-05:00 AC	5	Check boresight star		
	6	For X-axis thrust If orb change ΔV Test & Null Bias Check, 7.6.1		EMS can monitor only Xsc axis thrusting. For deorbit thrust, check accomplished during EMS Entry Test, 14.1.3, if desired.
		ΔV Setup, 7.6.2		Set to ΔV obtained from charts, P30, and/or STDN.
CP	7	If P47 for thrust monitor Key V37E 47E		G&N monitoring highly desirable, but not required. Refer to 8.1.6 for P47 description.
		Poss PROG alarm (8.1.16)		R02.

NORMAL/BACKUP

STA/T	STEP	PROCEDURE	PANEL	REMARKS
CP		FL V16 N83	2	
		ΔVX, Y, Z (cont) XXXX.X FPS		
		If desired		
		Key N62E		
		VI XXXXX. FPS		Inertial velocity.
		H dot XXXXX. FPS		Altitude rate.
		H pad XXXX.X NM		Altitude above launch pad radius.
		KEY REL (to return to N83)		
-00:30				
AC,				
CP	8	RHC (both) - ARMED		
AC		THC - ARMED		
		ATT DBD - MIN	1	
		LIM CYCLE - OFF		
DP		UP TLM CMD - RSET then NORM	3	
		PCM BIT RATE - HI		
		TAPE RCDR FWD - FWD		
AC		EMS MODE - NORM	1	6.1.1, note 10.
00:00				
	9	Perform thrust by manually nulling ΔV ind		
CP		If PSM deorbit, mon SM RCS QTY ind	2	
		If <____%		
		PRO (exit P47)		
AC		EMS MODE - STBY	1	
CP		Rcd ΔV ind		
		SM RCS PSM PRPLNT (4) - CLOSE	2	
		SM RCS PSM PRPLNT tb (4) - bp		

STA/T	STEP	PROCEDURE	PANEL	REMARKS
CP		SM RCS PSM He - CLOSE	2	
		SM RCS PSM He tb - bp		
		SM RCS QUAD He (4) - OPEN		
		SM RCS QUAD He tb (4) - gray		
		SM RCS PRPLNT (4) - OPEN		
		SM RCS PRPLNT tb (8) - gray		
		Return to 1		
AC	10	EMS MODE - STBY	1	6.1.1, note 10.
DP		PCM BIT RATE - LO	3	
AC		Rcd ΔV compnts	1	
		If orb change	1	
		EMS FUNC - OFF		
AC,DP		RHC (both) - LOCKED		
AC		THC - neut, LOCKED		
DP		If deorbit		
		TAPE RCDR FWD - off (ctr)	3	
CP		(To re-zero registers, V32E)	2	Provides capability to monitor another burn without going through R00.
	11	PRO (exit P47)		
	12	FL V37		R00 turns off average G.
		Key XXE		
	13	If deorbit		
		Go to CM/SM Sep, 4.14.2		

STA/T	STEP	PROCEDURE	PANEL	REMARKS
	12.3.3	SCS Hybrid Deorbit Thrusting		This procedure can be utilized for a pure CM RCS deorbit by omitting steps 10 and 11.
		CMC - on (desired), 8.1.3 ISS - on & orient known (desired), 8.1.3 & sec 13 SCS - on (req), 8.4.2 Veh Prep (req), 12.1		CMC and ISS on, and orientation known, necessary for P47 monitor.
CP	1	Key V37E 00E	2	P00 updates state vector periodically.
	2	Establish Tot Att disp, 7.2.5		
	3	Sel desired Att Cont, 7.1		Thrusting attitude for SM RCS portion of hybrid burn is nominally a retrograde +X translation with heads down and BEF.
		Mnvr to thrust att R_____°, P_____°, Y_____°		
	4	Establish SCS Att Hold, 7.1.4		Limit cycle, maximum deadband, and low rate should be selected for propellant conservation until prior to thrusting.
DP	5	Configure & preload bats		Prepares for battery preloading prior to CM/SM separation and verifies batteries transferred to main buses.
		CAUTION		
		If either bat bus A(B) current fails to incr after cycling MN BUS TIE sws, configure bats to main buses using cb BAT C TO BAT BUS A(B)	250	Assumes reconfiguration BAT A(B) and BAT C to MNA(B). Cb MN A(B) BAT C closed in Deorbit and Entry Vehicle Preparation, 14.1.

STA/T STEP	PROCEDURE	PANEL	REMARKS
CP -10:00	MN BUS TIE BAT A/C - on (up) Verify bat bus A current incr &/or bat voltage decr MN BUS TIE BAT B/C - on (up) Verify bat bus B current incr &/or bat voltage decr	5	Verification of current increase for appropriate battery bus via DC AMPS indicator (panel 3) confirms successful operation of main bus tie motor switches. MN BUS TIE BAT A/C and B/C switches at on provide two batteries on line if cb MNA & B BAT C (2) - open, or three batteries on line for deorbit and entry if cbs closed (panel 275).
-05:00 AC 6	Check boresight star		
7	For X-axis thrust ΔV Setup, 7.6.2		If G&N inoperative, X axis only direction ΔV can be measured.
CP 8	If P47 for thrust monitor Key V37E 47E	2	G&N monitoring desirable but not required. Refer to 8.1.6 for P47 description.
	Poss PROG alarm (8.1.16)		R02.
	FL V16 N83 ΔVX, Y, Z (cont) XXXX.X FPS		
	If desired Key N62E VI XXXXX. FPS H dot XXXXX. FPS H pad XXXX.X NM		Inertial velocity. Altitude rate. Altitude above launch pad radius.
	KEY REL (to return to N83)		

NORMAL/BACKUP

STA/T	STEP	PROCEDURE	PANEL	REMARKS
-00:30				
AC,				
CP	9	RHC (both) - ARMED	2	
AC		THC - ARMED		
		ATT DBD - MIN	1	
		LIM CYCLE - OFF		
DP		UP TLM CMD - RSET then NORM	3	
		PCM BIT RATE - HI		
		TAPE RCDR FWD - FWD		
AC		EMS MODE - NORM	1	6.1.1, note 10.
00:00				
	10	Perform SM RCS thrust Mon ΔV ind or EVNT TMR ind		
	11	SM RCS thrust complete EMS MODE - STBY		6.1.1, note 10.
DP		PCM BIT RATE - LO	3	
		Rcd ΔV ind, EVNT TMR ind		
	12	Sel SCS Att Cont mode, 7.1		
	13	Perform Sep, 14.2		Separation at SM deorbit attitude saves time. Only one minute allowed between burns.
	14	Mnvr to CM RCS deorbit att R_____°, P_____°, Y_____°	2	Both CM RCS systems should be enabled. CM RCS portion completed with +X axis ≈70° below velocity vector (apex down and forward); ≈110° +pitch maneuver from heads down, BEF, SM RCS portion of deorbit.
		Verify using external visual cues MAN ATT ROLL, YAW - RATE CMD	1	
		MAN ATT PITCH - ACCEL CMD RATE - HI FDAI SCALE - 5/5		

SCS HYBRID DEORBIT THRUSTING

STA/T	STEP	PROCEDURE	PANEL	REMARKS
AC	15	EVNT TMR ind - SM RCS C/O +2 min EMS MODE - NORM	1	Two minutes after SM RCS cutoff, start CM RCS burn. 6.1.1, note 10.
CP		RHC 1 - contin -pitch	2	Negative pitch jets have ≈25 to 30% less authority than positive jets because of jet location and thrust direction relative to CM c.g.
AC		RHC 2 - pulse +pitch to maintain att in 3 axes	1	
		xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx If only 1 RHC Pulse RHC + & - 5° from pitch retro att, maintaining rates <3°/sec xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx		
	16	Mon ΔV ind or EVNT TMR ind for req value		ΔV indicator cutoff cue must be adjusted to account for EMS sensing axis (along X) being reversed from SM RCS burn and biased off ≈70° from CM RCS velocity vector. (ΔVems = ΔVcm Cos 70°).
	17	Term CM RCS deorbit burn MAN ATT (3) - RATE CMD or ACCEL CMD EMS MODE - STBY Rcd ΔV ind THC - LOCKED		6.1.1, note 10.
	18	Set up for CM RCS Sys 1 AUTO RCS A/C ROLL (4) - OFF AUTO RCS CM 1 (6) - MNA or MNB AUTO RCS CM 2 (6) - OFF	8	Electrically isolates system 2 for entry. If a problem develops in system 1, disable affected channel and use direct RCS control.
CP	19	PRO (exit P47)	2	
	20	FL V37 Key XXE Go to SCS Entry, 14.4		

NORMAL/BACKUP

STA/T	STEP	PROCEDURE	PANEL	REMARKS
		13.0 ALIGNMENTS		For general G&C operating data, refer to operating notes, 6.1.
		13.1 G&N ALIGNMENTS		
		13.1.1 (P50) Soyuz Orientation Determination		Computes matrix describing relative orientation between CSM and Soyuz. Option 2 may not be usable if Soyuz does not have a star tracker.
		CMC - on (req), 8.1.3		
		ISS - on & orient known (req), 8.1.3 & sec 13		Options 1 and 2.
		SCS - on (desired), 8.4.2		Provides total attitude monitoring and attitude control capability. Minimum impulse control using RHC available (SCS & G&N) for sighting mark target alignment.
AC		CMC ATT - IMU (verify)	1	
		LOGIC 2/3 PWR - on (up)	7	Required for control and display functions if SCS - on option not selected.
		Opt - on (req), 8.1.4		Options 1 and 2.
		Att Cont (req), 7.1		Allows maneuvering, and provides inertial stability of CSM to ensure accuracy of alignments.
		Soyuz - solar inertial (req)		Options 1 and 2.
		Soyuz star tracker - locked on celestial body (req)		Option 2. Assumes Soyuz has a star tracker.
CP	1	Key V37E 50E		
		FL V04 N06		
		00012 (ref option)		
		0000X (desired option)		CMC initializes R2 = 00001.

STA/T STEP	PROCEDURE	PANEL	REMARKS
CP	(X = 1, 2, or 3)		Reference options are as follows: R2 = 00001 - Soyuz sun sensor, IMU 00002 - IMU, Soyuz sun sensor & star tracker 00003 - Soyuz angles from independent source
	Accept PRO Option 1 or 2, go to 2 Option 3, go to 7 Reject Key V22E Load desired option	2,140	CMC computes present NB to Soyuz matrix as desired IMU orientation.
	Poss PROG alarm		R02 (8.1.15).
	(R53 - Sighting Mark Routine)		
2	FL V51 (please mrk) MARK	122	
	If option 2 Record star tkr angles at time of MARK for input to N14		
	To terminate Key V37E XXE	2,140	
	or Key V34E FL V37 Key XXE		

(P50) SOYUZ ORIENTATION DETERMINATION

STA/T STEP	PROCEDURE	PANEL	REMARKS
CP	Poss PROG alarm Key V05 N09E (to verify alarm) 31211 (illegal interrupt of ext verb) When mrking complete Reselect ext verb		Alarm generated if mark system busy or if extended verb active.
3	FL V50 N25 00016 (term mrks) Accept PRO Opt 1, go to 7 Opt 2, go to 4 Reject MARK REJ, return to 2	2,140	Due to coding, noun and R1 not blanked on recycle.
4	FL V01 N71 Trgt code OOCDE Accept PRO		C - Source of sighting data 0 - CSM optics 1 - Soyuz sun sensor 2 - Soyuz star tracker DE - Target (celestial body) codes: 00 - Planet (any planet except earth) 01 to 45 - Star 46 - Sun 47 - Earth
	Poss OPR ERR Recycles disp		Target code negative, >47 or if C = 1 and CDE ≠ 146.
	Reject Key V21E Load desired data		

STA/T	STEP	PROCEDURE	PANEL	REMARKS
CP	5	FL V06 N14 (tracker angles)	2,140	
		OGA XXXXX. ARC MIN		Tracker azimuth.
		IGA XXXXX. ARC MIN		Tracker elevation.
		Poss OPR ERR (recycles N14)		If N14 (R1 or R2) >180°.
		Accept PRO		
		Reject Key V24E		
		Load desired tracker angles		
	6	FL V06 N88 (planet only)		
		X, Y, Z .XXXXX		This flash will occur only if marks were made on a planet. X, Y, Z - components of planet unit position vector at present time.
		Accept PRO		
		Reject Key V25E		Use on-board tables to determine planet position vector at present time.
		Load desired data		
	7	FL V06 N23		
		R, P, Y (NB to Soyuz ang) XXX.XX DEG		Gimbal angles based upon CSM body axes and desired orientation.
		Accept PRO		
		Reject Key V25E		
		Load desired data		
	8	FL V37		
		Key XXE		
	9	Opt Pwr Down, 8.1.4		

STA/T	STEP	PROCEDURE	PANEL	REMARKS
		13.1.2 (P51/P53) IMU Orientation Determination		(P51) IMU Orientation Determination defines inertial orientation of IMU using optics, Soyuz sun sensor, or star tracker. (P53) Alternate LOS IMU Orientation Determination defines inertial orientation of IMU using backup optical device (COAS), Soyuz sun sensor, or star tracker. P53 may also be used with failed optics or MARK pb.
		CMC - on (req), 8.1.3 ISS - on (req), 8.1.3 SCS - on (desired), 8.4.2		Provides total attitude monitoring and attitude control capability. Minimum impulse control using RHC available (SCS & G&N) for sighting mark target alignment.
		If Soyuz or star tkr		If Soyuz sun sensor or star tracker are to be used as source of sighting data.
		P50 - completed Soyuz - solar inertial (req)		If valid transformation not previously established via P50.
CDR		CMC ATT - IMU (verify) LOGIC 2/3 PWR - on (up)	1 7	Required for control and display functions if SCS - on option not selected.
		Opt - on (req, P51), 8.1.4 COAS - calib (req, P53), 13.1.8 Att Cont (req), 7.1		Optics required for P51; COAS used for P53. Allows maneuvering, and provides inertial stability of CSM to ensure accuracy of alignments.
		Total Att Disp (req), 7.2.5		Both ISS and GDC attitude displays recommended for monitoring of IMU coarse align and SC motion.

STA/T	STEP	PROCEDURE	PANEL	REMARKS
CP	1	Key V37E 51E/53E	2,140	
		Poss PROG alarm FL V37 Key V05 N09E (to verify alarm) 00210 (ISS not on) Perform ISS turnon Key 51E/53E		R02 not entered in P51/P53.
	2	FL V50 N25 00015 (trgt acq)	2,140	Targets (celestial bodies).
		a. Desired att cont mode, 7.1 Mnvr to acq tgts, if necessary PRO If P51 go to 3 If P53 go to 4		V16 N20 may be keyed in to monitor for impending gimbal lock if operating from LEB where no FDAI available.
		or b. To coarse align IMU to SC axes ENTR (when att acpt) V41 N22 (coarse align) R, P, Y 000.00 DEG NO ATT lt - on, then out Recycle 2 (R53, Sighting Mark Routine)		Time and RCS fuel may be saved and subsequent IMU alignment decisions greatly simplified if IMU left inertially stabilized as close as possible to orientation required for future CMC programs.
	3	FL V51 (please mrk) OPT ZERO - OFF OPT MODE - MAN	122	Not necessary for Soyuz sun sensor.

(P51/P53) IMU ORIENTATION DETERMINATION

STA/T STEP	PROCEDURE	PANEL	REMARKS
CP	Ctr trgt in SXT MARK (on trgt), go to 6		SCT may be used if reduced accuracy acceptable. MARK REJ with no marks produces 00110 alarm. PRO recycles FLV51. If star tracker used, record star tracker angles at time of MARK for input to N14.
	To terminate Key V37E XXE		
	or Key V34E FL V37 Key XXE		
	Poss PROG alarm Key V05 N09E (to verify alarm) 31211 (illegal interrupt of ext verb)	2,140	Alarm generated if mark system busy or if extended verb active.
	When mrking complete Reselect ext verb		
	(R56, Alternate LOS Sighting Mark Routine)		To perform sighting marks using COAS.
4	FL V06 N94 SA XXX.XX DEG TA XX.XXX DEG		
	Accept PRO Reject Key V24E Load desired SA & TA		Values obtained from COAS Calibration, 13.1.8. Nominal SA and TA for COAS sightings are: SA - 000.00 DEG TA - 57.470 DEG

STA/T	STEP	PROCEDURE	PANEL	REMARKS
CP	5	FL V53 (please mrk) RHC - ctr trgt in COAS reticle		SCS minimum impulse mode is recommended.
		ENTR, go to 6		CMC interprets ENTR as a mark. An inadvertent PRO instead of ENTR will recycle FL V53. If star tracker used, record star tracker angles at time of MARK for input to N14.
	6	FL V50 N25 00016 (term mrks)		
		Accept PRO	2,140	
		Reject If P51, MARK REJ pb - push	122	An unsatisfactory mark may be rejected by pressing MARK REJ pushbutton (P51) or ENTR (P53) anytime prior to terminating marking sequence. In P51, possible program alarms if marks rejected without prior marks or if surplus marks made. In P51, due to coding, noun and R1 not blanked on recycle.
		Return to 3		
		If P53, ENTR, return to 5	2,140	CMC interprets ENTR as a mark reject.
	7	FL V01 N71 Trgt code OOCDE		C - Source of sighting data 0 - CSM optics 1 - Soyuz sun sensor 2 - Soyuz star tracker
		Accept PRO		DE target (celestial body) codes: 00 - Planet (any planet except Earth) 01 to 45 - Star 46 - Sun 47 - Earth

(P51/P53) IMU ORIENTATION DETERMINATION

STA/T	STEP	PROCEDURE	PANEL	REMARKS
CP		Poss OPR ERR Recycles disp		Target code negative, >47, or C = 1 & CDE ≠ 146.
		Reject Key V21E Load trgt code		
		If C = 0 or 1 & DE ≠ 00 For trgt 2 P51, return to 3 P53, return to 4		
		After 2nd pass Go to 10		
		If C = 0 or 1 & DE = 0, go to 9		
		If C = 2, go to 8		
	8	FL V06 N14 (tracker angles)	2,140	
		OGA XXXXX. ARC MIN		
		IGA XXXXX. ARC MIN		
		Accept PRO Reject Key V24E Load desired tracker angles		
		For trgt 2 (DE ≠ 00) Return to 3 After 2nd pass, go to 10		

STA/T	STEP	PROCEDURE	PANEL	REMARKS
CP	9	FL V06 N88 (planet only) X, Y, Z .XXXXX Accept PRO Reject Key V25E Load desired data For trgt 2 P51, return to 3 P53, return to 4 (R54, Sighting Data Display Routine)		This flash will occur only if marks were made on a planet. X, Y, Z - components of planet unit position vector at present time. Use on-board tables to determine planet position vector at present time. Tests accuracy of pair of target sightings.
	10	FL V06 N05 Sighting angle diff XXX.XX DEG Sighting angle XXX.XX DEG Accept PRO Reject Key V32E, return to 2	2,140	CMC calculates and stores IMU orientation as REFSMMAT.
	11	FL V37 Key XXE		R00.
	12	If P51 and no P52 Opt Pwr Down, 8.1.4		

(P51/P53) IMU ORIENTATION DETERMINATION

STA/T STEP	PROCEDURE	PANEL	REMARKS
	13.1.3 (P52/P54) IMU Realign		(P52) IMU Realign, and (P54) Alternate LOS IMU Realign, aligns IMU from known orientation to one of three orientations selected by crew. Sightings made on two targets (celestial bodies) with optics, Soyuz sun sensor, or star tracker in P52, or with COAS, Soyuz sun sensor, or star tracker in P54. Provides option for automatically pulse torquing gyros to prevent gimbal lock problem during plane change burn (NPC sequence). Orientation options available are: o Preferred o Nominal o REFSMMAT
	CMC - on (req), 8.1.3 ISS - on & orient known (req), 8.1.3 & sec 13 SCS - on (desired), 8.4.2		Provides total attitude monitoring and attitude control capability. Minimum impulse control using RHC available (SCS & G&N) for sighting mark target alignment.
	If Soyuz or star tkr		If Soyuz sun sensor or star tracker are to be used as source of sighting data.
	P50 - completed ATM - solar inertial (req)		If valid transformation not previously established via P50.
CDR	CMC ATT - IMU (verify) LOGIC 2/3 PWR - on (up)	1 7	Required for control and display functions if SCS - on option not selected.
	Optics - on (req, P52), 8.1.4 COAS - calib (req, P54), 13.1.8		Optics required for P52; COAS used for P54.

NORMAL/BACKUP

STA/T	STEP	PROCEDURE	PANEL	REMARKS
AC		Att Cont (req), 7.1		Allows maneuvering, and provides inertial stability of CSM to ensure accuracy of alignments.
		DAP - Load & activate (req), 8.2.1 or 2		R03 or R04.
		Tot Att Disp (req), 7.2.5		Both ISS and GDC attitude displays recommended for monitoring of IMU coarse align and SC motion.
CP	1	If MINKEY auto call Go to 4	2,140	P52 automatically called by MINKEY controller for pulse torquing during NPC sequence.
	or	Key V37E 52E/54E Go to 2		
		Poss PROG alarm		R02 (8.1.15).
	2	FL V04 N06		If preferred orientation defined, R2 = 00001. Otherwise R2 = 00003 (REFSMMAT alignment).
		Option code 00001 Option 0000X		Options available are: 00001 - Preferred (operator ensures preferred orientation defined) 00002 - Nominal 00003 - REFSMMAT
		Accept PRO Reject Key V22E Load desired option		
		a. If 00001, go to 4		
	or	b. If 00002, go to 3		
	or	c. If 00003, go to 8		
	3	FL V06 N34 GET align 00XXX. HRS 000XX. MIN 0XX.XX SEC		GET align - Time at which nominal orientation defined. Display initially 0, 0, 0. If this value accepted, nominal orientation will be defined for GET align automatically selected as present time.

STA/T	STEP	PROCEDURE	PANEL	REMARKS
CP		Accept PRO	2,140	
		Reject Key V25E Load desired GET align		
	4	FL V06 N22 R, P, Y XXX.XX DEG		
		Accept PRO, go to 6		
		or If P52 plane change PRO, go to 5		Occurs when P52 automatically called for plane change torquing.
		Reject Desired att control mode, 7.1 Mnvr SC Key V32E		To obtain acceptable MGA. V32E recycles to update gimbal angle display.
		or Key V37E XXE Exit P52/P54		
	5	FL V50 N25 00020 (perform NPC torquing)		Allows option to bypass pulse torquing.
		Accept CMC MODE - FREE		Prevents jet firing (SC rotation) during gyro torquing.
		PRO		If PRO (pulse torquing) done prior to burn, must key PRO (to establish original alignment) after burn (PCFLAG is reset on exit from P52).
		V16 N20 (present gmbl angles) R, P, Y XXX.XX DEG		

STA/T STEP	PROCEDURE	PANEL	REMARKS
CP	NPC torque (preburn) exit P52, go to 12.2.1/12.2.2		CMC computes and torques gyros for NPC burn.
	NPC torque (postburn) exit P52		
	Reject ENTR	2,140	Controller selects P41 for burn. Do not ENTR if first pulse torquing done and this is second pass.
	Poss PROG alarm Key V05 N09E (to verify alarm) 00402 (honor 2nd NPC torque request) KEY REL Recycle 5		If first pulse torquing done, PCFLAG reset on exit from P52 making it imperative that second pulse torquing be done.
6	FL V50 N25 00013 (coarse align or pulse torque)		
	Coarse align PRO, go to 7		Selects coarse align R50 and allows auto optics positioning.
	Pulse torque ENTR		To pulse torque gyros. Bypasses R50 and auto optics positioning.

STA/T	STEP	PROCEDURE	PANEL	REMARKS
CP		V16 N20 (present gmbl angles) R, P, Y XXX.XX DEG	2,140	If it appears that IMU will be torqued into gimbal lock, maneuver should be performed to avoid condition. If SC CONT at CMC and CMC MODE at AUTO or HOLD, the DAP will maneuver vehicle to follow platform as it moves. If N93 used for display, scaling of N93 will not remain XX.XXX. Initially, N93 will display proper values; thereafter, R2, then R3, and finally R1 will diminish to zero as each gyro axis is torqued.
		Go to 21		
		(R50, Coarse Align Routine)		During coarse alignment, if SC CONT at CMC and CMC MODE at AUTO or HOLD, DAP will maneuver vehicle to follow platform as it moves.
	7	Verify coarse align complete NO ATT lt - on, then out Mon ball motion		If required gimbal angle change <1 degree, IMU will not be coarse-aligned.
	8	FL V50 N25 00015 (trgt acq)		
		a. For CMC assist in sel Desired att cont mode, 7.1 Mnvr to acq trgt		After target acquisition, SCS minimum impulse operation desirable for minimum fuel consumption and reduction of vehicle rates to minimum.
		PRO		CMC performs target selection routine. However, for P54, since primary optics are not being used, selected stars may not be acceptable for backup optics sightings.

NORMAL/BACKUP

STA/T STEP	PROCEDURE	PANEL	REMARKS
CP	Poss FL V05 N09 00405 (accept pair not avail) Mnvr until suitable trgt acq PRO, go to 9	2,140	
	or Key V32E, recycle 8		
or	b. To bypass CMC sel ENTR		Crew manually acquires target.
9	FL V01 N70 Trgt code OOCDE		C - Source of sighting data 0 - CSM optics 1 - Soyuz sun sensor 2 - Soyuz star tracker
	Accept If P52 & C = 0 OPT ZERO - OFF	122	
	OPT MODE - as desired PRO	2,140	DE - Target (celestial body) codes: 00 - Planet (any planet except Earth) 01 to 45 - Star 46 - Sun 47 - Earth
	If P52 & C ≠ 0 (or P54) PRO		
	Poss OPR ERR Recycles disp		Target code negative, >47 or if C = 1 and CDE ≠ 146.
	Reject Key V21E Load desired code		

STA/T STEP	PROCEDURE	PANEL	REMARKS
CP	For P52 If C = 0 & DE ≠ 00 & OPT MODE - CMC, go to 11	122	
	or OPT MODE - MAN, go to 12		
	If C ≠ 0 & DE ≠ 00, go to 12		
	For P54 If DE ≠ 00, go to 13		
10	FL V06 N88 (planet only) X, Y, Z .XXXXX	2,140	X, Y, Z - Components of planet unit position vector at present time.
	Accept If P52 PRO		
	If OPT MODE - MAN or C ≠ 0, go to 12	122	
	If P54 PRO, go to 13	2,140	
	Reject Key V25E Load desired data		Use on-board tables to determine planet position at present time.
	(R52, Auto Optics Positioning)		Points SLOS of optics at selected target.
11	V06 N92 (desired opt angles) SA XXX.XX DEG TA XX.XXX DEG		Optics will drive to acquire selected target. No display if R52 reselected after R53 called.
	Poss FL V05 N09 (2 sec priority) 00404 (TA >90°)		

STA/T	STEP	PROCEDURE	PANEL	REMARKS
CP		a. Desired att cont mode, 7.1 Mnvr to reduce TA		If required optics angles not being displayed, key V16 N92E to obtain display.
		PRO	2,140	
		or b. Key V34E FL V37 Key XXE		R00.
		If TA >50° & <90° Desired att cont mode, 7.1		If TA >50° and <90°, trunnion driven to upper limit (=49.7754°) and held at this angle.
		Mnvr to reduce TA		If required optics angles not being displayed, key V16 N92E to obtain display.
		When sighting mrks are desired OPT MODE - MAN	122	Calls R53. To regain auto optics positioning, select OPT MODE - CMC (prior to completion of R53).
		(R53, Sighting Mark Routine)		
	12	FL V51 (please mark) Ctr trgt in SXT	2,140	SCT may be used if reduced accuracy acceptable.
		MARK (on trgt), go to 15	122	If star tracker used, record star tracker angles at time of MARK for input to N14.
		To terminate Key V37E XXE	2,140	
		or Key V34E FL V37 Key XXE		

STA/T STEP	PROCEDURE	PANEL	REMARKS
CP	Poss PROG alarm Key V05 N09E (to verify alarm) 31211 (illegal interrupt of ext verb) When mrking complete Reselect ext verb	2,140	Alarm generated if mark system busy or if extended verb active.
	(R56, Alternate LOS Sighting Mark Routine)		To perform sighting marks using COAS.
13	FL V06 N94 SA XXX.XX DEG TA XX.XXX DEG Accept PRO Reject Key V24E Load desired SA & TA		Values obtained from COAS Calibration, 13.1.8. Nominal SA and TA for COAS sightings are: SA - 000.00 DEG TA - 57.470 DEG
14	FL V53 (please mrk) RHC - ctr trgt in COAS reticle ENTR		SCS minimum impulse mode recommended. CMC interprets ENTR as a mark. An inadvertent PRO instead of ENTR will recycle FL V53. If star tracker used, record star tracker angles at time of MARK for input to N14.
15	FL V50 N25 00016 (term mrks)		

STA/T STEP	PROCEDURE	PANEL	REMARKS
CP	Accept PRO	2,140	An unsatisfactory mark may be rejected by keying MARK REJ pushbutton (P52) or ENTR (P54) anytime prior to terminating marking sequence. In P52, possible program alarms if marks rejected without prior marks or if surplus marks made. In P52, due to coding, noun and R1 not blanked on recycle.
	Reject If P52, MARK REJ pb - push, return to 12		
	If P54, ENTR, return to 14		
16	FL V01 N71		C - Source of sighting data 0 - CSM optics 1 - Soyuz sun sensor 2 - Soyuz star tracker
	Trgt code OOCDE		
	Accept PRO		DE - Target (celestial body) codes: 00 - Planet (any planet except Earth) 01 to 45 - Star 46 - Sun 47 - Earth
	Poss OPR ERR Recycles disp		Target code negative, >47 or if C = 1 and CDE ≠ 146.
	Reject Key V21E Load trgt code		
	If C = 0 or 1 & DE ≠ 00 For trgt 2 Return to 9		
	If C = 2, go to 17		

STA/T	STEP	PROCEDURE	PANEL	REMARKS
CP	17	FL V06 N14 (tracker angles) OGA XXXXX. ARC MIN IGA XXXXX. ARC MIN Accept PRO Reject Key V24E Load desired tracker angles For trgt 2 (DE ≠ 00) Return to 9	2,140	
	18	FL V06 N88 (planet only) X, Y, Z .XXXXX Accept PRO Reject Key V25E Load desired data For trgt 2 Return to 9 (R54, Sighting Data Display Routine)		This flash will occur only if marks are made on a planet. X, Y, Z - Components of planet unit position vector at present time. Use on-board tables to determine planet position vector at present time. Test accuracy of pair of target sightings.
	19	FL V06 N05 Sighting angle diff XXX.XX DEG Sighting angle XXX.XX DEG Accept PRO Reject Key V32E, go to 21		

STA/T STEP	PROCEDURE	PANEL	REMARKS
	(R55, Gyro Torquing Routine)		Calculates and displays gyro torquing angles for final (fine) alignment of inertial platform and to torque gyros.
CP 20	FL V06 N93 (Δ gyro angles) X, Y, Z XX.XXX DEG	2,140	X, Y, Z Gyro - Angle through which each gyro must be torqued to obtain desired orientation. Once this step is complete, CMC will reset preferred orientation flag. If SC CONT at CMC and CMC MODE switch is at AUTO or HOLD during R55, DAP will maneuver CSM to follow platform as it moves.
	Accept CMC MODE - FREE PRO (gyros torqued)		Pulse IRIGS through desired angle.
	Reject V32E, go to 21		Do not torque gyros.
	or Key V37E 00E, go to 23		
21	FL V50 N25 00014 (fine align check)		
	Accept PRO, return to 8		PRO repeats target sightings (R52 & R53) for P52; (R56) for P54; sighting data test (R54), and gyro torquing (R55) to verify accuracy of alignment.
	Reject ENTR		
22	FL V37 Key XXE		R00.
23	If P52 Opt Pwr Down, 8.1.4		

STA/T	STEP	PROCEDURE	PANEL	REMARKS
	13.1.4	(P55) Soyuz Star Tracker Gimbal Angle Program		Computes and displays Soyuz star tracker gimbal angles required to acquire a specified star. This program may not be usable on ASTP if the Soyuz does not have a star tracker.
		CMC - on (req), 8.1.3 ISS - on & orient known (req), 8.1.3 & sec 13 SCS - on (desired), 8.4.2		Option 1. Provides total attitude monitoring and attitude control capability. Minimum impulse control using RHC available (SCS & G&N) for sighting mark target alignment.
		P50 - completed		Operation of P55 assumes P50 previously selected to establish required relative orientation matrix.
AC		CMC ATT - IMU (verify) LOGIC 2/3 PWR - on (up)	1 7	Required for control and display functions if SCS - on option not selected.
		Opt - on (req), 8.1.4		Option 2.
		Att Cont (req), 7.1		Allows maneuvering, and provides inertial stability of CSM to ensure accuracy of alignments.
		Soyuz - solar inertial (req)		Option 2.
CP	1	Key V37E 55E		
	2	FL V04 N06 00013 (ref option) 0000X (desired option)		CMC initializes R2 = 00001.

NORMAL/BACKUP

STA/T	STEP	PROCEDURE	PANEL	REMARKS
CP		(X = 1 or 2)		Reference options are as follows: R2 = 00001 - IMU. 00002 - Optics and Soyuz sun sensor.
		Accept PRO Option 1, go to 7 Option 2, go to 3 Reject Key V22E Load desired option	2,140	CMC initializes N70/N71 star code to 46 (sun).
		If option 1 Poss PROG alarm		R02 (8.1.15).
		(R53 - Sighting Mark Routine)		
	3	FL V51 (please mrk) OPT ZERO - OFF OPT MODE - MAN Ctr trgt in SXT	122	Required for centering target using OHC. SCT may be used if reduced accuracy acceptable.
		MARK (on trgt)		MARK REJ with no marks produces 00110 alarm. PRO recycles FLV51.
		To terminate Key V37E XXE	2,140	
		or Key V34E FL V37 Key XXE		

(P55) SOYUZ STAR TRACKER GIMBAL ANGLE PROGRAM

STA/T STEP	PROCEDURE	PANEL	REMARKS
CP	Poss PROG alarm Key V05 N09E (to verify alarm) 31211 (illegal interrupt of ext verb) When mrking complete Reselect ext verb	2,140	Alarm generated if mark system busy or if extended verb active.
4	FL V50 N25 00016 (term mrks) Accept PRO Reject MARK REJ, return to 3		Due to coding, noun and R1 not blanked on recycle.
5	FL V01 N71 Trgt code 00CDE Accept PRO DE ≠ 00, go to 7 C = 2, go to 9		CMC initializes C to 0 (optics) and DE to 46 (sun). C - Source of sighting data 0 - CSM optics 1 - Soyuz sun sensor (not significant for P55) 2 - Soyuz star tracker (not significant for P55) DE - Target (celestial body) codes: 00 - Planet (any planet except Earth) 01 to 45 - Star 46 - Sun 47 - Earth
	Poss OPR ERR Recycles disp		Target code negative, >47 or if C = 1 and CDE ≠ 146.

NORMAL/BACKUP

STA/T	STEP	PROCEDURE	PANEL	REMARKS
CP		Reject Key V21E Load trgt code	2,140	
	6	FL V06 N88 (planet only) X, Y, Z . .XXXXX Accept PRO Reject Key V25E Load desired data		This flash will occur only if marks were made on a planet. X, Y, Z - Components of planet unit position vector at present time. Use on-board tables to determine planet position vector at present time.
	7	FL V01 N70 Trgt code 00CDE Accept PRO DE ≠ 00, go to 9 Reject Key V21E Load trgt code Poss PROG alarm Key V05 N09E (to verify alarm) 00107 (excessive tracker angles) Poss OPR ERR Recycles disp		Source code C must be zero. Any non-zero digit turns on OPR ERR lt. C - Source of sighting data 0 - CSM optics 1 - Soyuz sun sensor (not significant for P55) 2 - Soyuz star tracker (not significant for P55) DE - Target (celestial body) codes: 00 - Planet (any planet except Earth) 01 to 45 - Star 46 - Sun 47 - Earth Target code negative, >47 or C ≠ 0.
	8	FL V06 N88 (planet only) X, Y, Z .XXXXX Accept PRO Reject Key V25E Load desired data		

STA/T STEP	PROCEDURE	PANEL	REMARKS
CP	Poss PROG alarm Key V05 N09E (to verify alarm) 00107 (excessive tracker angles)	2,140	
9	FL V06 N14 (tracker angles) OGA XXXXX. ARC MIN IGA XXXXX. ARC MIN Accept PRO Reject Key V32E, return to 7		
10	FL V04 N19 OGA OSABC IGA OODEO Accept PRO Reject Key V32E, return to 7		Tracker azimuth: S - sign (0 = positive, 1 = negative) ABCDE - absolute value (octal equivalent of R1 of N14).
11	FL V37 Key XXE		
12	Opt Pwr Down, 8.1.4		

STA/T	STEP	PROCEDURE	PANEL	REMARKS
		13.1.5 (V40) Zero ICDU Extended Verb		o Ensures synchronization between ISS CDU counters and CDU counters in CMC.
		CMC - on (req), 8.1.3 ISS - on (req), 8.1.3		o Terminates IMU coarse align mode and enters fine align mode (inertial IMU).
CP	1	Key V40E NO ATT lt - OFF Wait 15 sec	2,140	
		Poss OPR ERR		If IMU stall routine in use.
		Poss PROG alarm Exit routine Key V05 N09E (to verify alarm) 00206 (zero encode not allowed) Key V41 N20E, 13.1.6		If ISS in coarse align mode with gimbal lock.

STA/T	STEP	PROCEDURE	PANEL	REMARKS
	13.1.6	(V41 N20) Coarse Align ICDU Extended Verb		Coarse aligns IMU to gimbal angles specified by crew.
		CMC - on (req), 8.1.3 ISS - on (req), 8.1.3		
CP	1	Key V41 N20E	2,140	
		Poss OPR ERR Exit coarse align		Occurs if another extended verb active.
	2	FL V21 N22 (new ICDU angles) R, P, Y XXX.XX DEG		Registers initially blank.
		Load desired angles		
	or	Key V33E		6.1.3, note 3m.
		DSKY - V41 NO ATT lt - on		NO ATT lt will remain on even after gimbals have been driven to specified angles.
		Poss PROG alarm Key V05 N09E (to verify alarm) 00211 (error >2°)		Present and specified gimbal angles may be compared by keying V16 N20E and V16 N22E. Alternate method is to key V62E (Mode 2) to display difference between N20 and N22 on FDAI error needles.
		To recover from PROG alarm Key V41 N20E		If IMU stall routine in use.
		Poss OPR ERR Exit coarse align		
	3	To extinguish NO ATT lt & term coarse align Key V40E Wait 15 sec		Zero ICDU extended verb, 13.1.5.
		or V42E		Torque gyros extended verb, 8.3.2.

NORMAL/BACKUP

STA/T	STEP	PROCEDURE	PANEL	REMARKS
	13.1.7	(V41 N91) Coarse Align OCDU Extended Verb		Drive optics to shaft and trunnion angles specified by crew. Not permitted from start of drive test until end of burn. (Ref note opposite 00117 alarm, step 3.)
		CMC - on (req), 8.1.3 Opt Pwr Up (req), 8.1.4		
CP	1	Key V37E 00E	2,140	V41 N91 from P00 only.
	2	OPT ZERO - OFF OPT MODE - CMC	122	
	3	Key V41 N91E	2,140	
		Poss OPR ERR Exit coarse align OCDUs		Occurs if another extended verb active.
		Poss PROG alarm Key V05 N09E (to verify alarm) 00115 (OPT MODE not CMC) OPT MODE - CMC	122	OPR ERR lt on.
		or 00117 (V41 N91 not avail) Exit coarse align	2,140	This alarm code indicates that OCDUs are being used by TVC DAP or gimbal drive test and that this procedure cannot be performed. May occur from start of drive test until end of burn (not expected since V41 N91 is restricted to P00).
	4	FL V21 N92 (new OCDU angles) SA XXX.XX DEG TA XX.XXX DEG		Registers initially blank.
		Load desired SA & TA		
		or Key V33E		6.1.3, note 3m.
	5	DSKY - V41		Key V16 N91E to monitor optics angles.
	6	Opt Pwr Down, 8.1.4		

(V41 N91) COARSE ALIGN OCDU EXTENDED VERB

STA/T	STEP	PROCEDURE	PANEL	REMARKS
	13.1.8	Inflight COAS Calibration		Provides method for in-flight calibration of COAS (i.e., equivalent shaft and trunnion angles). Spare COAS light bulbs (2) are stowed in volume U3. When installing COAS on window mount, align (rotate COAS barrel to detent) as indicated by arrow on decal.
		CMC - on (req), 8.1.3 ISS - on & orient known (req), 8.1.3 & sec 13 SCS - on (req), 8.4.2		
AC		CMC ATT - IMU (verify) .05 G sw - OFF (verify) COAS installed	1	
		COAS PWR - on (up)	15	6.1.1, note 15.
		COAS filter installed (req)		Filter used to reduce glare of reticle image when sighting on low intensity targets.
	1	Opt Pwr Up, 8.1.4		
	2	Sel Tot Att Disp, 7.2.5		
CP	3	Key V37E 52E	2,140	
		Poss PROG alarm		R02 (8.1.15).
	4	FL V04 N06 Option code 00001		If preferred alignment flag is set, R2 will display 00001. Otherwise, R2 will display 00003 (REFSMMAT alignment).
		Option 0000X		Options available are: 00001 - Preferred (operator ensures preferred orientation defined) 00002 - Nominal 00003 - REFSMMAT
		Sel REFSMMAT orient (V22E, 3E) PRO		

STA/T	STEP	PROCEDURE	PANEL	REMARKS
CP	5	FL V50 N25 00015 (trgt acq) Att Cont Mode, 7.1 Mnvr to acq trgt in COAS ENTR	2,140	Target (celestial bodies).
	6	FL V01 N70 Trgt code 00CDE OPT ZERO - OFF OPT MODE - CMC Reject Key V21E Load trgt code of trgt centered in COAS Accept PRO Poss OPR ERR Recycles display If trgt not a planet, go to 8	122 2,140	C - Source of sighting data 0 - CSM optics 1 - Soyuz sun sensor 2 - Soyuz star tracker DE - Target (celestial body) codes: 00 - Planet (any planet except Earth) 01 to 45 - Star 46 - Sun 47 - Earth Target code negative, >47, or if C = 1 and CDE ≠ 146.
	7	FL V06 N88 (planet only) X, Y, Z .XXXXX Accept PRO Reject Key V25E Load desired data		X, Y, Z - Components of planet unit position vector at present time.

STA/T	STEP	PROCEDURE	PANEL	REMARKS
		(R52, Auto Optics Positioning Routine)		
CP	8	V06 N92	2,140	Display will be updated every ≈0.5 second.
		SA XXX.XX DEG		
		TA XX.XXX DEG		
		When trgt centered in COAS & SA & TA relatively constant Key VERB (to freeze disp)		
		Accept Rcd SA & TA for use in P20/P53/P54		
		Reject KEY REL Repeat 8		
	9	Opt Pwr Down, 8.1.4		
AC		COAS PWR - OFF	15	
	10	Sel new prog		

STA/T	STEP	PROCEDURE	PANEL	REMARKS
		13.2 SCS ALIGNMENTS		
		13.2.1 Alternate SC Inertial Attitude Determination and GDC Alignment		
		SCS - on (req), 8.4.2		
AC		CMC ATT - IMU (verify) .05 G sw - OFF (verify)	1	
	1	Opt Pwr Up, 8.1.4		
	2	Sel Tot Att, Att Err & Rate Disp for SCS, 7.2		If IMU off, only FDAI 1 need be powered or selected.
	3	Sel SCS Att Hold/Rate Cmd, 7.1.4		For fuel conservation, max deadband preferred until stars obtained.
CP	4	Obtain 2 stars in SCT Sel Opt Cont, 7.5.2 OHC - ctr star on R-line OHC - ctr star in FOV Hold star 1 in ctr of FOV Hold star 2 on R line	121	 OHC - Optics hand control. Final adjustment required OPT COUPLING - DIRECT. Minimum impulse control can be used to allow positioning of stars on R line.
AC	5	BMAG MODE (3) - RATE 2 ATT DBD - MIN BMAG MODE (3) - ATT 1/RATE 2	1	Stars must be kept aligned while BMAGs caged.
CP	6	Read & rcd angles on trun & shft ind(s) & xmit with star data to STDN	121	

STA/T	STEP	PROCEDURE	PANEL	REMARKS
CP	7	Obtain inertial att values for ATT SET tw from STDN	121	
	8	Align GDC to STDN values, 7.3		
	9	Opt Pwr Down, 8.1.4		

STA/T	STEP	PROCEDURE		PANEL	REMARKS
	13.2.2	Inplane GDC Alignment			Provides method for aligning SCS attitude reference system in orbital plane (+Y axis of reference along V x R). This allows use of ORDEAL on FDAI 2 with IMU out of plane.
		CMC - on (req), 8.1.3 ISS - on & orient known (req), 8.1.3 & sec 13 SCS - on (req), 8.4.2			
AC		CMC ATT - IMU (verify)		1	
	1	Sel Tot Att Disp, 7.2.5 FDAI SEL - 1/2			
CP	2	Key V37E 52E		2,140	
		Poss PROG alarm			R02 (8.1.15).
	3	FL V04 N06			
		Option code	00001		Options available are: 00001 - Preferred (operator ensures preferred orientation defined) 00002 - Nominal 00003 - REFSMMAT
		Option	0000X		
		Select nom option Key V22E 2E			
		PRO			
	4	FL V06 N34			
		GET align	00XXX. HRS 000XX. MIN 0XX.XX SEC		GET align - Time at which vehicle position and velocity vectors selected to define IMU local vertical orientation.

INPLANE GDC ALIGNMENT

STA/T	STEP	PROCEDURE	PANEL	REMARKS
CP		Key V25E Load present time plus 10 min	2,140	
	5	Establish Att Cont, 7.1 Damp veh rates PRO		Selected to prevent drift between gimbal angle calculation and GDC alignment.
	6	FL V06 N22 R, P, Y XXX.XX DEG		IMU gimbal angles for desired IMU orientation at present SC attitude.
AC	7	ATT SET tw - adj to Euler angles disp on DSKY	1	
	8	Align GDC, 7.3		
	9	Sel new program		

NORMAL/BACKUP

STA/T	STEP	PROCEDURE	PANEL	REMARKS
		13.2.3 Backup GDC Alignment With COAS		Aligns GDC without IMU, CMC or optics.
		SCS - on (req), 8.4.2 CMC - off or STBY (req)		A more accurate alignment can be performed if COAS calibration procedure, 13.1.8, has been performed earlier and calibration information provided to STDN for use in computation of R, P and Y ALIGN.
		COAS - installed		6.1.1, note 15.
AC		COAS PWR - on (up)	15	
		.05 G sw - OFF (verify)	1	
		CMC ATT - IMU (verify)		
CP	1	Rcd following data from STDN GDC Align Values (step 2) R ALIGN ____, P ALIGN ____ Y ALIGN ____		
		Boresight star data (step 13) Boresight star SPA ____° SXP ____°		SPA - Sight pitch angle SXP - Star X position
		Nav stars Prim star ____ (step 5) Sec star ____ (step 8) Star diff angle ____° (step 7)		Star difference angle cannot exceed 35° since this is maximum COAS field of view in pitch.
	2	SCS att set for FDAI 1, 7.2.4		
AC		ATT SET tw - set R, P, Y ALIGN		
	3	Set reticle to 0° pitch		

STA/T	STEP	PROCEDURE	PANEL	REMARKS
AC	4	Sel SCS att cont mode, 7.1		
	5	Mnvr to position prim star on crosshairs of COAS reticle		
	6	Establish att hold with min P & Y dbd		
	7	Pitch COAS reticle up Star Angle Diff value		
	8	Roll SC to place sec star on pitch axis of COAS reticle		
	9	Establish att hold with min roll dbd		
	10	Repeat 3 through 9 as necessary		
	11	Align GDC, 7.3 GDC ALIGN pb - push, when stars positioned, until err null on FDAI 1	1	
	12	Mnvr to ΔV att ATT SET tw - set to ΔV att Mnvr Null errors on FDAI		
	13	Perform Boresight Star ck		
	14	COAS PWR - OFF	15	

STA/T	STEP	PROCEDURE	PANEL	REMARKS
		13.3 G&C ALIGNMENTS		
		13.3.1 Backup GDC and/or IMU Alignment		Aligns GDC and/or IMU without CMC.
		SCS - on (req), 8.4.2		
		CMC - off or STBY (for step 3a)		
		COAS installed		6.1.1, note 15.
AC		COAS PWR - on (up)	15	
		.05 G sw - OFF (verify)	1	
		CMC ATT - IMU (verify)		
CP	1	Rcd following data from STDN		
		GDC Align Values (step 8)		
		R ALIGN_____, P ALIGN_____,		
		Y ALIGN_____		
		SXTS data (step 10)		SXTS - Sextant star.
		SXTS_____		
		SHAFT_____°		
		TRUN_____°		
		Boresight star data (step 4)		
		Boresight star_____		
		SPA_____°		SPA - Sight pitch angle.
		SXP_____°		SXP - Star X position.
				0° and 0° allows SC to be rolled about boresight star in 7.
		Nav stars (step 7)		
		Prim star_____(0° mark on R line of SCT reticle)		
		Sec star_____(R line)		

STA/T	STEP	PROCEDURE	PANEL	REMARKS
CP	2	ISS att set for FDAI 1, 7.2.4		
	3	Cage IMU		This step is bypassed, if only GDC aligned.
		If IMU in stby IMU PWR - on (up) (IMU automatically cages)	100	Guarded. Occurs only if CMC off, or in STBY.
		If IMU powered up		
		a. IMU PWR - OFF Wait 5 min for gyros to run down IMU PWR - on (up)		Guarded. Guarded.
AC	or	b. ATT SET tw - set to 0°, 0°, 0° Mnvr SC to 0°, 0°, 0° & null FDAI 1 errors	1	IMU gimbal angles should be 0±5° before caging to avoid damaging gyros.
		IMU CAGE - on (up) & hold until 11		Guarded.
	4	Sel desired SCS Att Cont Mode, 7.1, & mnvr to position boresight star in COAS		
	5	Opt Pwr Up, 8.1.4		
CP	6	Set opt to 0° shft & 352.5° trun, 7.5		0° shaft and 352.5° trunnion places 0° mark of SCT reticle along +Zsc axis.
		OPT PWR - OFF	100	Eliminates optics drift.

STA/T	STEP	PROCEDURE	PANEL	REMARKS
CP	7	Mnvr to position stars in SCT		Roll SC around boresight star to acquire navigation stars. After positioning primary star on 0° mark, SC may be yawed about this star to place secondary star on R line.
AC	8	Align GDC ATT SET tw - set to R, P, Y ALIGN ATT SET - GDC GDC ALIGN pb - push when stars positioned, until err null on FDAI 1	1	ELEC PWR - GDC/ECA (required for GDC ALIGN) satisfied by SCS Power Up, 8.4.2.
	9	Mnvr to ΔV att ATT SET tw - set to ΔV att Mnvr Null err on FDAI 1		
	10	Perform SXTS ck & adj SC att if necessary		With optics set to proper shaft and trunnion angles, and SC at ΔV attitude, specified star should appear in SXT.
	11	Uncage IMU IMU CAGE - on (up) and rel If 3b was used IMU CAGE - rel		This frees IMU at 0°, 0°, 0°. (For deorbit, GDC will be at 180°, 180°, 0°.)
	12	Opt Pwr Down, 8.1.4 COAS PWR - OFF	15	

BACKUP GDC AND/OR IMU ALIGNMENT

Basic Date 20 June 1974 Change Date 15 Oct 1974 Page 14-1

STA/T	STEP	PROCEDURE	PANEL	REMARKS
		14.0 ENTRY		For general G&C operating data, refer to operating notes, 6.1.
		14.1 DEORBIT AND ENTRY VEHICLE PREPARATION		
		(Proced in 14.1.1 thru 14.1.4 not designated as "req" are optional)		Vehicle preparation applies to any deorbit (SPS or RCS, pure or hybrid, whether G&N, SCS or manually controlled) and should be done prior to deorbit thrust to minimize crew workload between deorbit and entry.
		14.1.1 General System Management		
CP	1	Open cool control atten pnl SEC EVAP H2O CONT - AUTO Close cool control atten pnl	382	**Covers panel 382.**
	2	Obtain update from STDN		
DP	3	Configure TLM (req) TAPE RCDR FWD - off (ctr) PCM BIT RATE - HI UP TLM CMD - RSET, then NORM	3	After STDN dumps and rewinds tape recorder and returns DSE control to crew at last contact prior to deorbit, TAPE RCDR FWD switch placed to off (ctr) and PCM BIT RATE switch to HI.
AC	4	SECS logic check cb SECS ARM (2) - close cb ELS/CM-SM SEP (2) - close ELS LOGIC - on (up) ELS AUTO - AUTO After STDN AOS SECS LOGIC (2) - on (up) Report logic arm STDN confirm GO for PYRO ARM (as req) SECS LOGIC (2) - OFF cb SECS ARM (2) - open cb ELS/CM-SM SEP (2) - open ELS LOGIC - OFF ELS AUTO - MAN	8	

NORMAL/BACKUP

STA/T	STEP	PROCEDURE	PANEL	REMARKS
	5	Propulsion Systems checks, 5.2.1 thru 5.2.3		
	6	Cryo Press - Qty & EPS DC & AC checks, 5.3.1, 5.3.3, & 5.3.4 Verify PYRO BAT A & B >35.0 vdc		
		xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx		
		If PYRO BAT A(B) <35.0 vdc		
DP		cb PYRO A(B)/SEQ A(B) - open	250	
		cb BAT BUS A(B) TO PYRO BUS - close		
		xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx		
	7	ECS Mon Check, 5.4.1 & Prim Gly Evap operation, 5.4.17		
	8	Sec Gly Evap operation		
CP		ECS IND sel - SEC		
		SEC COOL PUMP - AC2		
		GLY DISCH PRESS - 39-52 psig		
		SEC COOL EVAP - EVAP		
		SEC GLY EVAP OUT TEMP - 38-50.5°F		
		ECS IND sel - PRIM		
	9	Stow loose gear (req)		
	10	Dry tunl		If necessary, absorb water with towel. Condensed moisture in tunnel rains on crew during thrusting.

STA/T	STEP	PROCEDURE	PANEL	REMARKS
CP	11	CMC Self-Check, 8.1.8		
	12	DSKY Condition Lt Test, 8.3.1		
	13	C&WS Oper Check, 5.5.1		
	14	P52 IMU Align, 13.1.3		
	15	Verify COAS locked in stowage mount		
		14.1.2 RSI Test and Alignment		Permits testing EMS roll stability indicator (RSI) and positioning to desired orientation for entry.
AC		ELEC PWR - GDC/ECA	7	
		ATT SET - GDC	1	
	1	EMS ROLL - on (up) GDC ALIGN pb - push, hold ATT SET YAW tw - Adj thru 45° angle, observe RSI tracks ≈45°, then position RSI GDC ALIGN pb - rel EMS ROLL - OFF		Avoid FDAI gimbal lock region.
	2	ATT SET YAW tw - reset GDC ALIGN pb - push (32 sec max)		This step required only if GDC was aligned and realignment required.
		14.1.3 EMS Deorbit and Entry Test		Light illumination other than those listed indicates malfunction. ΔV/EMS SET switch slews G-V scroll and sets RNG indicator. [Lift vector up light (G >0.2) and down light (G <0.2) for entry from lunar mission only.]

NORMAL/BACKUP

STA/T	STEP	PROCEDURE	PANEL	REMARKS
	1	Init EMS prep		
AC		EMS FUNC - OFF (verify)	1	
		cb EMS (2) - close	8	
		EMS MODE - STBY	1	
	2	EMS FUNC - EMS TEST 1 (CCW)		Test 1 checks lower trip-point of .05 G comparator.
		Wait 5 sec		
		Adj alphanumeric brightness (option)		
	3	EMS MODE - NORM		Ten seconds should be allowed to verify no malfunctions. No light on before or after 10 seconds.
		Wait 10 sec minimum		
		All ind lts - out		
		RNG ind - 0.0		
		Slew scroll until hairline superimposed on notch in next self-test pattern		EMS scroll can be slewed only one inch in reverse.
	4	EMS FUNC - EMS TEST 2 (CCW)		Test 2 checks .05 G comparator upper trip-point. No other light on before or after 10 seconds.
		.05 G lt - on		
		Wait 10 sec		
		All other lts out		
	5	EMS FUNC - EMS TEST 3 (CCW)		Test 3 checks corridor verification circuitry associated with lift vector down light.
		.05 G lt - on		
		Lift vector dn lt - on (10 sec after .05 G lt)		G <0.2.
		Set RNG ind to 58.0 NM $\pm$0.0		RNG indicator displays minus sign for negative numbers or no sign for positive numbers in most significant digit.

EMS DEORBIT AND ENTRY TEST

STA/T	STEP	PROCEDURE	PANEL	REMARKS
AC	6	EMS FUNC - EMS TEST 4 (CCW) .05 G lt - on (all others out) G-V trace (during 10 sec period) within test pattern After 10 sec, G-V trace stops at lower right corner of test pattern at ≈9 G RNG ind (during 10 sec period) counts toward zero. After 10 sec, stops at ≈0.0±0.2 NM	1	Test 4 checks range-to-go integrator circuits, range-to-go indicator, G-V servo circuits, G-V plotter.
	7	EMS FUNC - EMS TEST 5 (CCW) .05 G lt - on Lift vector up lt - on (10 sec after .05 G lt) RNG ind - 0.0 Scribe traces vert line ≈9 G to 0.28±0.1 G & stops (trace within test pattern) Align G-V scroll to entry pattern (hairline on 37K fps line)		Test 5 checks corridor verification circuitry associated with lift vector up light and enables scroll slewing to start of entry pattern. After scroll set to <37K fps, reselecting EMS TEST 5 switch position not permitted; range integrator and scroll synchronization would be lost.
	8	EMS FUNC - RNG SET (CCW) G-V traces vert line ≈0.28 G to 0.0±0.1 G & stops		
	9	EMS FUNC - Vo SET (CCW) CAUTION Never slew scroll in increase direction more than 1500 fps. Ensures range integrator remains slaved to scroll velocity.		Scroll can be slewed only one inch in reverse. In Vo SET position, both initial velocity in range integrator and scroll velocity change simultaneously.

NORMAL/BACKUP

STA/T	STEP	PROCEDURE	PANEL	REMARKS
AC		Slew scroll until display index (arrow) aligned to predicted entry velocity	1	
	10	ΔV Test and Null Bias Check, 7.6.1		
	14.1.4	Systems Preparation		
		If suited Press Suit Circuit & PGA Check at 5.0 psia, 5.4.9		
ALL		Life vests - donned		
CP		EMER CAB PRESS sel - OFF	351	
CP	1	CM RCS temp check SYS TEST (2) - 6A, 6B, 6C, 6D, 5C, 5D	101	Checks CM RCS 12, 14, 16, 21, 24, and 25 jet injector valve temperatures, respectively.
		If lowest reading <3.9 vdc (28°F)		
AC		cb CM RCS HTRS (both) - close	8	
		cb RCS LOGIC (2) - close		
		CM RCS LOGIC - on (up)	1	
CP		CM RCS HTRS - on (up) for 20 minutes	101	Jet injector valve direct coils utilized for preheating jets.
	2	URINE DUMP - OFF		
	3	WASTE H2O DUMP - OFF		
	4	Align RSI & GDC, 14.1.2		
	5	Set FDAI 2 on ORB RATE & restow, 8.4.8		
	6	CM RCS heating completion (if accomplished) CM RCS HTRS - OFF		

STA/T	STEP	PROCEDURE	PANEL	REMARKS
	7	Configure entry bats (req)		
DP		cb MNA BAT C - close	275	
		cb MNB BAT C - close		
AC	8	Panel 8 - all cb closed (req) except	8	
		cb PL VENT FLT/PL - open		
		cb FLOAT BAG (all) - open		
		cb EDS (all) - open		
		cb CM RCS HTR (both) - open		
		cb DOCK PROBE (2) - open		
		cb SECS ARM (2) - open		
		cb ELS/CM-SM SEP (2) - open		
	9	Config RCS		(Deleted)
CP		SM RCS PRPLNT (4) - OPEN	2	OPEN position is momentary.
		SM RCS PRIM PRPLNT tb (4) - gray		Gray indicates quad fuel and oxidizer isolation valves open.
		SM RCS SEC PRPLNT tb (4) - gray		Gray indicates quad fuel and oxidizer isolation valves open.
		SM RCS PSM He - CLOSE		CLOSE position is momentary.
		SM RCS PSM He tb - bp		Barber pole indicates helium isolation valves in PSM closed.
		SM RCS PSM MANF ISOL vlv - CLOSE		
		SM RCS PSM MANF ISOL tb - bp (verify)		Barber pole indicates both fuel and both oxidizer isolation valves in PSM closed.

STA/T	STEP	PROCEDURE	PANEL	REMARKS
CP		RCS IND sel - A (B,C,D)	2	
		SM RCS IND sw - PRPLNT QTY		PSM quantity monitored during deorbit for possible required switchover to quad propellant.
		SM RCS PSM PRPLNT (4) - CLOSE		CLOSE position is momentary.
		SM RCS PSM PRPLNT tb (4) - bp		Barber pole indicates at least one PSM manifold to quad propellant (fuel or oxidizer) isolation valve closed for separation. Any position of PSM helium and manifold isolation switches acceptable.
		SM RCS QUAD He (4) - OPEN		OPEN position is momentary.
		SM RCS QUAD He tb (4) - gray		Gray indicates both helium tank isolation valves open in each quad.
	10	CM RCS activation (req)		
		cb SECS ARM (2) - close		
		After STDN AOS		
AC		SECS LOGIC (both) - on (up)	8	Lever lock.
		Report logic arm		
		After GO from STDN		
		SECS PYRO ARM (2) - on (up)		Lever lock.
CP		CM RCS PRPLNT (both) - on (up) (verify)	2	On position is momentary.
		CM RCS PRPLNT tb (both) - gray		Indicates fuel and oxidizer isolation valves open.
		CM RCS PRESS - on (up)		Guarded. On position is momentary.
		RCS IND sel - CM 1, then 2		
		CM RCS He PRESS ind - 3600-3800 psia (after 15 min)		Immediately after pressurization, He pressure may drop below 3600 psia.
		CM RCS MANF PRESS ind - 287-302 psia		
AC	11	SECS PYRO ARM (2) - SAFE	8	Lever lock.
CP		If SCS - select P00	2	
	12	Strut unlock lanyard (2) - unstow & attach handle ends to MDC (req)	Side hatch	
	13	Go to THRUSTING, sec 12		

STA/T	STEP	PROCEDURE	PANEL	REMARKS
	14.2	CM/SM SEPARATION		
DP	1	If SM RCS deorbit Configure & preload bats		Prepares for battery preloading prior to CM/SM separation and verifies batteries transferred to main buses. (Previously configured in SPS or Hybrid Deorbit Thrusting of 12.2.1, 12.2.3, 12.3.1 or 12.3.3.)
		CAUTION If either bat bus A(B) current fails to incr after cycling respective MN BUS TIE switch, configure bats to main buses using cb BAT C TO BAT BUS A(B)	250	Assumes reconfiguration BAT A(B) and BAT C to MNA(B). cb MNA(B) BAT C closed in Deorbit Entry Vehicle Preparation, 14.1.
		MN BUS TIE BAT A/C - on (up) Verify bat bus A current incr &/or bat volt decr MN BUS TIE BAT B/C - on (up) Verify bat bus B current incr &/or bat volt decr	5	Verification of current increase for appropriate battery bus via DC AMPS indicator (panel 3) confirms successful operation of main bus tie motor switches. MN BUS TIE BAT A/C and B/C switches at on provide two batteries on line if cb MNA & B BAT C (2) - open, or three batteries on line for entry if circuit breakers closed (panel 275).
	2	Configure RCS		Assumes desired Attitude Control mode, 7.1, previously selected.
AC		AUTO RCS B/D ROLL B1 & B2 - MNA AUTO RCS B/D ROLL D1 & D2 - MNB AUTO RCS PITCH A3 & C4 - MNB AUTO RCS PITCH C3 & A4 - MNA AUTO RCS YAW B3 & D4 - MNA AUTO RCS YAW D3 & B4 - MNB	8	
CP		SM RCS PRPLNT (4) - OPEN (verify)	2	OPEN position is momentary. Opens 16 quad isolation valves.

NORMAL BACKUP

STA/T	STEP	PROCEDURE	PANEL	REMARKS
CP		SM RCS PRPLNT tb (8) - gray (verify)	2	Gray indicates quad fuel and oxidizer isolation valves open.
		SM RCS SEC FUEL PRESS (4) - OPEN (verify)		OPEN position is momentary. No talkbacks. Opens helium isolation valves between quad helium regulators and secondary fuel tanks.
		RCS IND sel - any quad SM RCS IND sw - PRPLNT QTY (verify)		If in PRPLNT QTY position, indicator reads PSM or QUAD propellant quantity depending on position of RCS IND sel switch.
		SM RCS PSM PRPLNT (4) - CLOSE (verify) SM RCS PSM PRPLNT tb (4) - bp (verify)		Barber pole indicates at least one PSM manifold to quad propellant (fuel or oxidizer) isolation valve closed for separation. Any position of PSM helium and manifold isolation switches acceptable.
	3	Mnvr to sep att		Nominally deorbit burn attitude plus a 45° yaw out of plane.
AC		If CMC cont SC CONT - SCS	1	During separation, CSM RCS DAP acting upon CM would produce undesirable rates.
		or CMC MODE - FREE		
CP	4	RCS TRNFR - CM Test jets (if min imp, 1 cycle) RCS TRNFR - SM	2	Minimum impulse may not produce audible jet firing. More than 1 cycle may be required to clear propellant lines of residual pressure and allow propellant to jets.
AC	5	DBD/RATE - MAX/HI ATT DBD - MAX RATE - HI	1	Conserves propellant between separation and .05 G.

STA/T	STEP	PROCEDURE	PANEL	REMARKS
DP	6	Configure telcom VHF AM (2) - off (ctr) OMNI ANT - C S BD ANT OMNI A - C S BD ANT - A/C If RCS deorbit TAPE RCDR FWD - FWD	3	
	7	Configure ECS		
AC		PRIM GLY TO RAD - BYP (pull)	325	
		REPRESS PKG vlv - FILL	326	Assures CM 02 supply full before CM/SM separation.
		SRG TK 02 vlv - ON (verify)		
CP		02 PRESS IND sw - SURGE TK	2	
		CRYO 02 PRESS 1 ind - 865-935 psia		
AC		REPRESS PKG vlv - ON	326	
		SM 02 SUP vlv - OFF		
DP		cb RAD CONT/HTRS (2) - open	5	
		(Deleted)		
		cb WASTE DUMP HTRS (2) - open		
CP		POT H2O HTR - OFF	2	
		GLY EVAP TEMP IN - MAN		Removes power from glycol mixer to conserve battery power.
AC		cb ELS/CM-SM SEP (2) - close	8	
	8	Arm SECS		
		SECS LOGIC (both) - on (up) (verify)		SECS LOGIC and PYRO ARM lever lock switches required for sequencing of CM/SM separation and landing events.
		SECS PYRO ARM (2) - on (up)		
CP	9	PRPLNT DUMP - RCS CMD (verify)	2	Was set to RCS CMD 61 seconds after lift-off. CM RCS activated in 14.1.4.
AC		EMS MODE - STBY (verify)	1	Should remain at STBY until just prior to entry interface to preclude false .05 G sensing.

STA/T	STEP	PROCEDURE	PANEL	REMARKS
CP	10	Sep from SM		
		CM/SM SEP (both) - on (up)	2	Guarded. On position is momentary. Low limit SM system lights on at separation.
		SM C/W lts - on		
		C/W CSM - CM		
AC		MASTER ALARM pb/lt - on, push	1	
CP		SM C/W lts - out	2	
		Perform DM Jett, 4.4		
		RCS TRNFR - CM		CM position is momentary. Backup to automatic RCS transfer.
AC		CM RCS LOGIC - OFF	1	
	11	Sel Att Cont mode, 7.1		Entry DAP not turned on.
		Mnvr to entry att (or to SM RCS deorbit att if hybrid deorbit)		
		R____°, P____°, Y____°		
	12	Set up for CM/RCS sys 1 (omit for hybrid deorbit)		G&N entry DAP will function with either one or both CM/RCS systems enabled.
		AUTO RCS A/C ROLL (4) - OFF	8	Electrically isolates CM RCS system 2 for entry. If a problem develops in system 1, disable affected channel and use direct RCS control.
		AUTO RCS CM 1 (6) - MNA or MNB		
		AUTO RCS CM 2 (6) - OFF		
	13	Go to P61 Entry Prep, 14.3.1		
	or	Go to SCS Entry, 14.4		
	or	If G&N Hybrid Deorbit, go to 12.2.3 (step 16)		
	or	If SCS Hybrid Deorbit, go to 12.3.3 (step 14)		

STA/T	STEP	PROCEDURE	PANEL	REMARKS
		14.3 G&N ENTRY		
		14.3.1 P61 Entry Preparation	P61	displays predicted entry interface parameters and obtains EMS initialization parameters for comparison with STDN values.
		Required CMC - on, 8.1.3 ISS - on & orient known, 8.1.3 & sec 13 SCS - on, 8.4.2 CMC ATT IMU (verify) .05 G sw - OFF (verify)		
CP	1	DSKY - P61 (sel at end of deorbit burn)	2	
	or	Key V37E 61E		
		Poss PROG alarm (8.1.16)		R02.
		(R41 - State Vector Integration)		
		COMP ACTY lt - on (R41) COMP ACTY lt - flashes every 2 sec (ave G on)		Indicates state vector integration in process. Indicates integration complete, and average G on.
		Poss PROG alarm V05 N09 (10 sec) 01427 (IMU reversed)		Zero roll on FDAI is lift-down. -Ysm within 30° of $\underline{V} \times \underline{R}$. Alarm 01427 always displayed following P40 or P41 deorbit if platform aligned to preferred orientation computed in P40 or P41.
		or 01426 (IMU unsatisfactory for entry)		Neither +Ysm or -Ysm within 30° of $\underline{V} \times \underline{R}$.

NORMAL/BACKUP

STA/T	STEP	PROCEDURE		PANEL	REMARKS
CP	2	FL V06 N61		2	
		Impact Lat (+N)	XXX.XX DEG		Latitude and longitude of desired impact point.
		Impact Long (+E)	XXX.XX DEG		
		Hds Up/Dn (+up)	+/-00001		Heads up/down defines entry roll attitude.
		Accept PRO			
		Reject V25E, load desired values			Normally, these values loaded prior to deorbit.
	3	FL V06 N60 (entry data)			
		G max	XXX.XX G		Predicted maximum G level for an entry at nominal bank angle (L/D = 0.18).
		V pred	XXXXX. FPS		Predicted inertial velocity at entry interface (65.8 NM, 400,000 ft) above Fischer ellipsoid.
		Gamma EI	XXX.XX DEG		Flight path angle (between inertial velocity vector and local horizontal) at 65.8 NM (400,000 feet) above Fischer ellipsoid. Minus indicates flight path below horizontal plane.
		Rcd values			
		PRO			
	4	FL V16 N63			Display relative to erasable preloaded altitude value above Fischer ellipsoid.
		RTOGO (.05 G to splash)	XXXX.X NM		Range to go from preloaded erasable altitude value to splash.
		VIO (at .05 G)	XXXXX. FPS		Predicted inertial velocity at preloaded altitude value.

STA/T	STEP	PROCEDURE	PANEL	REMARKS
CP		TFE (time from .05 G) XXBXX MIN-SEC	2	Predicted time from now to preloaded altitude value (updated every 2 seconds). Predicts about 3 minutes longer than actual, following hybrid deorbit when called half hour before .05 G. Error varies, depending on how early P61 called after deorbit. 59B59 maximum reading (-above, +below).
		Rcd & compare with STDN		
AC		EMS - STBY/RNG SET (CW)	1	
		EMS MODE - STBY		
		EMS FUNC - RNG SET (CW)		Do not go through EMS TEST positions.
		Set RNG ind - RTOGO from .05 G (STDN value)		Range to go from preloaded value to splashdown.
		If req EMS FUNC - Vo SET (CCW)		
		Align scroll Vo to exact entry velocity (if req)		Predicted entry velocity may have been preset in EMS Entry Test, 14.1.3. Scroll can be slewed only one inch in reverse. In Vo SET position, both initial velocity in range integrator and scroll velocity change simultaneously.
		EMS FUNC - ENTRY		
		Position EMS lt filter down (lts not covered)		Removing filter improves visibility of EMS lights during entry.
CP		Accept PRO (Exit P61)	2	
		P61 calls P62		
		Go to G&N Entry, 14.3.2		
		Reject V32E, recycle to step 3		Obtains new state vector and updated N60.

NORMAL/BACKUP

STA/T	STEP	PROCEDURE	PANEL	REMARKS
		14.3.2 P62, P63, P64, P67 Entry		
		Required CMC - on, 8.1.3 ISS - on & orient known, 8.1.3 & sec 13 SCS - on, 8.4.2 CMC ATT - IMU (verify) .05 G sw - OFF (verify)		
CP	1	DSKY - P62 Auto sel by P61 (bypasses state vctr extrapolation reqt)	2	
	or	If FL V37 Key 62E		
	or	Key V37E 62E (ave G reinitiated)		
		Poss PROG alarm (8.1.16)		R02.
		(R41 - State Vector Integration)		R41 bypassed if P62 called by P61.
		COMP ACTY lt - on (R41)		Indicates integration in process.
		COMP ACTY lt - flash every 2 sec (ave G on)		Indicates integration complete, and average G on.
		Poss PROG alarm V05 N09 (10 sec) 01427 (IMU reversed)		Zero roll on FDAI is lift-down. -Ysm within 30° of $\underline{V} \times \underline{R}$. Alarm 01427 always displayed following P40 or P41 deorbit if platform aligned to preferred orientation computed in P40 or P41.

STA/T STEP	PROCEDURE	PANEL	REMARKS
CP	or 01426 (IMU unsatisfactory for entry)	2	Neither +Ysm or -Ysm within 30° of V x R.
2	FL V50 N25 00041 (request CM/SM sep)		If CM and SM not separated prior to this step, separation should be accomplished now per 15.2. V37s except P00, inhibited after response to this display. Any program not requiring DAP control may be selected from P00. P62 should be reselected before entry into atmosphere since average G terminates by going to P00.
3	PRO		Starts entry DAP. Roll attitude error scaling changed in G&N for compatibility with 50/15/50/10 FDAI scale position. After PRO and until 50/15/50/10 selected, full scale roll error 20°, not 5°.
4	FL V06 N61 Impact lat (+N) XXX.XX DEG Impact long (+E) XXX.XX DEG Hds Up/Dn (+up) +/-00001		Latitude and longitude of desired impact point. Defines entry roll attitude.
	Accept PRO If α <45° - DSKY P63, go to 6 Reject V25E load new data		If α within 45° of (-) velocity vector, P63 automatically called.
5	V06 N22 (mon) R, P, Y XXX.XX DEG		Final gimbal angles at EI. Display bypassed and P63 called if α within 45°.
	If α >45° 21 sec after α <45°, DSKY P63		

STA/T	STEP	PROCEDURE	PANEL	REMARKS
CP	6	ORDEAL Pitch - ___° (Hds up) ORDEAL Pitch - ___° (Hds down)	2	IMU inertial attitude on FDAI 1 and ORDEAL local vertical attitude on FDAI 2.
	7	DSKY - P63		
AC	8	After CM/SM sep & CM stab at entry att EMS MODE - NORM	1	Left in STBY until after separation and stabilization; if no postburn update, and for RCS deorbit, start EMS by positioning EMS MODE from STBY to BU at STDN supplied value of RET .05 G. Also refer to 6.1.1, note 10.
		DBD/RATE - MAX/HI ATT DBD - MAX RATE - HI FDAI SCALE - as desired		
AC,CP		Mon FDAIs & RSI	1,2	
		xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx		
AC		If abnormal veh dynamics Damp rates with dir RCS RHC PWR DIR (both) - OFF	1	This procedure sequence minimizes failure isolation time. (Another functionally acceptable method disables AUTO RCS switches first, then RHC direct power.)
		If abnormal veh dynamics continue RHC PWR DIR (both) - MNA/MNB Damp rates with dir RCS AUTO RCS (affected axis) - OFF Continue with dir RCS (affected axis)	8	
		xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx		

STA/T	STEP	PROCEDURE		PANEL	REMARKS
CP	9	V06 N64 (mon)		2	N68 and N74 available if desired.
		Drag accel	XXX.XX G		
		VI	XXXXX. FPS		Inertial velocity (nominal).
		Range to splash (+ overshoot)	XXXX.X NM		Range to go to desired splashpoint located at calculated impact time (decreasing). Display bypassed on first 2-second cycle.
DP		PCM BIT RATE - HI		3	
		TAPE RCDR RCD - RCD			
		TAPE RCDR FWD - FWD			
AC		BMAG MODE (3) - RATE 2		1	Cages attitude BMAGs. Prevents SCS-driven FDAI roll stability indicator from jumping when GA 1 BMAGs automatically cage at .05 G.
		MAN ATT (3) - RATE CMD			Configuration required for auto G&N entry and normally selected at last status check prior to .05 G.
		SC CONT - CMC			
		CMC MODE - AUTO, HOLD, or FREE			Entry DAP does not look at CMC MODE switch.
CP		DSKY - P64 (at .05 G)		2	CMC changes Entry DAP from attitude hold in alpha and beta to rate damping in pitch and yaw (roll unchanged).
		EMS MODE - BU			EMS started manually to ensure start of range indicator at fixed position (range from target) as defined by RTCC.
		.05 G lt - on			.05 G lt will not necessarily occur simultaneously with P64 on DSKY.

STA/T	STEP	PROCEDURE		PANEL	REMARKS
AC		.05 G sw - on (up) EMS ROLL - on (up) Scroll slews to left RNG ind decr		1	.05 G and EMS ROLL switches should be placed on simultaneously to minimize EMS error.
CP	10	V06 N74 (mon)		2	N64 and N68 available if desired.
		Beta	XXX.XX DEG		Commanded bank angle.
		VI	XXXXX. FPS		Inertial velocity (decreasing).
		Drag accel	XXX.XX G		Drag acceleration (increasing).
AC		Compare RSI & ball for lift vctr G-V plot within limits		1	Violation of an EMS G onset ray should be followed by an orientation to lift vector up. Violation of an EMS G offset ray should be followed by an orientation to lift vector down. If at point of tangency, G&N not commanding lift-up or lift-down, manually orient CM and terminate G&N steering.
0.2G					
CP	11	DSKY - P67		2	P67 continues entry guidance from ≈0.2 G until termination of steering when the CM velocity with respect to earth = 1000 ft/sec (≈10.7 NM altitude). N64, N68, and N74 available if desired.
AC		EMS - 0.2 G (if 10 sec since .05 G)		1	
CP	12	V06 N66 (mon)		2	
		Beta	XXX.XX DEG		Commanded bank angle (-command will correct for + cross range error).
		CRSRNG ERR	XXXX.X NM		CMC solution for cross range error (+ target south of direction of motion).
		DWNRNG ERR	XXXX.X NM		CMC solution for down range error (decreasing); + is overshoot. Will be 9999.9 after overshoot of target.

STA/T	STEP	PROCEDURE	PANEL	REMARKS
CP		Key VERB (freeze disp) Compare DWNRNG ERR to pad data (DWNRNG ERR within 100 NM of pad data)	2	
		xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx		
AC		If DWNRNG ERR not within 100 NM Maintain BBA entry		
		xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx		
CP		KEY REL (reinstates V06 N66 mon)		
AC		Fly roll cmd Mon lift vctr on RSI & ball	1	
CP	13	FL V16 N67 (mon) Range to splash (+ ovsht) XXXX.X NM Lat present position (+ N) XXX.XX DEG Long present position (+ E) XXX.XX DEG (V REL = 1000 fps at ≈65K')	2	Range to go to desired splashpoint (+ is overshoot). Latitude of present position (+ is north). Longitude of present position (+ is east).
AC		If R1 = -, lift-up; +, lift-down Mon altimeter Rcd lat, long, & voice to RECY at 10K' Rcd EMS RTOGO EMS - STBY/OFF EMS MODE - STBY EMS FUNC - OFF	1	
	14	Go to Earth Ldg Phase (<50K'), sec 15		

STA/T	STEP	PROCEDURE	PANEL	REMARKS
	14.4	SCS ENTRY		Assumes CM and SM separated. During entry, do not "fly to" a pegged rate needle. For this contingency, control to operational attitude ball or out-the-window visual cues.
		CMC - on (desired), 8.1.3 ISS - on & orient known (desired), 8.1.3 & sec 13 SCS - on (req), 8.4.2 CMC ATT - IMU (verify) .05 G sw - OFF (verify) RSI aligned, 14.1.2		
AC	1	Verify/mnvr to entry att		SCS acceleration command recommended until .05 G for failure takeover considerations.
		EMS Entry Test (req), 14.1.3		
	2	EMS - STBY/RNG SET (CW) EMS MODE - STBY EMS FUNC - RNG SET (CW)	1	Do not go through EMS TEST positions. The following steps to be done as soon as possible after deorbit ΔV.
		Set RNG ind - RTGO from .05 G (STDN value)		
	3	EMS FUNC - Vo SET Realign scroll Vo to exact entry velocity (if req)		Predicted entry velocity may have been preset in EMS Entry Test, 14.1.3. Scroll can be slewed only one inch in reverse. In Vo SET position, both initial velocity in range integrator and scroll velocity change simultaneously.

STA/T	STEP	PROCEDURE	PANEL	REMARKS
AC	4	EMS FUNC - ENTRY	1	
	5	Align RSI to desired angle (if necessary) ATT SET - GDC EMS ROLL - on (up) GDC ALIGN pb - push, hold ATT SET YAW tw - adj ±45°, position RSI		This alignment may be performed prior to launch or prior to deorbit.
		GDC ALIGN pb - rel EMS ROLL - OFF ATT SET YAW tw - reset GDC ALIGN pb - push (32 sec max)		EMS roll stability indicator alignment provides indication of backup bank angle (BBA).
	6	After CM SM sep & CM stab at entry att EMS MODE - NORM		Left in STBY until after separation and stabilization; if no postburn update, and for RCS deorbit, start EMS by positioning MODE switch from STBY to BU at STDM supplied value of RET .05 G. Also refer to 6.1.1, note 10.
		DBD/RATE - MAX/HI ATT DBD - MAX RATE - HI FDAI SCALE - 50/15/50/10 BMAG MODE (3) - RATE 2 MAN ATT ROLL - ACCEL CMD MAN ATT PITCH & YAW - RATE CMD		Cages attitude BMAGs, preventing SCS-driven FDAI RSI jumping at .05 G when GA 1 attitude BMAGs automatically caged to furnish rate information for SCS-driven FDAI RSI. This configuration can be delayed, as close to .05 G as convenient, for propellant conservation.
DP		PCM BIT RATE - HI TAPE RCDR RCD - RCD TAPE RCDR FWD - FWD	3	

NORMAL/BACKUP

STA/T	STEP	PROCEDURE	PANEL	REMARKS
AC,CP		Monitor FDAIs & RSI	1,2	
		xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx		
AC		If abnormal veh dynamics Damp rates with dir RCS RHC PWR DIR (both) - OFF	1	This procedure sequence minimizes failure isolation time. (Another functionally acceptable method disables AUTO RCS switches first, then RHC direct power.)
		If abnormal veh dynamics continue RHC PWR DIR (both) - MNA/MNB Damp rates with dir RCS AUTO RCS (affected axis) - OFF Continue with dir RCS (affected axis)	8	
		xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx		
	7	EVNT TMR ind - mon for .05 G time .05 G lt - on	1	
		xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx		
		If no .05 G lt by RET .05 G +3 sec		Backup cue may be obtained from STDN or CMC.
		EMS MODE - BU		Lift vector lights do not function in EMS BU mode. If RNG indicator not decreasing, EMS ranging capability lost.
		xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx		
		.05 G sw - on (up)		At .05 G +10 sec, one lift vector light will come on; disregard light.
		EMS ROLL - on (up)		.05 G and EMS ROLL switches should be placed to on simultaneously to minimize roll attitude error.

SCS ENTRY

STA/T STEP	PROCEDURE	PANEL	REMARKS
AC	Scroll slews to left, RNG ind decreases	1	If scroll slews in one axis (V or G), that axis is usable.
	Mnvr to BBA & maintain until range potential guidelines can be interpreted, then null range err using range potential guidelines & EMS RNG ind. While nulling range err, avoid tangency to G on-set lines. Reverse bank angle at RETRB to null lateral range err.		BBA is backup bank angle. Disregard corridor lamps (as corridor verification cues) for entry from earth orbit (entry velocity <35K fps). RETRB is retrofire elapsed time to reverse bank.
8	Go to Earth Landing Phase (<50K'), sec 15		

NORMAL/BACKUP

STA/T	STEP	PROCEDURE	PANEL	REMARKS
		15.0 EARTH LANDING PHASE (<50K')		
AC				
50K'		CAB PRESS RELF vlv (2) - BOOST/ENTR (safety latch on)	325	
		Report CM stable		
		xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx		
		CM unstable		
CP				
40K'		RCS CMD - OFF	2	OFF position is momentary.
AC		APEX COVER JETT pb - push	1	Guarded.
		DROG DPLY pb - push (2 sec after apex cover jett)		Guarded.
		xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx		
30K'		ELS LOGIC - on (up)		Guarded.
		ELS AUTO - AUTO		
CP		SEC COOL EVAP - off (ctr)	2	Required only if secondary loop in operation.
		GLY EVAP H2O FLOW - off (ctr)		
24K'		SCS RCS disable (auto)		
		xxxxxxxxxxxxxxxxx		
		RCS CMD - OFF		OFF position is momentary.
		xxxxxxxxxxxxxxxxx		
		Apex cover jett (auto)		Apex cover will be jettisoned at 24K feet plus 0.4 second.

STA/T	STEP	PROCEDURE	PANEL	REMARKS
		xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx		
AC		APEX COVER JETT pb - push	1	Guarded.
		xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx		
		Drogue chutes deployed (auto)		Drogue parachutes deployed at 24K feet plus 2.0 seconds. The CM may be very unstable until drogue chutes disreef in ≈11 seconds.
		xxxxxxxxxxxxxxxxxxxxxxxx		
		DROG DPLY pb - push		Guarded.
		xxxxxxxxxxxxxxxxxxxxxxxx		
		xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx		
		If no drogue deployment ELS AUTO - MAN Stabilize CM with dir RCS 5K' MN DPLY pb - push ELS AUTO - AUTO		Guarded.
		xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx		
CP 23.5K'		Monitor CAB PRESS ind - starts increase	2	No increase indicates cabin pressure relief valve failure.
		xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx		
AC		If no increase by 17K' rh CAB PRESS RELF vlv - DUMP (safety latch off)	325	RH valve has four positions.
CP		If still no increase CAB PRESS DUMP vlv - open (CCW)	Side hatch	
		xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx		

STA/T	STEP	PROCEDURE	PANEL	REMARKS
CP				
10K'		CAB PRESS ind - 10 psia	2	Indication of main chute deploy altitude.
		Main chutes & VHF recovery ant deploy (auto)		Auto deployment occurs between 10,950 and 9,100 feet. Parachutes disreef ≈15 seconds after pilot mortars fire.
AC		MN DPLY pb - push	1	Guarded.
		(Deleted)		
		REPRESS PKG vlv - OFF	326	Isolates repress package for postflight oxygen requirements.
DP		Set up entry communications		
		VHF ANT - RECY	3	
		VHF AM A - SIMPLEX		If VHF AM B - SIMPLEX or VHF AM A - DUPLEX required, turn off beacon during period of communication.
		VHF BCN - ON		
AC		Transmit voice (VHF AM) reporting		Continue voice transmission until touchdown.
		Position		
		Main chutes disreefed		
		Splash error		
		Crew status		
CP		Crew couch struts (4) - unlock		
AC		CAB PRESS RELF vlv (2) - DUMP	325	
		(safety latch off)		
		If night landing		
		cb FLOAT BAG (all) - close	8	
		PL BCN LT - LO	15	The postlanding beacon light has longer operating life in LO.

NORMAL/BACKUP

STA/T	STEP	PROCEDURE	PANEL	REMARKS
DP		cb FLT/PL BAT BUS A, B & BAT C (3) - close	275	Connects battery bus A, B, and battery C to flight and postlanding bus.
		cb FLT/PL MNA & B (2) - open		
AC		cb SPS PITCH (both) - open	8	
		cb SPS YAW (both) - open		
CP		CM RCS PRPLNT (both) - OFF	2	OFF position is momentary.
		CM RCS PRPLNT tb (both) - bp		Barber pole indicates at least one valve (fuel or oxidizer) closed in the particular system 1 or 2.
AC				
3K'		FLOOD FIXED - POST LDG	8	Provides power from flight and postlanding bus to one floodlight in LH couch area and one floodlight in center couch area. Minimize floodlight use during postlanding. Maximum utilization should be 9.6 hours per 48-hour period.
		FLOOD DIM - 1 or 2		Position 1 provides power to two secondary floodlights and position 2 provides power to two primary floodlights when FLOOD FIXED switch in POST LDG position after dc main buses are deactivated.
800'		CAB PRESS RELF vlv (2) - CLOSE (safety latch off)	325	Valves must be closed prior to touchdown to prevent water from entering CM.
		xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx		
CP		If CAB PRESS DUMP vlv used to equalize ΔP, CAB PRESS DUMP vlv - close (CW)	Side hatch	
		xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx		

STA/T	STEP	PROCEDURE	PANEL	REMARKS
AC		ELS AUTO - AUTO (verify)	1	
		ELS LOGIC - on (up) (verify)		Guarded.
		DIRECT O2 vlv - OPEN (CCW) (if suited)	7	
DP		MN BUS TIE (2) - OFF	5	Removes battery power from dc main buses.
		CAUTION MN BUS TIE switches must be left OFF to ensure that entry batteries A, B, & C are used to power PL bus only, & to prevent battery shorting caused by water entering CM feed-thru connectors.		
		cb BAT RLY BUS (2) - open		
		Postlanding Check, sec 16		

STA/T	STEP	PROCEDURE	PANEL	REMARKS
		16.0 POSTLANDING		
		16.1 POSTLANDING STABILIZATION		
DP		cb MN REL (2) - close	229	
CP		MN REL - on (up)	2	Guarded. On position is momentary. Releases main parachutes.
		xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx		
		If no main chute release		
AC		ELS AUTO - AUTO (verify)	1	Switch should have been on at least 14 seconds to allow timer to time out and enable MN REL switch.
		ELS LOGIC - on (up) (verify)		Guarded.
CP		MN REL - on (up)	2	Guarded. On position is momentary.
		xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx		
		WARNING		
		If fire or smoke after impact, refer to Fire/Smoke in CM During Postlanding, 20.3.1		
AC		SECS PYRO ARM (2) - SAFE	8	Lever lock.
		SECS LOGIC (both) - OFF		Lever lock.
		If not in contact with recovery forces		
ALL		VHF AM (3) - RCV	9,10,6	
DP		VHF AM A - off (ctr)	3	
		VHF AM RCV - A		

NORMAL/BACKUP

STA/T	STEP	PROCEDURE	PANEL	REMARKS
AC		cb PL VENT FLT/PL - close	8	
		cb FLOAT BAG (all) - close		
DP		cb UPR SYS COMPR (both) - close	278	
		If floating upright		
		CAUTION Wait 10 minutes prior to initiating bag fill. This allows ablator to cool sufficiently prior to inflation. Heat can destroy bags.		
AC		FLOAT BAG (all) - FILL for 7 min, then OFF	8	Lever lock. Wait 15 minutes prior to running compressors again.
		xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx		
		If floating inverted		
		FLOAT BAG (all) - FILL		Lever lock.
DP		VHF BCN - OFF	3	
		VHF AM A - off (ctr)		
		Two min after upright		
AC		FLOAT BAG (all) - OFF	8	Lever lock.
DP		VHF BCN - ON	3	
		If in contact with recovery forces prior to floating inverted		
		VHF AM A - SIMPLEX		If VHF AM B SIMPLEX or VHF AM A DUPLEX required, turn off beacon during period of communication.

STA/T STEP	PROCEDURE	PANEL	REMARKS
	If CM fails to upright in 7 min & CM rolls CW		Crew reposition procedures may be required if uprighting does not occur in 7 minutes and sea state is minimal.
AC	FLOAT BAG 2 R - OFF (Continue uprighting for 8 additional min)	8	Lever lock.
CP,AC	If uprighting does not occur in 3 min, reposition to area behind AC's couch and CP's couch as near as poss to B3 stowage locker		
	or CM rolls CCW		
AC	FLOAT BAG 1 L - OFF (Continue uprighting for 8 additional min)		Lever lock.
DP,CP	If uprighting does not occur in 3 min, reposition to area behind DP's couch & CP's couch		
	or No roll		
AC	FLOAT BAG 3 CTR - OFF (Continue uprighting for 8 additional min)		Lever lock.

STA/T STEP	PROCEDURE	PANEL	REMARKS
CP,DP	If uprighting does not occur in 3 min, reposition to area on top of or along lower equip bay canisters WARNING If CM still does not upright, egress should be completed before total time in unventilated CM exceeds 2-1/2 hours. Refer to Stable II Water Egress Procedure, 16.4.3.		

STA/T	STEP	PROCEDURE	PANEL	REMARKS
		16.2 POST STABILIZATION AND VENTILATION		
ALL		Release footstraps Release restraint harness		
DP		cb MNA BAT BUS A & BAT C (2) - open cb MNB BAT BUS B & BAT C (2) - open cb FLT/PL BAT C - open	275	Battery C held in reserve for use after depletion of battery A and B charge.
		cb PYRO A/SEQ A - open cb PYRO B/SEQ B - open	250	
		DC IND sel - BAT BUS A,B DC VOLTS ind - >27.5 vdc When BAT BUS A(B) = 27.5 vdc, monitor that bus continuously	3	
		xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx		
		If BAT BUS A(B) <27.5 vdc cb FLT/PL BAT BUS A(B) - open Go to Comm Low Pwr Procedures, 16.3.3	275	
		If BAT BUS A & B (2) <27.5 vdc cb FLT/PL BAT BUS A & B (2) - open cb FLT/PL BAT C - close Go to Comm Low Pwr Procedures, 16.3.3, and monitor BAT C voltage		
		xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx		
CP		PLV distribution duct (3) - unstow and install		Stowed in aft bulkhead stowage area.
		Remove debris trap from left X-X head strut at MDC		Allows cabin air to flow to PL valve exhaust port on forward bulkhead.

STA/T	STEP	PROCEDURE	PANEL	REMARKS
		CAUTION PL VENT vlv handle must be fully extended (pulled until detent button re-extends) to disengage valve locking pins.		
CP		PL VENT VLV - PULL (unlock)	2	Press detent button to release handle. Handle secured in locked or unlocked position when detent button extended.
AC		PL VENT - HI or LO	15	PLV fan can operate in high flow for 12 hours maximum. During periods of no PLV fan operation, cycle PLV 5 minutes every half hour. If RCS fumes are noticed, prepare to egress immediately. PL VENT should be cycled from HI to LO prior to using manual backup procedure.
		xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx		
		If no PLV operation or ventilation inadequate		
		To disengage locking pins		Audible fan operation does not indicate both inlet and outlet valves are open.
		PL VENT - OFF		
		PL VENT VLV - push then PULL	2	
		PL VENT - HI or LO	15	
		If still no PLV operation		
		To initially open valves		
		PLVC sw - OPEN	376	If PLV valves cannot be opened, side hatch or dump valve can be opened as required to obtain fresh air.
		To close valves		Total time in unventilated CM should not exceed 2-1/2 hours.
		PL VENT - OFF	15	
		To reopen valves		
		PL VENT - HI or LO		
		xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx		

STA/T	STEP	PROCEDURE	PANEL	REMARKS
AC		PL BCN LT - LO	15	After dark only. Place PL BCN LT - HI only at request of recovery forces.
		xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx		
		If no flashing light		Perform backup duty cycle at request of recovery forces.
		FLOOD FIXED - POST LDG for 1/2 min OFF for 1/2 min	8	
		xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx		
		Deploy dye marker & swimmer umbilical DYE MARKER - on (up)	15	Guarded. On (up) position is momentary.
ALL		INTERCOM (3) - T/R (verify)	9,10,6	Required for swimmer umbilical operation.
AC		Deploy line grappling hook (if req) CAB PRESS DUMP vlv - remove Grappling hook & line - deploy through valve opening Cover plate - secure	Side hatch	Grappling hook deployed on request for snagging sea anchors deployed by recovery forces. Adapter E and driver R tools required to remove cabin pressure dump valve and secure cover plate on side hatch (over valve opening).
		Go to Nominal Egress, 16.5		

STA/T STEP	PROCEDURE	PANEL	REMARKS
	16.3 POSTLANDING COMMUNICATIONS		
	16.3.1 Normal Postlanding Communications		
DP	VHF BCN - ON (verify) VHF ANT - RECY (verify)	3	
	If no contact with recovery forces VHF AM B - SIMPLEX Monitor for VHF beacon 1000 Hz tone (2 sec on, 3 sec off) VHF AM B - off (ctr) If VHF beacon not audible Remove survival transceiver from stowage and mount antenna Select VOICE on transceiver Monitor VHF beacon for 1000 Hz tone (2 sec on, 3 sec off) If VHF beacon operating Turn off survival transceiver Stow transceiver in RHFEB		
	xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx If no VHF beacon signal, turn off transceiver, remove antenna, & connect transceiver to S/C antenna per 16.3.2 Select BCN on transceiver Monitor VHF AM for comm initiated by recovery aircraft xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx		
	16.3.2 Survival Transceiver Communications		
	VHF BCN - OFF (if no contact after 24 hrs)	3	Conserve spacecraft power for terminal phase of recovery operations.

SURVIVAL TRANSCEIVER COMMUNICATIONS

STA/T	STEP	PROCEDURE	PANEL	REMARKS
DP		Survival transceiver/VHF BCN antenna cable connection		
		Remove survival transceiver from stowage		
		Unlatch & open VHF antenna access door		A 5/32" hex wrench (tool E), required for opening two hex fasteners on antenna cable access door.
		Disconnect P112 connector from beacon		An adjustable wrench (tool F), is used to loosen 5/8" hex on coax connector.
		Attach transceiver cable P1 connector to transceiver (verify)		
		Connect transceiver cable J1 connector to P112 connector		
		Select BCN on transceiver		
	16.3.3	Communications Low Power Procedures		
		VHF BCN - OFF		
AC		FLOOD FIXED - OFF	8	Turns off postlanding floodlights.
DP		VHF AM A - off (ctr)	3	
		VHF AM RCV - A		
AC		PL VENT sys - minimize use		
		Survival transceiver - connect to VHF BCN antenna cable (refer to Survival Transceiver Communications, 16.3.2)		
	16.3.4	S/C Power Down (Extended Comm Period)		Spacecraft power conserved for extended survival communications period.
		PL VENT - OFF	15	Postlanding vent system use should be minimized; however, total time without ventilation or CM O2 supply should not exceed 2-1/2 hours. Side hatch or dump valve can be opened as required to obtain fresh air if no PL VENT operation.
DP		cb ENTRY/PL BAT A, B, C (3) - open	250	

NORMAL/BACKUP

STA/T STEP	PROCEDURE	PANEL	REMARKS
	16.4 UNAIDED EGRESS PROCEDURES		
	xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx		
	If no ventilation or CM 02 supply STABLE I - open side hatch as req STABLE II - initiate egress within 2-1/2 hours		
	xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx		
	16.4.1 Egress Preparation		
ALL	Disconnect umbilicals (if suited) Neck dams on (if suited) Configure couch seat pans Center couch - 270° position L & R couch - 270° position (if stable II egress anticipated)		
AC,DP	Armrests folded (stowed)		
ALL	If unsuited, transfer scissors from suit to coveralls Tape flight penlight to wrist (night egress)		Scissors may be required to cut mooring lanyard in an emergency.
DP	Survival kits removed from stowage Remove lanyards from rucksack kit No. 2 & reclose rucksack	R-4	
CP	Connect liferaft mooring line (olive drab) to CM Connect lanyard titled "attach to first crewman out" to suit (if unsuited attach to buckle on life vest)		

STA/T	STEP	PROCEDURE	PANEL	REMARKS
DP		Connect lanyard titled "attach to second crewman out" to suit (if unsuited attach to buckle on life vest)		
AC		Connect lanyard titled "attach to third crewman out" to suit (if unsuited attach to buckle on life vest)		
		16.4.2 Stable I Water Egress		
AC		PL VENT - OFF	15	
DP		cb ENTRY/PL BAT A, B, C (3) - open	250	
CP		Charge hatch counterbalance GN2 ratchet handle - operate GN2 vlv handle - unlock & push outboard	Side hatch	
		Open side hatch Lock pin rel knob - UNLATCH Gear box sel - UNLATCH Actr handle sel - U (unlatch) Actr handle rel - push or squeeze		Push button or squeeze bar to release actuator handle for operation.
		Actr handle - operate (until hatch can be opened) Push hatch open Actr handle sel - N (neut) GN2 vlv handle - vent (pull inboard) GN2 vlv handle - press (push outboard)		

NORMAL/BACKUP

STA/T	STEP	PROCEDURE	PANEL	REMARKS
CP		Check pressure gage (mid-white)	Side	Counterbalance vented to mid-white range to assist in securing spacecraft hatch after crew egress.
		Repeat vent, press cycle, as req to obtain mid-white range	Hatch	
AC		Remove life raft from rucksack kit No. 2		
		Simultaneously throw life raft overboard and pull inflation lanyard		
		Place hardware rucksack in raft		
		Egress, inflate life vest, board raft		
DP		Egress, inflate life vest, board raft		
CP		Egress, inflate life vest, board raft		
	16.4.3	Stable II Water Egress		
ALL		PWR (3) - OFF	6,9,10	
		SUIT PWR (3) - OFF		
CP		PRESS EQUAL vlv - OPEN	Fwd hatch	Pull detent knob on end of handle, then pivot up 90°. Rotate crank ≈3 turns CCW to fully open valve. This will flood tunnel prior to opening hatch.
		WARNING To prevent injury to crew members, do not unlock hatch until flooding stops and pressure equalizes in CM.		
CP		Actr handle rel - pull and rotate	Fwd hatch	To free actuator handle for operation, release is rotated to mechanical stop.

STABLE II WATER EGRESS

STA/T	STEP	PROCEDURE	PANEL	REMARKS
CP		Actr handle - pull to stop	Fwd hatch	Actuator handle should move ≈80°.
		Actr handle sel - U (unlatch) (CCW 90°)		
		Actr handle - push to stop		Actuator handle should move 60° to release hatch.
		Actr handle sel - stow (CW 90°)		
		Actr handle - push to stowed position		
CP,DP		Remove & stow fwd hatch		Forward hatch weighs ≈85 lbs and is stowed in LHEB.
CP		Lower hardware rucksack down tunl. When rucksack clear of tunl, lower life raft package down tunl holding package with yellow lanyard		
		Exit feet first; when clear of CM, inflate life vest		
DP		Exit feet first; when clear of CM, inflate life vest		
CP, DP		Remove life raft from rucksack No. 2 and inflate raft		
AC		Disconnect life raft mooring line (olive drab) from CM and return end of line (AC's discretion)		
		Exit feet first; when clear of CM inflate life vest		
		Reconnect life raft mooring line (olive drab) to SC exterior - sea anchor hardpoint or EVA handles (AC's discretion)		
	16.4.4	Side Hatch Operations - Rough Sea		
CP		Close side hatch	Side hatch	Vents counterbalance piston chamber. Squeeze handle to unlock.
		GN2 vlv handle - pull (inboard)		

NORMAL/BACKUP

STA/T	STEP	PROCEDURE	PANEL	REMARKS
CP		GN2 press ind - minimum	Side hatch	
		Open door rel handle - pull		D-ring.
		Verify latches are in open position		
		Close hatch		
		Actr handle sel - L (latch)		
		Gear box sel - LATCH		
		Open door rel handle - stow		
		Actr handle rel - push or squeeze		Push button or squeeze bar to release actuator handle for operation.
		Actr handle - operate (while holding hatch closed)		
		Lock pin rel knob - LOCK (auto)		Verify lock pin has automatically engaged.
		LOCK PIN ind - not extended		Indicates lock pin engaged.
		Actr handle - stowed		
		Re-open side hatch		
		Lock pin rel knob - UNLOCK		Pin can be sheared if left in LOCK position.
		Gear box sel - UNLATCH		
		Actr handle sel - U (unlatch)		
		Actr handle rel - push or squeeze		
		GN2 vlv handle - push (outboard)		
		GN2 press ind - green		
		Actr handle - operate (until hatch can be opened)		Actuator handle should not be operated until immediately prior to egress.

SIDE HATCH OPERATIONS - ROUGH SEA

STA/T STEP	PROCEDURE	PANEL	REMARKS
	16.5 NOMINAL EGRESS PROCEDURES		
	16.5.1 Nominal Egress Preparation		
ALL	Disconnect umbilicals (if suited)		
	Neck dams on (if suited)		
CP	Configure center couch - 270° position		
AC,DP	Armrests folded (stowed)		
	16.5.2 Nominal Egress & Power Down		
AC	PL VENT - OFF	15	
DP	cb panel 250 (all) - open	250	
	xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx		
	Post abort panel config		
	PL BCN LT - LO (verify)		VHF beacon and flashing light left operating to aid CM recovery after an abort.
ALL	VHF AM - OFF (ctr)	6,9,10	
DP	VHF AM A(B) - OFF (ctr)	3	
	VHF BCN - ON (verify)		
	xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx		
CP	Charge hatch counterbalance	Side hatch	
	GN2 ratchet handle - operate		
	GN2 vlv handle - unlock & push outboard		
	Open side hatch (after collar installed)		

STA/T	STEP	PROCEDURE	PANEL	REMARKS
CP		Lock pin rel knob - UNLOCK	Side hatch	
		Gear box sel - UNLATCH		
		Actr handle sel - U (unlatch)		
		Actr handle rel - push or squeeze		Push button or squeeze bar to release actuator handle for operation.
		Actr handle - operate (until hatch can be opened)		
		Push hatch open		
		Actr handle sel - N (neut)		
		GN2 vlv handle - vent (pull inboard)		
		GN2 vlv handle - press (push outboard)		
		Check pressure gage (mid-white)		Counterbalance vented to mid-white range to assist in securing spacecraft hatch after crew egress.
		Repeat vent press cycle as req to obtain mid-white range		
AC		Egress, inflate life vest, board raft		
DP		Egress, inflate life vest, board raft		
CP		Egress, inflate life vest, board raft		

STA/T	STEP	PROCEDURE	PANEL	REMARKS
	17.0	CSM/DM EXPERIMENTS		Technical investigations (experiments) that support science in general or provides engineering, technological, medical, or other data; and technical (in flight) demonstrations of the capabilities of apparatus and/or processes to illustrate or utilize the unique conditions of space flight environment.
	17.1	CSM EXPERIMENT COVERS		
	17.1.1	Covers Tie Down Release		
DP		cb ELECTROPHORESIS/COVERS (2) - close (verify)	274	
		cb EXPERIMENT COVERS (2) - close (verify)	230	
		EXPERIMENT COVERS ARM - ARM		
		EXPERIMENT COVERS TIE DOWN - RELEASE		
		EXPERIMENT COVERS ARM - SAFE		
	17.1.2	Covers Open (Close)		Provides cover opening and closing procedures for experiments located in Service Module bay 1. Covers will be closed during SPS burns.
		cb ELECTROPHORESIS/COVERS (2) - close	274	
		cb EXPERIMENT COVERS (2) - close	230	
		EXPERIMENT COVERS ARM - ARM		
		Verify covers tie down release, 17.1.1		
		AUTO RCS A2, A4, B1, & B4 (4) - OFF	8	
		X-RAY COVER - OPEN (CLOSE)	230	Cover must be closed when instrument FOV centerline within 10° of sun. Cover must be closed during and remain closed for 15 minutes following effluent dumps.
		X-RAY COVER tb - gray,-bp (<5 sec), -gray		Talkback is barberpole while cover is between full open or full closed, (less than 5 seconds).
		xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx		
		If bp >15 sec EXPERIMENT COVERS ARM - SAFE	230	Contact STDN and/or go to appropriate malfunction procedures for further instructions. Remove power with ARM/SAFE switch so that X-RAY cover switch provides cover position indication until problem resolved.
		xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx		

STA/T	STEP	PROCEDURE	PANEL	REMARKS
DP		He GLOW COVER - OPEN (CLOSE)	230	Cover must be closed during and remain closed for 5 minutes after X-Ray Purge and for 1 hour after all other spacecraft dumps except furnace venting.
		He GLOW COVER tb - gray,-bp (<5 sec), -gray		
		xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx		
		If bp >15 sec EXPERIMENT COVERS ARM - SAFE		Contact STDN and/or go to appropriate malfunction procedures with ARM/SAFE switch so that He GLOW cover switch provides cover position indication until problem resolved.
		xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx		
		EUV COVER - OPEN (CLOSE)		Cover must be closed when instrument FOV centerline within 10° of sun. Cover must be closed during and remain closed for 5 minutes after X-Ray Purge and for 1 hour after all other spacecraft dumps except furnace venting.
		EUV COVER tb - gray,-bp (<5 sec), -gray		
		xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx		
		If bp >15 sec EXPERIMENT COVERS ARM - SAFE		Contact STDN and/or go to appropriate malfunction procedures for further instructions. Remove power with ARM/SAFE switch so that EUV cover switch provides cover position indication until problem resolved.
		xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx		
		EXPERIMENT COVERS ARM - SAFE		The door activation (OPEN/CLOSE) switches remain in the last activation position to provide a visual indication of cover position. Arming or safing the system prior or subsequent to each door activation is accomplished with the ARM/SAFE switch.

STA/T STEP	PROCEDURE	PANEL	REMARKS
	17.2 G&C SYSTEMS PREPARATION		Establishes basic requirements for guidance, control, and maneuver functions required for experiment operations.
	CMC - on (req), 8.1.3 ISS - on & orient known (req), 8.1.3 & 13 SCS - on (desired), 8.4.2 RCS DAP - load & activate (req), 8.2.1		
AC	Config SM RCS for single jet control	8	Maintain SM RCS single jet control during experiment operations.

STA/T	STEP	PROCEDURE	PANEL	REMARKS
		17.3 X-RAY OBSERVATIONS		MA048. Map and observe celestial and earth atmospheric soft X-ray emissions. In order to acquire maximum supplementary data, the X-ray observation instrument will be operated as much as possible during the mission, including sleep periods, whenever hardware constraints are not violated. A number of other experiments, for the most part, will be operating simultaneously.
		17.3.1 X-Ray Startup		
DP		cb X-RAY MNA - close	274	
		X-RAY HV PWR - off (ctr) (verify)	230	
		Verify X-Ray deep space FOV		Instrument must be pointed toward deep space at turn on.
		Open X-RAY COVER, 17.1.2		Cover must be open 10 minutes before X-RAY LV PWR on.
		X-RAY LV PWR - ON		
		X-RAY HV PWR tb - bp		Talkback is barberpole when both HV power supplies deenergized.
		17.3.2 X-Ray Operation		
		Verify X-RAY startup, 17.3.1		
		Maneuvers/Target Pointing		X-ray instrument pointing accuracy must be within ±2 degrees.
		(V49) Crew Defined Mnvr, 8.3.4		V49 and P20 options 2 and 5, will be used in various maneuver combinations for mapping (scanning) celestial X-rays, pointing (discrete target) source observations, and X-ray observations of the atmosphere (auroral). Refer to Flight Plan for timelined maneuver and pointing requirements.
		(P20) Options 2 & 5, 10.2.1		

X-RAY OPERATION

STA/T	STEP	PROCEDURE	PANEL	REMARKS
DP		X-RAY HV PWR - 1 (or 2) X-RAY HV PWR tb - gray	230	Positioned as directed in flight plan.
	17.3.3	X-Ray Deactivation		Deactivation must be accomplished during effluent dumps.
		X-RAY HV PWR - off (ctr) X-RAY HV PWR tb - bp X-RAY LV PWR - OFF Close X-RAY COVER, 17.1.2		
	17.3.4	X-Ray Background		Background measurements of one-minute duration will be performed at initial turn-on and an additional four-per-day required during experiment operation, except during crew rest periods. The protective cover must be closed during these measurements.
		Verify X-RAY Operation, 17.3.2 Close X-RAY COVER, 17.1.2 Open X-RAY COVER, 17.1.2		
	17.3.5	X-Ray Purge		Verify EUV telescope deactivated and He Glow shutdown before proceeding.
		Verify X-RAY Operation, 17.3.2 X-RAY PURGE - START (mom) X-RAY HV PWR tb - bp		Talkback is barberpole for duration of the purge (≈5 minutes). X-ray will return to nominal operation mode at completion of purge. Five minute gas purge will be performed at initial turn-on and as recommended by STDN during experiment operation, except during crew rest periods. The protective cover must be open prior to and during purges. A maximum of 4 purges per day will be performed.

NORMAL/BACKUP

STA/T	STEP	PROCEDURE	PANEL	REMARKS
		17.3.6 X-Ray Calibration		
		Verify X-RAY Operation, 17.3.2		
		(Deleted)		
DP		**X-RAY PURGE - CAL** (mom), hold for 20 seconds, then ctr	230	X-ray detector is exposed to Fe 55 calibration source for the time that switch is held in CAL position. A 20-second calibration will be performed approximately every three hours of experiment operation, except during crew rest periods. Calibration while real time data reception is available is desirable.
		(Deleted)		
		17.3.7 X-Ray Backup Purge		Verify EUV Telescope deactivated and He Glow shutdown and covers closed before proceeding.
		Verify X-RAY Startup, 17.3.1		
		X-RAY BACKUP PURGE - ON (mom)		Backup purge is used to deplete the P-10 gas supply or if nominal purge cannot be accomplished.
		X-RAY BACKUP PURGE tb - bp		
		Continue purge as directed by STDN		
		X-RAY BACKUP PURGE - OFF (mom)		
		X-RAY BACKUP PURGE tb - gray		

STA/T	STEP	PROCEDURE	PANEL	REMARKS
		17.4 HELIUM GLOW DETECTOR (HGD)		MA-088. Measure intensity and spatial distribution of interplanetary helium and in-flow velocity of interstellar medium within the solar system. In order to acquire maximum supplementary data, the He Glow Detector is operated, as much as possible during the mission, including sleep periods, whenever hardware constraints are not violated.
		17.4.1 HGD Operation		
		Maneuvers/Target Pointing		He Glow instrument pointing accuracy must be within ±2.0 degrees.
		(V49) Crew Defined Mnvr, 8.3.4 (P20) Options 2 & 5, 10.2.1		V49 and P20 options 2 and 5 used in various maneuver combinations for mapping (scanning) and pointing (discrete target) source observations to measure He line radiations, and determine shape of spectral line and motion of their sources. Refer to Flight Plan for detailed maneuver and pointing requirements.
DP		cb He GLOW MNB - close Open He GLOW COVER, 17.1.2	274	The protective cover must be open for at least 10 seconds before HGD is activated.
		HELIUM GLOW - ON	230	
		17.4.2 HGD Shutdown		
		HELIUM GLOW - OFF Close He GLOW COVER, 17.1.2		The protective cover must be closed within TBD seconds after HGD deactivation.
		17.4.3 HGD Helium Inhibit		Helium inhibit is used to stop the flow of helium to a detector in event of a malfunction within the helium system.
		Verify HGD Operation, 17.4.1 HELIUM GLOW He INHIBIT - DET 1 (DET 2)		

NORMAL/BACKUP

STA/T	STEP	PROCEDURE	PANEL	REMARKS
		17.5 EXTREME ULTRAVIOLET TELESCOPE (EUVT)		MA-083. Search for radiation sources of EUV in region between 50 and 1000 Angstrom units. In order to acquire maximum supplementary data, the EUV Telescope will be operated as much as possible during the mission, including sleep periods, whenever hardware constraints are not violated.
		17.5.1 EUVT Activation		
		Maneuver/Target Pointing		EUV Telescope LOS pointing accuracy must be within ±2.0 degrees.
		(V49) Crew Defined Mnvr, 8.3.4 (P20) options 2 & 5, 10.2.1		V49 and P20 options 2 and 5, used in various maneuver combinations for mapping (scanning) discrete and extended radiation sources, and pointing (discrete target) source observations. Refer to the Flight Plan for detailed maneuver and pointing requirements.
		Open EUV COVER, 17.1.2		The protective cover must be open for at least 10 seconds before EUVT is activated.
DP		EUV TELESCOPE PWR - on (up) EUV TELESCOPE DET - DET 1 (mom) (-DET 2 (mom))	230	Positioned as directed in flight plan.
		17.5.2 EUVT Deactivation		
		EUV TELESCOPE PWR - OFF		EUV COVER must not be closed while EUV TELESCOPE PWR is on.
		Close EUV COVER, 17.1.2.		

EUVT DEACTIVATION

STA/T	STEP	PROCEDURE	PANEL	REMARKS
		17.6 ULTRAVIOLET ABSORPTION (UVA)		MA-059. Measure concentrations of atomic oxygen and atomic nitrogen in the atmosphere by optical absorption spectroscopy. Performed with tunnel 1 hatches open to provide drag through cable access from Command Module to Docking Module.
		17.6.1 Connect Drag Thru Cable		
DP		Verify cb UV/DOPPLER MNA - open	274	
		UV ABSORPTION PWR - OFF	230	
		UV ABSORPTION LAMPS - OFF		
		EXPERIMENT COVERS ARM - SAFE		
		UV COVER - ctr		
		UV COVER tb - gray		
		Remove UV ABSORPTION J1 dust cap on pnl 230		
		Obtain UVA drag thru cable from stowage. Remove & stow connector dust caps		
		Conn drag thru connector P1 to J1 on pnl 230 (red dot to red dot)		
		Route P2 end of drag thru cable through tunnel 1 to crewman in DM.		
(DM)		Remove UV ABSORPTION J2 dust cap on pnl 862	862	
		Conn drag thru connector P2 to J2 on pnl 862 (yellow dot to yellow dot)		

NORMAL/BACKUP

STA/T	STEP	PROCEDURE	PANEL	REMARKS
		17.6.2 UV Cover Open (Close)		
		DRAG THRU CABLE connected, 17.6.1		
DP		cb ELECTROPHORESIS/COVERS (2) - close (verify)	274	
AC		AUTO RCS B3, C4, & D4 (3) - OFF	8	
DP		cb EXPERIMENT COVERS (2) - close (verify)	230	
		EXPERIMENT COVERS ARM - ARM		
		UV COVER - OPEN (CLOSE)		Cover must be closed during and remain closed for 15 minutes following spacecraft dumps. Cover must be closed when instrument FOV centerline within 20° of sun.
		UV COVER tb - gray,-bp (<5 sec),-gray		Talkback is barberpole while cover is between full open or full closed, (less than 5 seconds).
		xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx		
		If bp >15 sec EXPERIMENT COVERS ARM - SAFE		**Contact STDN and/or go to appropriate malfunction procedures for further instructions. Remove power with ARM/SAFE switch so that UV cover switch provides cover position indication until problem resolved.**
		xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx		
		EXPERIMENT COVERS ARM - SAFE		
		17.6.3 UVA/COAS Alignment		Provides alignment check of UVA to COAS FOV and star UV reference data accumulation.
		G&C Syst Prep, 17.2		
		Opt - on, 8.1.4		
AC		COAS PWR - on (up)	15	COAS previously installed and calibrated for IMU alignment at Post Orbital Insertion.
		Open UV COVER, 17.6.2		

STA/T	STEP	PROCEDURE	PANEL	REMARKS
DP		cb UV/DOPPLER MNA - close	274	
		UV ABSORPTION PWR - ON	230	Instrument turned on 5 minutes prior to operation for data accumulation to allow star tracking system warmup.
CP		SYS TEST (2) - 8C	101	UVA EXP POINTING ERROR display.
		SYS TEST ind - 0-5 vdc (cycling)		With no return signal, meter cycles between 0 and 5 vdc once per second.
		UVA FOV to COAS FOV Calib Close UV COVER, 17.6.2 if mnvr thru sun line to calib star Using 1st mag or brighter trgt star perform UVA FOV calibr, 13.1.8 steps 1 thru 6, then PRO to N92 V06 N92	2,140	
		SA XXX.XX DEG TA XX.XXX DEG		
		Open UV COVER, 17.6.2 if closed for mnvr Mnvr in yaw to zero tgt star in COAS. Trim yaw to maximize pointing signal (V→2.5) **Note COAS Yaw Offset.**		
		SYS TEST ind - mnvr in pitch to attain 2.5V UV pointing signal on meter. If necessary retrim yaw. When SA & TA relatively constant & 2.5V UV pointing signal	101	If meter oscillating, pointing attitude is >1.5 degrees in yaw or >3 degrees in pitch off center of UVA target FOV. If meter indicates <2.0V, pitch down. If meter indicates >3.0V, pitch up.

NORMAL/BACKUP

STA/T	STEP	PROCEDURE	PANEL	REMARKS
CP		KEY VERB (to freeze disp) Accept Rcd SA & TA for use in mnvr to UV trgt Reject KEY REL Repeat V06 N92	2,140	Provides UV instrument alignment offset bias to enable more precise maneuver pointing accuracy.
		Sel desired prog Opt - as req		
AC		COAS PWR - OFF UVA Calibration, 17.6.6	15	
	17.6.4	UVA Operation		
		C&G Syst Prep, 17.2 (req) COAS PWR - on (up) Open UV COVER, 17.6.2		
DP		cb UV/DOPPLER MNA - close (verify) UV ABSORPTION PWR - ON UV ABSORPTION LAMPS - ON	274 230	Lamps must be on for 20 minutes prior to operation for data accumulation.
CP		SYS TEST (2) - 8C VHF AM Ranging Mode, 5.6.4 (V49) mnvr to acq Soyuz reflector	101	UV EXP POINTING ERROR display. Maneuver using PAD or on-board chart data corrected for UV instrument alignment offset bias.
		Verify Soyuz reflector aligned to COAS Yaw Offset Value. Trim yaw to maximize pointing signal (V→2.5)		

UVA DEACTIVATION

STA/T	STEP	PROCEDURE	PANEL	REMARKS
CP		SYS TEST ind - mnvr in pitch to 2.5V, UV pointing signal on meter	101	If meter indicates <2.0V, pitch down. If meter indicates >3.0V, pitch up.
		Mnvr as req for data collection To rotate about a target vector, sel P20, Opt 2, 10.2.1		Maneuver includes rotating about Soyuz at distances of 150, 500, and 1000 meters with CSM sweep at approximately 3°/min, across Soyuz retro-reflector, while maintaining experiment pointing accuracy.
		To translate for subs data collection Close UV COVER, 17.6.2		
AC		AUTO RCS - as req (Deleted)	8	
		Reconfigure for data collection when translation complete		
		When data collection complete COAS PWR - OFF	15	
DP		VHF RNG - OFF	3	
		UVA Calibration, 17.6.6		
	17.6.5	UVA Deactivation		
		UV ABSORPTION LAMPS - OFF (verify)	230	
		UV ABSORPTION PWR - OFF		
		Close UV COVER, 17.6.2		
	17.6.6	UVA Calibration		
		After		
		UVA/COAS Alignment, 17.6.3		UVA Calibration performed after UVA/COAS alignment and following each UVA operation for data accumulation.
	or	UVA Operation, 17.6.4		

NORMAL/BACKUP

STA/T	STEP	PROCEDURE	PANEL	REMARKS
CP		SYS TEST - 8C	101	
DP		VHF RNG - OFF (verify)	3	
		Mnvr off tgt - verify pnl 101 meter cycling		Vehicle +X axis about 10° above Soyuz and away from earth.
		Calibration		
		a. Lamps on - covers open (30 sec) UV ABSORPTION LAMPS - ON (verify) UV COVER - OPEN (verify)	230	
		b. Lamps on - cover closed (30 sec) UV COVER - CLOSE		
		c. Lamps off - cover closed (30 sec) UV ABSORPTION LAMPS - OFF		
		d. Lamps off - cover open (30 sec) UV COVER - OPEN		
	17.6.7	Disconnect Drag Thru Cable		Drag thru removed and stowed in preparation for CSM/DM separation.
		Verify		
		cb UV/DOPPLER MNA - open	274	
		UV ABSORPTION PWR - OFF	230	
		UV ABSORPTION LAMPS - OFF		
		UV COVER closed, 17.6.2		
		Remove drag thru Cable from J1, panel 230. Install J1 dust cap. Pass cable thru tunnel for stowage in DM		

STA/T	STEP	PROCEDURE	PANEL	REMARKS
		17.7 DOPPLER TRACKING (DT)		MA-089. DM will be tracked to detect and record relative accelerations between CSM and DM (map earth gravity field anomalies). To minimize non-gravitational contribution to experiment data, all activities that impact translation to SC should be inhibited during data collection. These include dumps, venting operations, SPS burns, and uncoupled RCS firings. Effects of crew motions should also be minimized.
		17.7.1 DT Receiver Standby		
DP		cb UV/DOPPLER MNA - close	274	
		DOPPLER RECEIVER - WARMUP	230	Place in WARMUP 50 hours before operation for data collection.
		17.7.2 DT Transmitter Standby		
(DM)		cb DOPPLER XMTR DMA - close	815	
		DOPPLER XMTR - WARMUP		Place in WARMUP 50 hours before operation for data collection.
		17.7.3 Connect Doppler Tape Recorder		
CP		Remove Doppler tape rcdr from launch stowage & locate in locker F2	F2	
		Obtain Doppler tape rcdr cable from stowage. Remove/stow dust caps		
		Pass P1 cable end thru locker access hole & conn to J1 on tape rcdr (white dot to white dot)		
DP		Remove dust cap from J6 - pnl 230	230	
		Route P2 end of cable to pnl 230 & conn to J6 (orange dot to orange dot)		

STA/T	STEP	PROCEDURE	PANEL	REMARKS
		17.7.4 Doppler Operations		Provides for nominal DM release and separation for the ASTP mission with compatible requirements for the Doppler Tracking experiment.
		DT Receiver Operate		
		Connect Doppler tape rcdr, 17.7.3		
		Verify warmup, 17.7.1		
DP		DOPPLER RECEIVER - OPERATE	230	Place in OPERATE 4 hours before operation for data collection.
		Notify STDN rcvr operating		Doppler tracking frame count must be recorded by STDN at least once after receiver turned to OPERATE. If turned OFF and then back to OPERATE, frame count must again be recorded by STDN.
		DT Transmitter Operate		
		Verify warmup, 17.7.2		
(DM)		DOPPLER XMTR - OPERATE (one continuous motion)	815	Set to OPERATE position at least one hour prior to jettison. Switch operation from WARMUP to OPERATE shall be one continuous motion.
		cb DOPPLER XMTR DMA - open		In OPERATE, transmitter receives power from transmitter battery.
		Notify STDN xmtr operating		
AC		FDAI SCALE - 5/1 (verify)	1	
CP		SYS TEST (2) - 8D	101	
		(Deleted)		

NORMAL/BACKUP

STA/T	STEP	PROCEDURE	PANEL	REMARKS
		DM Jett Conf, 18.4.4		
		Fwd hatch seal integrity ck, 5.7.3		
		Perform DM Jett Prep		
DP		cb DM PWR (2) - open	274	
AC		cb SECS ARM (2) - close	8	
		After STDN AOS		
		SECS LOGIC (both) - on (up)		Lever lock.
		Report logic arm		
		After GO from STDN		
		SECS PYRO ARM (2) - on (up)		Lever lock.
		Maneuvers/Target Pointing		Subsequent to DM release, CSM is maneuvered behind and in same plane as DM.
		(V49) mnvr to DM jett att, 8.3.4 (DM Z-axis normal to orbital plane)		
		(P20) opt 2, 10.2.1 Initate spin about DM Z-axis (≈5°/sec)		Provides DM rotational stability after release. Gamma and Rho of P20 (N78) specifies axis of rotation. ≈35-seconds required to establish 5°/sec rotation. Spin should be stabilized such that after DM release, coning angle about DM Z-axis <10°.
		DM Jett		
DP		cb CSM/DM FNL SEP (2) - close	277	
CP		CSM/DM FNL SEP (both) - on (up)	2	Guarded and momentary. Provides jettison of docking ring, with probe and DM attached, from CSM. Refer to Operational Data Book, Para 4.8.1.2 for data relative to separation velocities.

STA/T	STEP	PROCEDURE	PANEL	REMARKS
		After jett, but prior to sep burn, damp (null) CSM R, P & Y rates		Permits determination of DM rotation rates via DAC.
		Postjett pnl reconfig		
AC		SECS PYRO ARM (2) - SAFE	8	Lever lock.
		SECS LOGIC (both) - OFF		Lever lock.
		cb SECS ARM (2) - open		
		(P20) opt 5 mnvr to Doppler trk att, 10.2.1		P20 option 5, used in various maneuver combinations for Doppler tracking and simultaneous earth observations. Doppler data taken from the point of CSM/DM separation. Doppler antenna pointing accuracy within ±30° with CSM deadbanding within ±5°.

NORMAL/BACKUP

STA/T	STEP	PROCEDURE	PANEL	REMARKS
		17.8 STRATOSPHERIC AEROSOL MEASUREMENT (SAM)		MA-007. Measure the concentration and vertical distribution of aerosols in the stratosphere.
		17.8.1 SAM Installation		
		Remove SAM from launch stowage and install on dovetail hard mount at RH side window with optic 90° to window plane. Remove J1 and J2 dust caps		
		Obtain SAM coax & pwr cables from stowage. Remove & stow cable dust caps		
DP		Conn coax conn P2 to J2 on SAM (Deleted)	SAM	SAM coax cable not color coded.
		Conn pwr cable conn P1 to J1 on SAM (white dot to white dot)		
		Route P79 end of coax & P2 end of pwr cable to pnl 227		
		Verify		
		cb SCI EQUIP HATCH - open	5	
		NONESS BUS - OFF		
		SCI PWR - OFF	227	
		Remove J79 and J85 dust caps, pnl 227		
		Conn coax P79 to (SAM) J79 at pnl 227. Conn pwr cable P2 to J85 on pnl 227 (orange dot to orange dot)		
		17.8.2 SAM Operation/Data Collection		
		G&C System Prep, 17.2		
		SAM Activation		
		Verify SAM Installation, 17.8.1		

STA/T	STEP	PROCEDURE	PANEL	REMARKS
DP		cb SCI EQUIP HATCH - close	5	
		NONESS BUS - MNA or MNB		
		SCI PWR - on (up)	227	
		SAM ind lt - on	SAM	
		Establish SAM sun LOS orient (P20) opt 1, 10.2.1 (N78 - Gamma = 53.35°, Rho = 25.83°)		Nominal SAM values.
		Mmnvr to SAM att		Should be established with sufficient time for calibration and to damp rates to acceptable values prior to data collection.
		SAM Inflight Alignment Cal		Delta values obtained from SAM inflight calibration target.
CP		Key V06 N78E Load final γ & ρ	2,140	
		(P20) opt 1, 10.2.1 Mnvr to final SAM att Verify solar disc centered in SAM trgt ring		SAM photometer LOS should be within ±2.0° of sun at start of data collection. Verification that solar disc is centered (inside 2.0° circle) in SAM target ring for initial sunset data collection, will provide adequate onset alignment for time critical sunrise data collection.

	γ	ρ
Nominal	53.35	25.83
Delta	X.XX	X.XX
Final	XX.XX	XX.XX

STA/T	STEP	PROCEDURE	PANEL	REMARKS
DP		SAM CAL - ON (5-sec)	SAM	Calibration establishes the base and verifies proper installation and cable connection.
		Null att errors & rates just prior to inhibiting jets		Minimum error and rates required to ensure entire solar disc will remain within 10° FOV of photometer during approximate 3-minute data collection period.
AC				
-00:30		CMC MODE - FREE	1	Inhibit RCS 30-seconds before data collection.
00:00		Start Data Collection		
		When data collection complete		
		G&C Control - as reqd		
		SAM Deactivation		
DP		SCI PWR - OFF	227	
		SAM ind lt - off	SAM	
	17.8.3	SAM Removal		
		Verify		
		SCI PWR - OFF	227	
		cb SCI EQUIP HATCH - open	5	
		NONESS BUS - OFF		
		Remove coax & pwr cable Connectors from J79 & J85 at pnl 227. Install J79 & J85 dust caps.	227	
		Remove coax & pwr cable connectors from J1 & J2 on SAM. Install J1 & J2 dust caps. Stow cables.	SAM	Cables stowed in DM for CM/DM separation.
		Remove SAM from dovetail hardmount & stow		For stowage, reference NASA-5-74-517.

SAM OPERATION/DATA COLLECTION

STA/T STEP	PROCEDURE	PANEL	REMARKS
	17.9 MULTIPURPOSE ELECTRIC FURNACE SYSTEM (MEFS)		MA-010. Perform experiments on solidification, crystal growth, and other procedures involving phase changes in various types of materials.
	17.9.1 Furnace Evacuation		
	CAUTION Prior to evacuating furnace verify experiment sample cartridges are installed to preclude depressurizing DM thru vent system.		
(DM)	He Isol vlv - CLOSE (verify) He Press vlv - CLOSE (verify) He Vent vlv - CLOSE (verify)	MEFS	
	FURNACE ISOL VALVE - OPEN	880	
	FURNACE VENT VALVE - VENT He Press vlv - OPEN, then CLOSE	MEFS	To vent DM 02/N2 from He injection cavity.
	DOCK SYS A TEST SEL - FURN PRESS DS A TEST ind - >4.0V	856	The system A meter provides for vacuum reading of furnace system from 3 x 10^{-3} TORR (0V) to 3 x 10^{-4} TORR (5V) with 1 x 10^{-3} TORR, required by the furnace, assured at 4.0V or greater.
	17.9.2 Furnace He Injection		Helium injection time for each specimen cartridge to be subsequent to illumination of END status indicator or as directed by ground control.
	FURNACE VENT VALVE - CLOSE FURNACE ISOL VALVE - CLOSE	880	
	He Isol vlv - OPEN, then CLOSE He Press vlv - OPEN, then CLOSE	MEFS	

NORMAL/BACKUP

STA/T STEP	PROCEDURE	PANEL	REMARKS
	17.9.3 Sample Cartridge Prep		
(DM)	FURNACE VENT VALVE - CLOSE (verify) FURNACE ISOL VALVE - CLOSE (verify) He Vent vlv - OPEN He Press vlv - OPEN, then CLOSE He Vent vlv - CLOSE	880 MEFS	Prior to initial sample processing, He Vent vlv & He Press vlv are opened to vent prelaunch He backfill in furnace.
	Retrieve sample cartridge from stowage Install sample cartridge in furnace		Sequence of sample cartridge processing defined in flight plan.
	For MA-060 Experiment Retrieve MA-060 pulser & control cable Install MA-060 pulser on furnace shroud cb GERM CRYS GROWTH MNA - open (verify) GERM CRYS GROWTH PWR - OFF Conn MA-060 cont cable connector P1 to J1 on pnl 862	 862	MA-060, Germanium Crystal Growth.
	Furnace Evacuation, 17.9.1 Set MEFS Control Param		Set soak setting, soak period, cooldown rate, and RATE RATIO according to Flight Plan tabular data. Approach soak and RATE RATIO settings slowly in CW direction. If desired, turn CCW 1/4 turn and reapproach setting.

SAMPLE CARTRIDGE PREP

STA/T STEP	PROCEDURE	PANEL	REMARKS
(DM)	Select Furnace soak temp	MEFS	Selectable from 40°C to 1150°C depending upon specific sample cartridge requirements.
	(Deleted)		
	Select Furnace soak period		Selectable from 1 to 64 hours, including manual, depending upon specific sample cartridge requirements.
	Select cool down rate		Selectable from passive to 0.6, 1.2, and 2.4°C/minute, depending upon specific sample cartridge requirements.
	Select RATE RATIO		
	Select control thermocouple pair TC1/TC2		Selects active thermocouple pair for MEFS monitoring (ie., TC1 = H_1/C_1 & TC2 = H_2/C_2).
	TM - 1/2		Selects thermocouple pair for CSM PCM processing.
17.9.4	Sample Cartridge Initiate		CSM overboard dumps are constrained from MEFS initiation through He injection.
	CAUTION Maintain spacecraft control mode that will minimize imparting accelerations to the experiment or disturbance of the sample solidification process will occur.		

NORMAL/BACKUP

STA/T	STEP	PROCEDURE	PANEL	REMARKS
		CMC (SCS) Min Impulse, 7.1.5 (7.1.2) (Select single jet by axis)		CSM minimum impulse single jet attitude control mode from initiation through termination imparts minimum vehicle acceleration to the experiment.
		Verify Sample Cartridge Prep, 17.9.3		
DP		cb DM FURNACE/CRYS GROWTH (3) - close	274	
		For MA-060 Experiment		
(DM)		cb GERM CRYS GROWTH MNA - close	862	
		GERM CRYS GROWTH PWR - ON		
		POWER - ON	MEFS	
		START - START (mom)		
		17.9.5 Sample Cartridge Termination		
		(Deleted)		
		FURNACE COOL lt - on (verify)		Touch temperature of furnace is less than 46°C.
		START - OFF		
		POWER - OFF		
		For MA-060 Experiment	862	
		GERM CRYS GROWTH PWR - OFF		
		cb GERM CRYS GROWTH MNA - open		
		MA-060 Pulser Cont Cable - disconn		
		Remove & stow pulser & cont cable		
		Equalize DM/furnace pressure		
		He Press vlv - close (verify)	MEFS	
		FURNACE ISOL VALVE - OPEN	880	
		FURNACE VENT VALVE - VENT (5 sec), then CLOSE		Purge He from furnace and lines.
		FURNACE ISOL VALVE - CLOSE		

SAMPLE CARTRIDGE TERMINATION

STA/T STEP	PROCEDURE	PANEL	REMARKS
(DM)	He Press vlv - OPEN He Vent vlv - OPEN (5 sec), then CLOSE He Press vlv - CLOSE	MEFS	Repressurize furnace with DM atmosphere.
	17.9.6 Furnace Lamp Test POWER - ON (verify) LAMP TEST - 1 Lamps, top row (4) - on LAMP TEST - 2 Lamps, bottom row (4) - on LAMP TEST - OFF POWER - OFF		
	17.9.7 Sample Cartridge Temp Verification Sample Cartridge Initiate, 17.9.4 CARTRIDGE TEMP - HOT 1/HOT 2 (DIGITAL READOUT 0-1150°C) CARTRIDGE TEMP - COLD 1/COLD 2 (DIGITAL READOUT 0-200°C)		On board verification of MEFS sample cartridge process temperature.

NORMAL/BACKUP

STA/T	STEP	PROCEDURE	PANEL	REMARKS
		17.10 ELECTROPHORESIS EXPERIMENT (EPE)		MA-014. ELECTROPHORESIS-GERMAN Experiment. Investigate possibilities of improved performance of free flow electrophoresis process in the absence of gravity.
		17.10.1 EPE Preparation		Verifies prelaunch EPE cooling of ECS secondary cooling loop and reconfigures for evaporative cooling prior to EPE Initiate.
DP		cb ELECTROPHORESIS/COVERS (2) - close (verify)	274	
CP		FREEZER - ON (verify)	EPE	Freezer power must be on at all times. Samples are in freezer.
		SAMPLE TEMP - 0-5°C (verify)		
		Open coolant contr atten pnl		Covers panel 382.
		SUIT HT EXCH SEC GLY - BYP	382	
		SEC CAB TEMP vlv - OFF (ccw)	303	
		GLY TO RAD SEC vlv - BYP (verify)	377	
		SEC EVAP H2O CONT - AUTO (verify)	382	
		ECS IND sel - SEC	2	
		SEC COOL PUMP - AC2 (verify)		
		SEC GLY DISCH PRESS ind - 39-52 psig		
		SEC ACCUM QTY ind - 30-60%		
		SEC COOL EVAP - EVAP		
		SEC GLY EVAP STM PRESS ind - 0.09-0.14 psia (when boiling) >0.14 psia (not boiling)		
		After 5 min		
		SEC GLY EVAP OUT TEMP ind - 40-45°F		SEC GLY EVAP OUT TEMP indication must be 40-45°F prior to initiating EPE.
		EPE COOLING - COOL (cw) (tool E) (verify)	165	For stowage of tool E reference NASA-S-74-517.

EPE INITIATE

STA/T	STEP	PROCEDURE	PANEL	REMARKS
		17.10.2 EPE Initiate		
		CAUTION Maintain spacecraft control mode that will minimize imparting accelerations to the experiment or acceleration induced sedimentation and thermal convection will occur.		
		CMC (SCS) Min Impulse, 7.1.5 (7.1.2) (Select single jet by axis)		CSM minimum impulse single jet attitude control mode during EPE operations imparts minimum vehicle accelerations to the experiment.
		Verify EPE Preparation, 17.10.1		
CP	1	Experiment start up EXPERIMENT - ON Verify Standby Status STANDBY lt - on PRERUN lt - out STEP 1/2/3 lt - out POST RUN lt - out FLUID NO GO lt - out CHAMBER NO GO lt - out RECORDER NO GO lt - out FREEZER NO GO lt - out LAMP CHECK pb - push (hold) Verify 8 lights on	EPE	

STA/T	STEP	PROCEDURE	PANEL	REMARKS
	2	Sample process initiation CAUTION Initiation of sample is irreversible for that sample. Remove sample (1, 2, or 3) from EPE receptacle or sample from MA011 freezer and install in SAMPLE INLET		
CP		SEQUENCE START pb - push Verify Sequence PRE RUN lt - on 200 sec STEP 1/2/3 lt - on 350 sec POST RUN lt - on 150 sec STANDBY lt - on	EPE	
	3	Remove sample from SAMPLE INLET, return to receptacle. If next sample processing to follow, return to step 2. If next sample processing to be delayed, proceed to 17.10.3.		
	17.10.3	EPE Termination EXPERIMENT - OFF FREEZER - OFF (only after last sample)		Freezer may be turned off following processing of last stored sample.
		SEC COOL EVAP - RSET 1 min, then off (ctr)	2	

EPE LAMP TEST

STA/T	STEP	PROCEDURE	PANEL	REMARKS
CP		SEC EVAP H2O CONT vlv - OFF	382	
		SEC COOL PUMP - off (ctr)	2	
		ECS IND sel - PRIM		
		SUIT HT EXCH SEC GLY - FLOW	382	
		Close coolant contr atten pnl		Covers panel 382.
		EPE COOLING - BYPASS (ccw) (tool E)	165	Reference NASA-S-74-517
		SEC CAB TEMP vlv - as desired	303	
	17.10.4	(Deleted)		

STA/T	STEP	PROCEDURE	PANEL	REMARKS
		17.11 ELECTROPHORESIS TECHNOLOGY EXPERIMENT (ETE)		MA-011. ELECTROPHORESIS - U.S.A. Experiment. Test new techniques for performing electrophoresis demonstrations in space flight.
		17.11.1 ETE Preparation		
		Obtain power cable from stowage. Remove & stow connector dust caps.		
DP		cb AC UTIL (3) - open (verify)	5	
CP		AC UTIL PWR - OFF (verify)	201	
		Conn power cable connector P2 to J1 on pnl 201. Route P1 cable end across LEB to ETE & Conn to J1 on ETE	ETE	ETE power cable not color coded.
		Lift ETE cover & lock upright		
		POWER - OFF (verify)		
		TEMP SELECT - OFF (verify)		
		MODE SELECT - OFF (verify)		
		SHUNTS - DISENGAGE (verify)		
		Set up ETE fluorescent lamp Remove lamp & cable from ETE console. Attach lamp to velcro on cover Connect cable from lamp to receptacle on back of ETE console.		
		Obtain 70 mm HEDC, 80 mm lens, lens extdr, film pack, & IVL from stowage		Hasselblad Electric Data Camera **Intervalometer**
		Config camera & attach to ETE cover brkt		
		Obtain freezer from stowage & position near ETE		
		Use tool E (5/32 allen wrench) to loosen freezer cover		

NORMAL/BACKUP

STA/T	STEP	PROCEDURE	PANEL	REMARKS
DP		cb AC UTIL (3) - close	5	
CP		AC UTIL PWR - on (up)	201	
		17.11.2 ETE Operation - Electrophoresis/ Isotachophoresis		
		CAUTION Maintain spacecraft control mode that will minimize imparting accelerations to the experiment or acceleration induced sedimentation and thermal convection will occur.		
		CMC (SCS) Min Impulse, 7.1.5 (7.1.2) (Select single jet by axis)		CSM minimum impulse single jet attitude control mode during ETE operations imparts minimum vehicle accelerations to the experiment.
		ETE Preparation, 17.11.1		
CP	1	Retrieve numbered column from ETE stowage comp't & place on thermoelectric cradle	ETE	ETE columns and sample slides are numbered and are required to be processed in order defined by flight plan: 1. Electro of fixed red blood cells 2. Electro of lymphocytes 3. Electro of kidney cells 4. Isotach of fixed red blood cells 5. Electro of fixed red blood cells 6. Electro of lymphocytes 7. Electro of kidney cells 8. Isotach of fixed red blood cells

STA/T	STEP	PROCEDURE	PANEL	REMARKS
CP		SHUNTS - ENGAGE (columns 1, 4, 5 & 8) - DISENGAGE (columns 2, 3, 6, & 7)	ETE	Shunts are engaged for processing of fixed red blood cells only.
		Clamp column in place		Do not twist end caps when placing column in cradle.
		Remove fluid connections from bypass loop, blot excess buffer from needle tips with absorbant material and attach fluid connections to column (each column except 4 & 8).		No fluid connections required for isotachophoresis of fixed red blood cells.
		Remove numbered sample slide from freezer & insert into column CAUTION Do not leave freezer cap off for more than 40 sec, or the freezer insert extended for more than 15 sec or samples will start to thaw.		
		COLUMN COVER - off (columns 1, 4, 5, & 8) - on (columns 2, 3, 6, & 7)		The cover is not installed for processing fixed red blood cells.
		Inspect/clean ETE airflow screen		

STA/T	STEP	PROCEDURE	PANEL	REMARKS
CP	2	POWER - ON	ETE	Allow 5 minutes after power on for the electronics to stabilize and sample to thaw before proceeding.
		TEMP SELECT - OFF (columns 1, 4, 5, & 8) - COOL (columns 2, 3, 6, & 7)		OFF is selected for fixed red blood cells. Cool is required for lymphocytes or kidney cells.
		TIME SELECT - 60		TIME SELECT - 60 is planned for all columns but may be changed after first column processing.
		CURRENT SELECT - HI		CURRENT SELECT - HI is planned for all columns, but may be changed after first column processing.
		Verify column temp (columns 2, 3, 6, & 7) COLUMN TEMP - +10 to 12°C		If TEMP SELECT - COOL required, column temp must be 10 (+2-0) °C before electrophoresis of the lymphocytes or kidney cells is initiated (≈15 minutes).
	3	Start camera operation MODE SELECT - ELECTRO (columns 1, 2, 3, 5, 6, & 7) - ISOTACH (columns 4 & 8)		Isotachophoresis required for fixed red blood cells, columns 4 and 8 only.
		CAUTION Do not touch column after power applied to column or disturbance of phoresis resulting in erroneous readings may occur.		
		Set 2-speed timer for 60 min		For the first column inform STDN of band positions, shapes, etc on a periodic basis during phoresis.
		After 2-speed timer run out Verify ETE timer run out, then MODE SELECT - OFF SHUNTS - DISENGAGE (columns 1, 4, 5, & 8) For columns 4 & 8 go to step 5.		

ETE OPERATION - ELECTROPHORESIS/ISOTACHOPHORESIS

STA/T	STEP	PROCEDURE	PANEL	REMARKS
CP	4	COLUMN COVER - off (column 2, 3, 6, & 7) COLUMN COVER - on (columns 1, 2, 3, 5, 6 & 7) TEMP SELECT - FREEZE Set 2-speed timer for 30 min. After 2-speed timer run out COLUMN COVER - off	ETE	Allow time for photographs of columns 2, 3, 6, & 7. Allow time for photographs of columns.
	5	Stop Camera operation After completing column 4 phoresis change camera magazine TEMP SELECT - OFF (columns 1, 2, 3, 5, 6, & 7) POWER - OFF Remove fluid connects, wipe off excess moisture on needles, & attach to bypass (columns 1, 2, 3, 5, 6, & 7) Remove frozen column and twist off each electrode (columns 1, 2, 3, 5, 6, & 7) Place frozen column in CRYO FREEZER CAUTION Do not leave freezer cover off for more than 40 sec, or the freezer insert extended for more than 15 sec or the samples will start to thaw		Allow 15 seconds for pump motor to stop. The removal of the frozen column and stowage in cryo freezer should be accomplished as quickly as possible to avoid any thawing of the column.

STA/T	STEP	PROCEDURE	PANEL	REMARKS
CP		Remove column & stow in ETE stowage compartment (columns 4&8)	ETE	
		17.11.3 ETE Termination		
		AC UTIL PWR - OFF	201	
DP		cb AC UTIL (3) - open	5	
CP		Disconnect power cable from ETE & from J1 on pnl 201. Restow	201	For stowage, reference NASA-S-74-517.
		Use tool E (5/32 allen wrench) to tighten freezer cover and return freezer to stowage		
		Disassemble camera equipt & return to stowage locations		
		Wipe off excess moisture on cradle and female column connectors	ETE	
		Close ETE cover		

STA/T	STEP	PROCEDURE	PANEL	REMARKS
		17.12 LIGHT FLASH (LF)		MA-106. Obtain data on the visual light flash phenomenon. During 90 minute manned period of data recording, angle between astronaut LOS and zenith to remain constant within 5-degrees. Additionally, while in the South Atlantic Anomaly (SAA), Astro LOS will be parallel to the earths magnetic lines of force within 5-degrees, and in a direction away from earth. Period within the SAA expected to be ≈5-minutes.
		17.12.1 LF Preparation		
		Obtain Power/Control Logic box, detector amplifier boxes, cables, & masks from stowage		
		Position power/control logic box on center couch		
		Position detector amplifier boxes on right & left couch headframe		
		Interconn power/contr logic box, detector amplifier boxes, & mask assemblies per cable color code		
CP		cb UTIL LEB MNB - open (verify)	229	
		UTIL PWR - OFF (verify)	100	
		Conn power/contr logic box cable P1 connector to J5 on pnl 100		Three cables for each crewman (event, detector, mask cables).
		Config LF Data Recorder	LF	
		If manned LF operation		
		Don light weight headsets		Intra crew communication required during experiment data gathering. Monitoring crewman operates experiment equipment and accomplishes experiment related support functions.
		Config comm for voice record, 5.6.7		
		Obs crewmen ingress Rt & left couches		Observing crewmen identify light flash occurrences
		Mon crewman install window shades & config for minimum ltg		

NORMAL/BACKUP

STA/T	STEP	PROCEDURE	PANEL	REMARKS
		(P20) opt 5, mnvr to LF att, 10.2.1		Attitude for LF experiment defined as CSM in retrograde position with -Z axis rotated 60° from zenith (+X axis 30° from zenith), and XZ plane rotated 35° from orbital plane such that +X axis is rotated towards North. Ground track passes through SAA are NW to SE (descending passes).
		17.12.2 LF Operation (Manned)		Flight plan will define specific orbital time to initiate manned operation.
		Verify LF Preparation, 17.12.1		
		Obs crewmen don light tight masks		
		Mon crewman config exper pnls		
CP		DARK ADAPTATION (4) - OFF (verify)	LF	
		POWER - OFF (verify)		
		cb UTIL LEB MNB - close	229	
		UTIL PWR - on (up)	100	
		POWER - DARK ADAPT, Record time	LF	Monitoring crewman enters start time, dark adaptation levels, and phenomena visual detection in written logs. Integral tape recorder activated with LF power on.
		POWER lamp - on (verify)		
		TAPE RECORDER lamp - on (verify)		
		DARK ADAPTATION (4) - as req		Dark adaptation is determined by monitoring crewman by selection of crewman 1/crewman 2 for each level of dark adaptation (1 thru 4) over a 20 minute period.
		POWER - DET 1 for ~23 min, then 2, etc		Monitoring crewman positions detector select every 23 minutes, from 1 through 4 (total 92 minutes). Dark adaptation is periodically verified with DARK ADAPTATION.
		POWER - OFF		
		DARK ADAPTATION (4) - OFF		
		UTIL PWR - OFF	100	If unmanned operation immediately follows, utility power is left on.

STA/T	STEP	PROCEDURE	PANEL	REMARKS
		17.12.3 LF Operation (Unmanned)		Flight plan will define specific orbital time to initiate unmanned operation.
		Verify LF Preparation, 17.12.1		
		Position mask assemblies & detector amplifier boxes on Rt & left couch head rests		For unmanned operation, the interconnected mask assemblies and detector amplifier boxes are placed on the right and left couch head rests for data gathering.
		Position pwr/contr logic box on ctr couch		
CP		cb UTIL LEB MNB - close (verify)	229	
		UTIL PWR - on (up)	100	
		DARK ADAPTATION (4) - OFF	LF	
		POWER - DARK ADAPT, Record time		Monitoring crewman enter start time.
		POWER lamp - on (verify)		
		TAPE RECORDER lamp - on (verify)		
		POWER - OFF		As directed by ground control or flight plan.
		UTIL PWR - OFF	100	
		17.12.4 LF Disassembly		
		POWER - OFF (verify)	LF	
		UTIL PWR - OFF (verify)	100	
		cb UTIL LEB MNB - open	229	
		Disconn cable assy's from power/control logic box, detector amplifier boxes, mask assemblies, and CSM pnl 100, J5		
		Retrieve tape cassette from power/control box		
		Stow cassette, detector amplifier boxes, mask assy's & written logs for return stowage		
		Stow cable assys, & power/contr box for DM off loading		

NORMAL/BACKUP

STA/T STEP	PROCEDURE	PANEL	REMARKS
	17.13 CRYSTAL GROWTH EXPERIMENT (CGE)		MA028. Determine if crystals can be grown by diffusion through water in zero gravity conditions.
	CAUTION After activating experiment, maintain spacecraft control mode that will minimize imparting accelerations to the experiment or disturbance will occur of the reactor solution diffusion process leading to crystal formation.		
	17.13.1 Crystal Growth Activation		
CP	Open U4 locker doors & restrain in open position	U4	
	Open Reactor Chamber Valves	CGE	Six reactors, each having two valves.
	Rotate knurl knob lock (CCW) to free key handle on each end of reactor chamber		Lock frees key handle for valve opening.
	Rotate key handle ~3 turns (CCW) to full open		Three revolutions stop to stop.
	Rotate knurl knob lock (CW) finger tight to secure valve in open position		
	Repeat proced for 5 other reactors		

CRYSTAL GROWTH ACTIVATION

STA/T STEP	PROCEDURE	PANEL	REMARKS
	xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx		
CP	If lock cannot be turned by hand Use spanner tool Rotate lock (CCW) to loosen If valve cannot be opened by hand	CGE	Spanner tool in U4, used to unseat knurl knob locks or key handles.
	CAUTION Do not force key handle if lock is not backed off.		
	Use spanner tool Rotate key handle (CCW) -3 turns to full open Rotate knurl knob lock (CW) to secure valve in open position		
	xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx		
	Close U4 locker doors		Doors closed carefully to avoid imparting accelerations to the reactors.
	17.13.2 Photographic Observations		Reaction process to be photographed at 6 to 10 hour intervals three times per day following activation
	Obtain 35 mm camera from stowage		
	Open U4 locker doors & restrain in open position	U4	
	FLOOD LTS - full BRT (cw)	100	
	Adjust LH mirror to illuminate cryst growth reactors		
	Photograph reactors	CGE	
	Close U4 locker doors		
	Restow camera		
	FLOOD LTS - as req	100	

NORMAL/BACKUP

STA/T STEP	PROCEDURE	PANEL	REMARKS
	17.14 GEODYNAMICS		MA-128. Detect and record relative accelerations between CSM and ATS-F Synchronous Relay Satellite. (A function of CSM-to-ATS-F doppler shift caused by gravity field anomalies.) Non-gravitational contributions to data collection must be minimized by inhibiting activities that impart translation to the SC such as dumps, venting operations, SPS burns, and uncoupled RCS firings. Crew motions should also be minimized.
	Configure G&C, 17.2 ATS-F HGA Oper, 5.6.15		
AC	FDAI - 5/1	1	Rates restricted to ±1/sec during data collection periods.
	Establish inertial hold (V49) mnvr to ATS-F trk att, 8.3.4 (P20) opt 5 ATS-F trking, 10.2.1		V49 and P20 opt 5 used in various maneuver combinations to enable ATS-F tracking and other simultaneous experiment operations requiring observations of star target sources or earth observations

STA/T STEP	PROCEDURE	PANEL	REMARKS
	17.15 EARTH OBSERVATION		MA-136. Observe and photograph earth features.
	Configure G&C, 17.2		
	(P20) opt 5, 10.2.1		Provides required pointing for visual observations of earth features and for photographic mapping of targets of prime scientific interest, and other photographs in support of visual observations.

NORMAL BACKUP

STA/T STEP	PROCEDURE	PANEL	REMARKS
	17.16 SOLAR ECLIPSE		MA-148 (AS-4). Test new methods of studying solar corona and contamination surrounding spacecraft.
	Configure G&C, 17.2		
	(V49) mnvr to undock att, 8.3.4		$-X_{D6}$ axis toward sun. Attitude hold accuracy, P $\pm$ 0.7°, R $\pm$ 1.0°.
	Set DAC for photos		
	Align COAS on docking trgt		
	Configure RCS, 7.1.1		
	Configure Dock System for sep, 18.1.2		
CP	Verify Dock System lts	2	
	Undock (sunrise +1.5 min)		At undocking, $+Z_{A4}$ and $-Y_{C5}$ axes in plane defined by spacecraft, Earth and Sun.
	THC (4 jet) -X (-3 sec)		
	Verify sep rate ~1 m/sec		
	DAC - operate (-5 min)		
	THC - +X (null Xlation rates)		

STA/T STEP	PROCEDURE	PANEL	REMARKS

18.0 APOLLO - SOYUZ OPERATIONS

18.1 DOCKING MODULE/SOYUZ DOCKING AND UNDOCKING CM ACTIVE

This section contains the procedural requirements for docking and undocking with the Soyuz with the CM Docking System in the active mode. (See figure 18-1 for status lights logic.)

MANEUVERS

(Deleted)

18.1.1 Docking With Soyuz, CM Active

1	The following are req CMC - on, 8.1.3 COAS - installed and calib, 13.1.8 SCS - on, 8.4.2 ISS - on & orient known, 8.1.3 & sec 14 RCS DAP load & activate, 8.2.1 R1 - 611XX R2 - X1111	Noun 46 display	At initiation of procedure, CSM shall be ≈15 to 50 feet from Soyuz properly aligned and in formation flight. Provides G&N control capability. Provides SCS control capability. Establishes G&N control capability as follows: CSM configuration, 4 quad translation (quads A, B, C, D - on). This maneuver should be performed in the following attitude and rate deadbands in either CMC or SCS control modes to simplify control task during docking.

	CMC	SCS
ATT DBD	±0.5° (R03)	±0.2° (MIN)
RATE DBD	+0.2°/sec (fixed)	±0.2°/sec (LO)
RATE CMD (RHC)	+0.5°/sec (R03)	±0.65°/sec

NORMAL/BACKUP

STA/T	STEP	PROCEDURE	PANEL	REMARKS
		Set SCS att controls		
AC		THC PWR - on (up)	1	
		RHC PWR DIR (both) - MNA/MNB		Enables direct RCS coils for contingency takeover.
		CMC MODE - HOLD		
		DBD/RATE - MIN/LO		
		ATT DBD - MIN		
		RATE - LO		
		LIM CYCLE - OFF		
		BMAG MODE (3) - ATT 1/RATE 2		
		MAN ATT (3) - RATE CMD		
		SC CONT - CMC		
		THC - ARMED		
		RHC (both) - ARMED		
	2	Verify control status for docking		
		COAS PWR - on (up)	15	
CP		EXT RENDZ LTS - SPOT	274	
		cb DM POWER (2) - close		
DP		Docking System A		
		cb DS A IND LOGIC MNA - close		
		cb DS A IND PWR AC1 - close		
		cb DS A CONTROL BAT A - close		
		cb DS A MOTORS AC1 (3) - close		
		Docking System B		
		cb DS B IND LOGIC MNB - close		
		cb DS B IND PWR AC2 - close		
		cb DS B CONTROL BAT B - close		
		cb DS B MOTORS AC2 (3) - close		
	3	Docking System Config for CM Active Docking		
DP		PASSIVE lt - on (verify)	2	

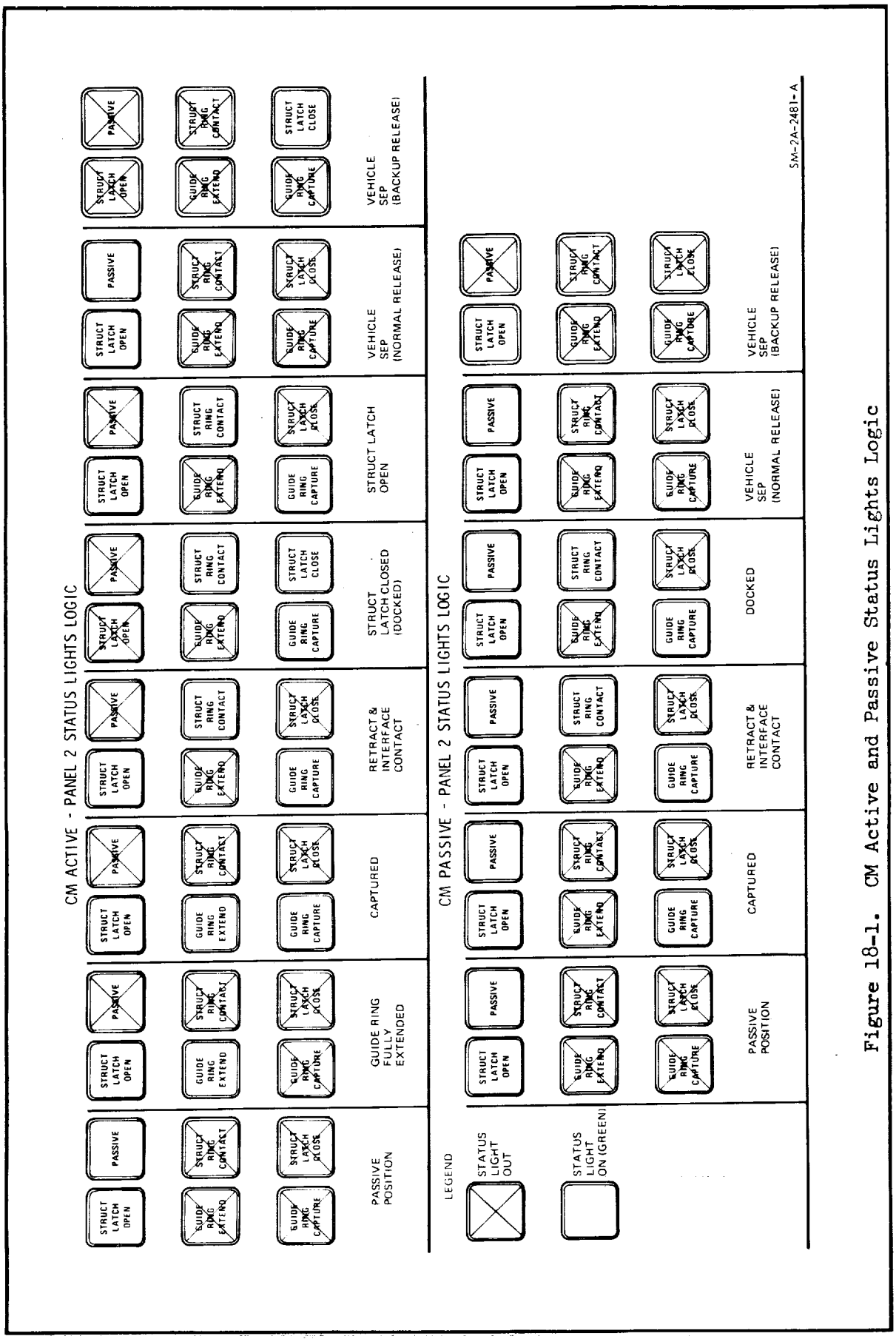


Figure 18-1. CM Active and Passive Status Lights Logic

18.1.1 DOCKING WITH SOYUZ, CM ACTIVE

NORMAL/BACKUP

STA/T	STEP	PROCEDURE	PANEL	REMARKS
CP		STRUCT LATCH OPEN lt - on (verify)	2	Refer to CM ACTIVE/PASSIVE POS status lts, Fig 18-1.
		CAUTION Guide ring EXTND/RETR must be operated on system A or B only (single motor). Dynamic forces using two motors could create loads in the structure beyond design limits.		
		GUIDE RING A - EXTND		System A only to be used. Guide ring fully extended in approximately 60 seconds. GUIDE RING A or B must be at EXTND until GUIDE RING EXTND lt on plus 8 seconds (minimum) after light on. This will ensure full deployment of guide ring. GUIDE RING EXTND light sense switches activate 1-1/2 inches from full deployment.
		PASSIVE lt - out		Refer to CSM ACTIVE/GUIDE RING FULLY EXTND status lts, Fig. 18-1. PASSIVE lt will go out prior to GUIDE RING EXTND lt on.
		GUIDE RING EXTND lt - on (8 sec min), then		Indicates guide ring extended and ready for soft dock - GUIDE RING EXTND lt on required for soft dock.

STA/T STEP	PROCEDURE	PANEL	REMARKS
	xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx		
	GUIDE RING EXTND lt not on	2	
	GUIDE RING A - off (ctr)		
	Wait up to 20 min until (cold) attenuators extend		
	STDN record docking system temp		
	GUIDE RING EXTND lt still not on		
	MN BUS TIE BAT B/C - on (up)	5	Battery on line during system B guide ring motor operation to prevent main bus undervoltage.
	GUIDE RING B - EXTND		
	GUIDE RING EXTND lt - on (8 sec min), then		
	GUIDE RING B - off (ctr)		
	GUIDE RING EXTND lt still not on		
	GUIDE RING EXTD LIMIT SW - BYPASS	862	
	GUIDE RING A - EXTND, until	2	
	GUIDE RING EXTND lt - on, (8 sec min), then		
	GUIDE RING A - off (ctr)		
	GUIDE RING EXTND lt still not on		
	GUIDE RING B - EXTND, until		
	GUIDE RING EXTND lt - on, (8 sec min), then		
	GUIDE RING B - off (ctr)		
	GUIDE RING EXTD LIMIT SW - NORMAL	862	
	MN BUS TIE BAT B/C - OFF	5	
	xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx		
	GUIDE RING A - off (ctr)		

STA/T	STEP	PROCEDURE	PANEL	REMARKS
CP AC	4	Initiate Capture THC - initiate to close at 0.2 to 0.4 fps RHC - maintain min relative alignment angles with the Soyuz. Maintain angular rates $\leq$0.2 deg/sec		
		THC - initiate translation thrust (4 thrusters) $+X_{A5}$ direction after initial contact (0.5 sec max)		Stop translation thrust in the $+X_{A5}$ direction a maximum of 0.5 sec after capture. GUIDE RING CAPTURE lt indicates capture of all three latches.
CP		GUIDE RING CAPTURE lt - on	2	Refer to CM ACTIVE/CAPTURED status lts, Fig 18-1. GUIDE RING CAPTURE lt on, before initiating guide ring retract.
		Spacecraft alignment achieved		
	5	Initiate Guide Ring Retract If System B required		
DP		MN BUS TIE BAT B/C - on (up)	5	Battery on line during system B guide ring motor operation to prevent main bus undervoltage.
CP		GUIDE RING A (B) - RETR GUIDE RING EXTND lt - out	2	System A or B only to be used. Guide ring fully retracted in approximately 50 seconds. GUIDE RING CAPTURE lt may flicker during retraction.
		STRUCT RING CONTACT lt - on		Refer to CM ACTIVE/RETR & INTERFACE CONTACT status lts, Fig 18-1. Indicates interface seal contact (required for structural latch preload).
		GUIDE RING A (B) - off (ctr)		2 seconds minimum after STRUCT RING CONTACT lt - on.
DP		If System B used MN BUS TIE BAT B/C - OFF	5	

STA/T	STEP	PROCEDURE	PANEL	REMARKS
CP	6	Structural Latch Preload		
		CAUTION Structural latches CLOSE must be operated by system A or B only (single motor). Stalled gear box load using two motors could exceed system cable breaking strength.		
		NOTE STRUCT LATCH CLOSE lt may flicker due to delay in relay lockup.		
DP		If System B required MN BUS TIE BAT B/C - on (up)	5	Battery on line during system B guide ring motor operation to prevent main bus undervoltage.
CP		STRUCT LATCH A (B) - CLOSE STRUCT LATCH OPEN lt - out	2	System A or B only to be used. Structural latches (8) locked in approximately 8 seconds.
		WARNING At least one light bulb behind STRUCT LATCH CLOSE light lens must be on before entering tunnel 2 regardless of structure latches load cell readings. This ensures gear box travel has moved structure latches over-center for tunnel 2 integrity.		All six DM status lights (panel 2) have two light bulbs, one for each system (A & B). If one light bulb is out the status light lens will be dimmed.

NORMAL/BACKUP

STA/T	STEP	PROCEDURE	PANEL	REMARKS
CP		STRUCT LATCH CLOSE lt - on	2	Indicates hard dock. Load cell verification provided in DM via selector switches (panel 856) and meters for an additional verification of structural latches locked. Refer to CM ACTIVE/STRUCT LATCH CLOSED (DOCKED) status lts, Fig 18-1.
		STRUCT LATCH A (B) - off (ctr)		Guarded.
		If System B used		
DP		MN BUS TIE BAT B/C - OFF	5	
		CAUTION Safing of Docking System must be performed, to prevent inadvertent undocking.		
	7	Safe Docking System		
		Docking System A		
		cb DS A CONTROL BAT A - open	274	
		cb DS A MOTORS AC1 (3) - open		
		Docking System B		
		cb DS B CONTROL BAT B - open		
		cb DS B MOTORS AC2 (3) - open		
CP		GUIDE RING (2) - off (ctr) (verify)	2	
		STRUCT LATCH (2) - off (ctr) (verify)		Guarded.
DP		EXT RNDZ LTS - OFF (ctr)	274	
AC		COAS PWR - OFF	15	
	8	Postdocking pnl config		
		Prepare for CSM/DM Docked operations, Appendix A		

STA/T	STEP	PROCEDURE	PANEL	REMARKS
		18.1.2 Undocking With Soyuz, CM Active		
	1	Perform prep for DM/Soyuz Undocking DM/SOYUZ umbilical removal, 18.6.2, step 2 SCS on, 8.4.2 Select desired displays, 7.2 Select SCS rate damping only, 7.1.4		
CP		Docking System A cb DS A CONTROL BAT A - close cb DS A MOTORS AC1 (3) - close	274	
		Docking System B cb DS B CONTROL BAT B - close cb DS B MOTORS AC2 (3) - close		
AC		MAN ATT (3) - RATE CMD DBD/RATE - MIN/HI ATT DBD - MIN RATE - HI THC PWR - ON (up) RHC PWR NORM (both) AC/DC RHC PWR DIR (both) - MNA/MNB RHC, THC - ARMED SC CONT - CMC CMC MODE - AUTO BMAG MODE (3) - ATT 1/RATE 2	1	
	2	Separation		
CP		Verify docking system GUIDE RING CAPTURE lt - on STRUCT LATCH CLOSE lt - on STRUCT RING CONTACT lt - on	2	Verifies docking system ready for undocking. Refer to CM ACTIVE/STRUCT LATCH CLOSED (DOCKED) status lts, Fig 18-1.
		NOTE STRUCT LATCH OPEN lt may flicker due to delay in relay lockup.		

NORMAL/BACKUP

STA/T	STEP	PROCEDURE	PANEL	REMARKS
CP		STRUCT LATCH A - OPEN	2	System A only to be used. Latches open in approximately 8 seconds
		STRUCT LATCH CLOSE lt - out STRUCT LATCH OPEN lt - on		Refer to CM ACTIVE/STRUCT LATCH OPEN status lts, Fig 18-1.
		xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx		
		If STRUCT LATCH CLOSE lt - on & STRUCT LATCH OPEN lt - out STRUCT LATCH A - off (ctr)		
DP		MN BUS TIE BAT B/C - on (up)	5	Battery on line during system B structure latch motor operation to prevent main bus undervoltage.
CP		STRUCT LATCH B - OPEN	2	
		If still STRUCT LATCH CLOSE lt - on & STRUCT LATCH OPEN lt - out STRUCT LATCH B - off (ctr)		
		Check load cell readout for 1 vdc delta increase over no load (no load recordings, 4.5, step 11) while repeating STRUCT LATCH A - OPEN	856	
		STRUCT LATCH A - off (ctr)		
		If still STRUCT LATCH CLOSE lt - on & STRUCT LATCH OPEN lt - out		
		Inform Soyuz crew of backup passive sep		
		CAPTURE LATCH (2) - RELEASE	2	
		STRUCT RING CONTACT lt - out GUIDE RING CAPTURE lt - out		Refer to CM ACTIVE/VEHICLE SEP (BACKUP RELEASE) status lts, Fig 18-1.

STA/T	STEP	PROCEDURE	PANEL	REMARKS
CP		BACKUP PASSIVE (2) - RELEASE (hold ≈3 sec)	2	System A and B simultaneously. Guarded (momentary) - passive hook pulley is driven to the release position (≈2 to 3 seconds) releasing both the passive and active hooks. Power is also provided to the body latch release solenoids releasing the body mounted latches.
		Verify Undocking & inform Soyuz crew		
		STRUCT LATCH A - OPEN		To ensure pully is driven to the structure latch open position.
		STRUCT LATCH A - off (ctr)		
		BACKUP PASSIVE - RESET then ctr (off)		Guarded. PASSIVE lt may flicker due to delay in relay lockup. Resets passive hooks and returns docking system to passive mode. The body mounted latches (3) return to lock position by spring actuation.
		PASSIVE lt - on		
DP		MN BUS TIE BAT B/C - OFF	5	
		xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx		
CP		CAPTURE LATCH (2) - RELEASE	2	Less than 1 second. System A and B simultaneously.
		GUIDE RING CAPTURE lt - out		
		PASSIVE lt - on		Guide ring positions from active docked retract position to fully retracted (passive) position.
		STRUCT RING CONTACT lt - out		
		STRUCT LATCH A - off (ctr)		
		Verify Undocking		Refer to CM ACTIVE/VEH SEP (NORM REL) status lts, Fig 18-1.
	3	Post Final Undocking Pnl config		
		Docking System A		
DP		cb DS A IND LOGIC MNA - open	274	
		cb DS A IND PWR AC1 - open		
		cb DS A CONTROL BAT A - open		
		cb DS A MOTORS AC1 (3) - open		

STA/T STEP	PROCEDURE	PANEL	REMARKS
DP	Docking System B		
	cb DS B IND LOGIC MNB - open	274	
	cb DS B IND PWR AC2 - open		
	cb DS B CONTROL BAT B - open		
	cb DS B MOTORS AC2 (3) - open		
CP	Docking System Status lights (all) - out	2	

NORMAL/BACKUP

STA/T STEP	PROCEDURE	PANEL	REMARKS

18.2 DOCKING MODULE/SOYUZ DOCKING AND UNDOCKING - CM PASSIVE

This section contains the procedural requirements for docking and undocking with the Soyuz with the CM Docking system in the passive mode. (See Figure 18-1 for status lights logic.)

MANEUVERS

(Deleted)

18.2.1 Docking With Soyuz, Apollo DM Passive

At initiation of procedure, CSM shall be ≈15 to 50 feet from Soyuz properly aligned and in formation flight.

1 The following are req

AC
- CMC - on, 8.1.3
- COAS - installed & calib 14.1.8
- SCS - on, 8.4.2
- ISS - on & orient known, 8.1.3 & sec 14
- RCS DAP load & activate, 8.2.1
  - R1 - 611XX
  - R2 - X1111

  Noun 46 display

Provides G&N control capability.

Provides SCS control capability.

Establishes G&N control capability as follows:
CSM configuration, 4 quad translation (quads A, B, C, D - on).

This maneuver should be performed in the following attitude and rate deadbands in either CMC or SCS control modes to simplify control task during docking.

	CMC	SCS
ATT DBD	±0.5° (R03)	±0.2° (MIN)
RATE DBD	+0.2°/sec (fixed)	±0.2°/sec (LO)
RATE CMD (RHC)	+0.5°/sec (R03)	±0.65°/sec

STA/T	STEP	PROCEDURE	PANEL	REMARKS
		Set SCS att controls		
AC		THC PWR - on (up)	1	
		RHC PWR DIR (both) - MNA/MNB		Enables direct RCS coils for contingency takeover.
		CMC MODE - HOLD		
		DBD/RATE - MIN/LO		
		ATT DBD - MIN		
		RATE - LO		
		LIM CYCLE - OFF		
		BMAG MODE (3) - ATT 1/RATE 2		
		MAN ATT (3) - RATE CMD		
		SC CONT - CMC		
		THC - ARMED		
		RHC (both) - ARMED		
	2	Verify control status for docking		
		COAS PWR - on (up)	15	
DP		EXT RNDZ LTS - SPOT	274	
		cb DM POWER (2) - close		
		Docking System A		
		cb DS A IND LOGIC MNA - close		
		cb DS A IND PWR AC1 - close		
		cb DS A CONTROL BAT A - close		
		cb DS A MOTORS AC1 (3) - close		
		Docking System B		
		cb DS B IND LOGIC MNB - close		
		cb DS B IND PWR AC2 - close		
		cb DS B CONTROL BAT B - close		
		cb DS B MOTORS AC2 (3) - close		

NORMAL/BACKUP

STA/T	STEP	PROCEDURE	PANEL	REMARKS
	3	Docking System Config for CM Passive Docking		
CP		STRUCT LATCH OPEN lt - on (verify) PASSIVE lt - on (verify)	2	Verifies guide ring retracted, body latches closed and passive hooks closed. Refer to CM PASSIVE/ PASSIVE POS status lts, Fig 18-1.
	4	Initiate Capture		
AC		THC - initiate to close at 0.2 to 0.4 fps RHC - maintain min relative alignment angles with the Soyuz. Maintain angular rates $\leq$ 0.2 deg/sec Initial contact - "Attitude hold - narrow dead band" THC - initiate translation thrust (4 thrusters) $+X_{A5}$ direction after initial contact, stop translation thrust (max of 0.5 seconds after capture)		
CP		GUIDE RING CAPTURE lt - on		Indicates Soyuz capture of all three body mounted latches. Refer to CM PASSIVE/CAPTURED status lts, Fig 18-1.
		Soyuz Guide Ring Retract	Soyuz	Soyuz crew transmit retract information to Apollo crew.
		STRUCT RING CONTACT lt - on	2	Indicates Soyuz guide ring has retracted and interface ring contact has been made. Refer to CM PASSIVE/RETR & INTERFACE CONTACT status lts, Fig 18-1.
		Soyuz initiate structural latch preload	Soyuz	Soyuz structural latch preload information transmitted to Apollo crew.

STA/T	STEP	PROCEDURE	PANEL	REMARKS
		CAUTION Safing of Docking System must be performed to prevent inadvertent undocking.		
	5	Safe Docking System		
		Docking System A		
DP		cb DS A CONTROL BAT A - open	274	
		cb DS A MOTORS AC1 (3) - open		
		Docking System B		
		cb DS B CONTROL BAT B - open		
		cb DS B MOTORS AC2 (3) - open		
		EXT RNDZ LTS - OFF		
AC		COAS PWR - OFF	15	
	6	Postdocking pnl config		
		Prepare for CSM/DM Docked operations Appendix A		
	18.2.2	Undocking With Soyuz, Apollo DS Passive		
	1	Perform prep for DM/Soyuz undocking		
		DM/SOYUZ umbilical removal, 18.6.2, step 2		
		SCS on, 8.4.2		
		Select desired displays, 7.2		
		Select SCS rate damping only, 7.1.4		
		cb DM POWER (2) - close (verify)		
		Docking System A		
DP		cb DS A IND LOGIC MNA - close	274	
		cb DS A IND PWR AC1 - close		
		cb DS A CONTROL BAT A - close		
		cb DS A MOTORS AC1 (3) - close		

NORMAL/BACKUP

STA/T	STEP	PROCEDURE	PANEL	REMARKS
DP		Docking System B	274	
		cb DS B IND LOGIC MNB - close		
		cb DS B IND PWR AC2 - close		
		cb DS B CONTROL BAT B - close		
		cb DS B MOTORS AC2 (3) - close		
AC		MAN ATT (3) - RATE CMD	1	
		DBD/RATE - MIN/HI		
		ATT DBD - MIN		
		RATE - HI		
		THC PWR - on (up)		
		RHC PWR NORM (both) - AC/DC		
		RHC PWR DIR (both) - MNA/MNB		
		RHC, THC - ARMED		
		SC CONT - CMC		
		CMC MODE - AUTO		
		BMAG MODE (3) - ATT 1/RATE 2		
	2	Separation		
		Verify Docking System		
CP		PASSIVE lt - on	2	Apollo crew transmit to Soyuz crew docking system ready for undocking. Refer to CM PASSIVE/DOCKED status lts, Fig 18-1. Soyuz crew verifies to Apollo crew readiness for undocking.
		GUIDE RING CAPTURE lt - on		
		STRUCT RING CONTACT lt - on		
		STRUCT LATCH OPEN lt - on		
		Soyuz initiate undocking		Soyuz crew transmits undocking information to Apollo crew. Apollo crew verifies to Soyuz crew.
		Apollo crew mon undocking and inform Soyuz crew		Refer to CM PASSIVE/VEH SEP (NORM REL) status lts, Fig 18-1.

UNDOCKING WITH SOYUZ, APOLLO DS PASSIVE

STA/T	STEP	PROCEDURE	PANEL	REMARKS
		xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx		
		If Soyuz unable to perform undocking, inform Soyuz crew CM will undock.		
		BACKUP PASSIVE (2) - RELEASE (hold ≈ 3 sec)		System A and B simultaneously. Guarded (momentary) - passive hook pulley is driven to the release position (≈2 to 3 seconds) releasing both the passive and active hooks. Power is also provided to the body latch release solenoids releasing the body mounted latches.
		GUIDE RING CAPTURE lt - out		
		PASSIVE lt - out		
		STRUCT RING CONTACT lt - out		
		Verify undocking & inform Soyuz crew		Refer to CM PASSIVE/VEHICLE SEP (BACKUP RELEASE) status lts, Fig 18-1.
		BACKUP PASSIVE (2) - RESET then ctr (off)		Guarded. Passive lt may flicker due to delay in relay lockup. System A and B simultaneously (≈2 to 3 seconds). Resets passive hooks and returns docking system to passive mode. The body mounted latches (3) return to lock position by spring actuation.
		PASSIVE lt - on		
		xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx		
		STRUCT RING CONTACT lt - out	2	
		GUIDE RING CAPTURE lt - out		
	3	Post Final Undocking Pnl Config		Docking system (DS) post undocking panel configuration defines those circuit breakers requiring operation to deactivate the DS independent of mission consideration.
		Docking System A		
DP		cb DS A IND LOGIC MNA - open	274	
		cb DS A IND PWR AC1 - open		
		cb DS A CONTROL BAT A - open		
		cb MOTORS AC1 (3) - open		

NORMAL/BACKUP

STA/T	STEP	PROCEDURE	PANEL	REMARKS
DP		Docking System B	274	
		cb DS B IND LOGIC MNB - open		
		cb DS B IND PWR AC2 - open		
		cb DS B CONTROL BAT B - open		
		cb DS B MOTORS AC2 (3) - open		
CP		Docking System Status lights (all) - out	2	

STA/T STEP	PROCEDURE	PANEL	REMARKS
	18.3 ENVIRONMENTAL CONTROL/LIFE SUPPORT SYSTEM OPERATIONS		
	18.3.1 Docking Module Press Integrity Check		
1	CM/DM ΔP ind - ≈150 to 570 mm Hg	Hatch 2	
2	DM Pressurization		
	DM PRESS ISOL vlv - OPEN	901	
	DM PRESS vlv - INCR (Increase press to 550 mm Hg. Mon CM/DM ΔP ind to ≈292 mm Hg)	Hatch 2	Approximately 12 minutes are required to increase DM pressure from zero to 550mm Hg during initial pressurization.
	DM PRESS vlv - OFF		
	DM PRESS Isol vlv - CLOSE	901	
	Mon CM/DM ΔP ind time 5 min (no detectable decr allowed)		
3	CM/DM Press Equalization		
	DM VENT ISOL vlv - OPEN	900	
	DM VENT vlv - VENT		
	Mon CM/DM ΔP ind to zero	Hatch 2	About eight minutes are required to decrease pressure from 550 to 258mm Hg.
	DM VENT vlv - CLOSE	900	
	DM VENT ISOL vlv - CLOSE		
	Retrieve Tool B		
	Engage Tool B in Hatch PRESS EQUAL VALVE - OPEN	Hatch 2	Final equalization of pressure between the CM and DM is accomplished by opening the pressure equalization valve in hatch #2.

NORMAL/BACKUP

STA/T STEP	PROCEDURE	PANEL	REMARKS
	18.3.2 DM Pressurization		
1	Unlock Hatch, swing to the open position, 18.6.1	Hatch 2	
2	Position oxygen hoses in DM retention device (snap in place) - AC/DP oxygen hoses		
3	Check PPO_2 SYS TEST (2) - 8A SYS TEST ind - 1.6 vdc SYS TEST (2) - 1B SYS TEST ind - 1.6 vdc	101	PPO_2 should read 165mm Hg before DM ingress. Equivalent to 165mm Hg
4	HIGH PRESS RELIEF vlv (2) - AUTO (verify)	821	
5	O_2 PURGE PRESS RELIEF vlv - CLOSE (verify)	828	
6	LOW PRESS RELIEF vlv - CLOSE (verify)		
7	O_2 REG A vlv - ON	824	
	O_2 REG B vlv - OFF (verify)		
	EMER PRESS REG vlv - 1	826	
	PRESS TO TEST		
	O_2 FLOW HI lt - on	815	
	MASTER ALARM pb/lt - on, push		

STA/T STEP	PROCEDURE	PANEL	REMARKS
	O_2 REG B vlv - ON	824	
	O_2 REG A vlv - OFF		
	EMER PRESS REG vlv - 2	826	
	PRESS TO TEST		
	O_2 FLOW HI lt - on	815	
	MASTER ALARM pb/lt - on, push		
	O_2 REG A vlv - ON	828	
	EMER PRESS REG - BOTH	826	
8	cb WALL HTRS (2) - open	815	
9	Perform elect DM Config, 18.4.1 & 18.4.2		
10	Remove CM oxygen hoses from DM & stow in CM		

NORMAL/BACKUP

STA/T	STEP	PROCEDURE	PANEL	REMARKS
	11	First trnfr after CM active docking, perform struct latch load cell test, 18.4.5, record (8 recordings, VDC) & report to STDN NOTE For acceptable structure latch close condition, each structure latch reading must be one VDC minimum increase over recordings in para 4.5, step 11.		
	12	Release Hatch, swing to closed position & latch, 18.6.1	Hatch 2	
	13	Unlock and close Hatch PRESS EQUAL VALVE (rotate handle cw)		Handle must be in the yellow-band area (indicates a fully closed valve).
		xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx Cannot close PRESS EQUAL VALVE. Obtain Tool B & insert in external interface for additional leverage, hold depressed, & rotate ccw. xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx	Hatch 2 CM side	For stowage, reference NASA-S-74-517.
	14	Lock PRESS EQUAL VALVE	Hatch 2	

NORMAL/BACKUP

STA/T	STEP	PROCEDURE	PANEL	REMARKS
	15	Unstow HAND-HELD ABSOLUTE GAGE (HHAG), stow in panel 821 recess		
	16	DM N2 PRESS ISOL vlv - OPEN	824	
	17	DM N2 PRESS vlv - INCR (Pressurize to 490 mm Hg)		Required to pressurize the DM from 258 to 490 mm Hg on initial pressurization in approximately two minutes.
		xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx		
		Unable to pressurize DM using DM N2		
		If DM N2 PRESS ISOL vlv or DM N2 PRESS vlv fails closed, use tunl 1 N2 vlvs		
CM		DM PRESS ISOL vlv - OPEN	901	
		DM PRESS vlv - INCR		CM/DM ΔP ind (Hatch 2, CM side) reading of 232 mm Hg is approximately 490 mm Hg in the DM.
DM		DM crew mon HHAG to 490 mm Hg		
CM		DM PRESS ISOL vlv - CLOSE		
		DM PRESS vlv - OFF		
DM		DM/CM ΔP ind - Mon 5 min for press change	Hatch 2	
		xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx		
	18	HHAG - Mon to 490 mm Hg	821	Temporarily stow.
	19	DM N_2 PRESS vlv - OFF	824	
	20	DM N_2 PRESS ISOL vlv - CLOSE		
	21	DM/CM ΔP ind - Mon 5 min for press change	Hatch 2	

STA/T STEP	PROCEDURE	PANEL	REMARKS
	18.3.3 DM Depressurization		
	Adjust DM press to assure proper Soyuz atmosphere DM N2 PRESS ISOL vlv - OPEN	824	Prior to depressurization, a Nitrogen adjustment to the total DM pressure is required to assure proper Soyuz atmosphere (340mm Hg).
	DM N2 PRESS vlv - INCR - Increase press as req		Allow 10 minutes mixing after N2 addition.
	Mon press increase with HHAG	821	
	DM N2 PRESS vlv - OFF	824	
	Unlatch Hatch & swing to closed position, 18.6.1	Hatch 3	
	Close and lock Hatch PRESS EQUAL VALVE		
	Remove and stow mixing duct		For stowage, reference NASA-S-74-517.
	DM/SOYUZ TUN VENT ISOL vlv - OPEN	803	
	DM/SOYUZ TUN VENT vlv - VENT		
	Vent Tunnel #2 to 260mm Hg - Mon DM/SOYUZ ΔP ind ≈230mm Hg	Hatch 3	Venting Tunnel #2 to 260mm Hg assures a positive pressure on Hatch #3 seals to prevent leakage.
	DM/SOYUZ TUN VENT ISOL vlv - CLOSE	803	
	DM/SOYUZ TUN VENT vlv - CLOSE		
	PRESS RELIEF VLV REF - VACUUM	824	
	02 PURGE PRESS RELIEF vlv - AUTO	828	
	02 TANK QTY (both) >40%	815	40% is equivalent to 450 psia 02 tank pressure.
	02 PURGE vlv - OPEN (ccw) for ≈4.5 min	824	Oxygen is added to insure PPO2 does not fall below acceptable limits during the depressurization sequence.
or	02 TANK QTY (both) <40%	815	
	SUPPLEMENTAL 02 FLOW vlv - ON	824	Puts two orifices in parallel for greater 02 flow to main 02 regulators.
	02 PURGE vlv - OPEN (ccw) for ≈4.5 min		

NORMAL/BACKUP

STA/T STEP	PROCEDURE	PANEL	REMARKS
	xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx		
	Unable to purge DM with 02 PURGE vlv		
	Don 02 face masks MASK 02 vlv - ON (during DM depress & equalization with CM)		
	EMERG PRESS REG vlv - PRESS TO TEST (hold) until	826	
	02 PART PRESS ind - 300 mm Hg & CABIN PRESS - 520 mm Hg	815	
	xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx		
	Mon 02 PART PRESS ind - 320 mm Hg & CABIN PRESS - 538 mm Hg	815	(Deleted).
	02 PURGE vlv - CLOSE (cw)	824	
	02 PURGE PRESS RELIEF vlv - CLOSE	828	
	PRESS RELIEF VLV REF - DM	824	
	LOW PRESS RELIEF vlv - AUTO	828	
	PRESS RELIEF VLV REF - VACUUM	824	Pressure in the DM will automatically vent overboard to a pressure between 290 and 321 mm Hg.
	Hatch PRESS EQUAL VALVE - Unlock & OPEN	Hatch 2	Final equalization of pressure between the DM and Tunnel #1 is accomplished by opening Hatch #2 Equalization Valve.
	Mon DM/CM ΔP ind to zero		
	Mon DM press to stabilization	HHAG	
	Unlock Hatch & swing to the open position 18.6.1		
	PRESS RELIEF VLV REF - DM		
	LOW PRESS RELIEF vlv - CLOSE	828	
	DM N2 PRESS vlv - OFF (verify)	824	
	DM N2 PRESS ISOL vlv - CLOSE		

STA/T STEP	PROCEDURE	PANEL	REMARKS
	CM Oxygen hoses - Install in DM retention device & snap in place (AC/DP oxygen hoses)		CM oxygen hoses are placed in the DM to provide circulation and remove CO_2 for 10 to 15 minutes. Return hose is blocked by retention bracket.
	(Deleted).		
	O_2 REG (2) - OFF	824	
18.3.4	Tunnel #2 Integrity Check		
	WARNING At least one light bulb behind STRUCT LATCH CLOSE light lens must be on before entering tunnel 2 regardless of structure latches load cell readings. This ensures gear box travel has moved structure latches overcenter for tunnel 2 integrity.		

STA/T	STEP	PROCEDURE	PANEL	REMARKS
SC		OM Pressurize Tunnel #2 to 260 mmHg		OM (orbital module). Tunnel is initially pressurized by the SC (Soyuz crew) to perform Tunnel #2 and Hatch #4 pressure integrity check.
		Mon DM/CM ΔP ind for no detectable change in ΔP	Hatch 4	Allowable delta-P 15 mm Hg.
		OM Pressurize Tunnel #2 to 520 mmHg		Requires coordination with DM.
		Mon delta-P gage & Soyuz press indicator (5 min) for no detectable delta-P		
		xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx		
		Tunl 2 leakage rate higher than 15 mmHg		DM N2 supply tank may be depleted prior to completing the fourth transfer.
		Number of transfers will be restricted within consumables available.		
		Restrict total time hatches 3 & 4 are open		
		xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx		

STA/T	STEP	PROCEDURE	PANEL	REMARKS
		xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx		
		Loss of tunl 2 pressure reading from DM Soyuz provides integrity check data for tunl 2 & hatch 3 DM pressurize & depressurizes tunl 2 using Soyuz Data		
		xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx		
AC		Mon Hatch DM/SOYUZ ΔP ind & HHAG for change in delta-P	Hatch 3 821	DM/OM compare mutual results.
AC/SC		DM/OM compare mutual results		
SC		Unlock & open Hatch PRESS EQUAL VALVE Mon Delta-P gage to zero - Open & secure Hatch #4	Hatch 4	
		DM N2 PRESS ISOL vlv - OPEN	824	
AC		DM N2 PRESS vlv - INCR (Increase press as req)		
		DM N2 PRESS vlv - OFF		
		DM N2 PRESS ISOL vlv - CLOSE		
		Unlock & open Hatch PRESS EQUAL VALVE - Mon DM/SOYUZ P ind to zero - Open & secure Hatch, 18.6.1	Hatch 3	
		First Transfer Install DM/SOYUZ umbilicals, 18.6.2		

TUNNEL #2 PRESSURIZATION

STA/T STEP	PROCEDURE	PANEL	REMARKS
	18.3.5 DM and Tunnel #2 Press Equalization and Pressurization		Second transfer through fourth transfer.
AC	Inform Soyuz: Equalizing DM tunl 2 press		
	Verify DM/SOYUZ ΔP ind - 0 to (-75 mm Hg)	Hatch 3	
	PRESS EQUAL VALVE - OPEN (ccw/lock) Mon Hatch DM/SOYUZ ΔP ind - 0 (2 min)		
	HIGH PRESS RELIEF vlv (2) - AUTO (Verify)	821	
	LOW PRESS RELIEF vlv - CLOSE (Verify)	828	
	O2 PURGE PRESS RELIEF vlv - CLOSE (Verify)		
	PRESS RELIEF VLV REF - DM (Verify)	824	
	Inform Soyuz: Initiating DM & tunl #2 pressurization		
	O2 PART PRESS ind (2) - <215 mm Hg	815	
	If DM PPO2 215-225 mm Hg Ask Soyuz: What is your PPO2 If Soyuz PPO2 >200 mm Hg: Pressurize DM to 520 mm Hg		

STA/T	STEP	PROCEDURE	PANEL	REMARKS
		xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx		
		If DM PP02 >225 mm Hg		
AC		LOW PRESS RELIEF vlv - AUTO	828	
		PRESS RELIEF VLV REF - VACUUM	824	
		DM N2 PRESS ISOL vlv - OPEN		
		DM N2 PRESS vlv - INCR		
		Mon 02 PART PRESS ind (2) & HHAG	815	
		When 02 PART PRESS incl (2) = 225 mm Hg		
		LOW PRESS RELIEF vlv - CLOSE	828	
		When DM press (HHAG) = 490 mm Hg		
		DM N2 PRESS vlv - OFF	824	
		DM N2 PRESS ISOL vlv - CLOSE		
		PRESS RELIEF VLV REF - DM		
		Inform Soyuz: DM pressurized to 490 mm Hg		
CP		Perform hatch #2 integrity check		
		Mon DM/CM ΔP ind - 5 min (<15 mm Hg)	Hatch 2	
		xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx		
AC		DM N2 PRESS ISOL vlv - OPEN	824	
		DM N2 PRESS vlv - INCR		
		Mon HHAG to 490 mm Hg (PP02 <215 mm Hg)		
		Mon HHAG to 520 mm Hg (PP02 >215 to 225 mm Hg, if Soyuz PP02 >200 mm Hg)		

STA/T	STEP	PROCEDURE	PANEL	REMARKS
AC		DM N2 PRESS vlv - OFF DM N2 PRESS ISOL vlv - CLOSE	824	
CP		Hatch #2 press integrity check Mon DM/CM ΔP ind - 5 min (<15 mm Hg)	Hatch 2	
		Inform Soyuz: DM PP02	815	
AC		Unlock and release Hatch, swing open & engage in hold open latch, 18.6.1 Inform Soyuz Hatch #3 open	Hatch 3	
SC		Soyuz & DM press equalization Open Hatch #4 & secure Install & secure duct between DM & Soyuz		
	18.3.6	Tunnel #2 Depressurization and Hatch #3 Integrity Check		
AC		DM/SOYUZ TUNL VENT ISOL vlv - OPEN DM/SOYUZ TUNL VENT vlv - VENT DM/SOYUZ ΔP ind - (-470 mm Hg)	803 Hatch 3	Final transfer sequence raises DM pressure to 520 mm Hg ΔP gage minimum increments 25 mm Hg.

NORMAL/BACKUP

STA/T STEP	PROCEDURE	PANEL	REMARKS
	xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx If unable to vent, Soyuz vent tunnel #2 to 0.0 mm Hg xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx		
	DM/SOYUZ TUNL VENT ISOL vlv - CLOSE DM/SOYUZ TUNL VENT vlv - CLOSE	803	
	Monitor DM/SOYUZ ΔP ind for 5 min for detectable change	Hatch 3	
18.3.7	Face Mask Operation		
	Remove face mask from DM stowage containers (2) MASK O2 vlv - ON Don face mask	828	Push mask pushbutton for continuous flow; otherwise, mask is demand flow.
18.3.8	High DM CO2 Partial Pressure (>15 mm Hg)		Usually from unexpected extended stay time in DM or unexpected high metabolic rates.
	Don masks, 18.3.7		

Basic Date 20 June 1974 Change Date 15 Oct 1974 Page 18-26A/18-26B

STA/T STEP	PROCEDURE	PANEL	REMARKS
	18.3.9 Backup Cabin Fan Activation		
	Obtain backup cab fan and power cable		For stowage, reference NASA-S-74-517.
	Install cab fan on failed cab fan outlet louvers	845	Velcro mounted.
	UTILITY POWER - OFF (verify)	808	
	Connect power cable to UTILITY POWER receptacle		
	UTILITY POWER - ON		
	NOTE Attach ventilation duct to backup fan outlet as required.		

NORMAL/BACKUP

STA/T STEP	PROCEDURE	PANEL	REMARKS
	18.4 ELECTRICAL POWER SYSTEM		
	18.4.1 DM Ingress Config		Configure circuit breakers at launch such that DM systems required for rendezvous, status and thermal control are available without entering the DM.
	LIGHTING 1 - START (verify)	815	
	LIGHTING 2 - START (verify)		
	cb CABIN FAN DMA - close (verify)		
	cb INST (2) - close (verify)		
	cb LIGHTING 1 - DMA - close (verify)		
	cb LIGHTING 2 - DMB - close (verify)		
	cb VHF FM XCVR DMA - close (verify)		
	cb WALL HTRS (2) - close (verify)		
	18.4.2 DM Occupied Config & C&WS Operational Check		
	LIGHTING 1 - ON		
	LIGHTING 2 - OFF		TV may require both LIGHTING switches on. (Refer to paragraph 18.4.8).
	cb LIGHTING DMA - close		
	cb CAUT/WARN DMB - close		Reset master alarm after closing circuit breakers.
	cb DM AUDIO/TV DMB - close		
	cb UTILITY DMA - close		
	cb SOYUZ POWER DMB - close		
	cb DMA/DMB TIE - open (verify)		
	cb WALL HTRS (2) - open (verify)		
	C&WS Operational Check		
	02 c/w pb (3) - push		
	02 c/w lt (3) - on		
	02 FLOW HI pb & 02 PP A pb - push (simultaneously)		

STA/T STEP	PROCEDURE	PANEL	REMARKS
	MASTER ALARM pb/lt & tone - on MASTER ALARM pb/lt - push MASTER ALARM pb/lt & tone - out		
18.4.3	DM Vacant Config		
	LIGHTING 1 - ON LIGHTING 2 - OFF (verify) cb CAUT/WARN DMB - open cb WALL HTRS (2) - close	815	Wall heaters (3) on only when DM unoccupied.
18.4.4	DM Jettison Config		
	UTILITY POWER - OFF TV CAMERA POWER - OFF AUDIO 2 POWER - OFF AUDIO 1 POWER - OFF LIGHTING 2 - OFF LIGHTING 1 - START, ON All cbs open on panel 815 except cb LIGHTING (2)	808 818 811 815	
18.4.5	Struct Latches Load Cell Test (CM Active)		Interface sealing may be performed normally when any six of the eight DM structural latch load cells show proper loads.
	DOCK SYS A TEST SEL - STRUCT LATCH 1,3,5,7 DS A TEST ind - Record VDC, & report to STDN	856	
	DOCK SYS B TEST SEL-STRUCT LATCH 2,4,6,8 DS B TEST ind - Record VDC, & report to STDN		

STRUCT LATCHES LOAD CELL TEST (CM ACTIVE)

STA/T STEP	PROCEDURE	PANEL	REMARKS
18.4.6	Struct Latches Load Cell Test (CM Passive)		Interface sealing may be performed normally when any any six of the eight DM structural latch load cells show proper loads (PASSIVE range).
	DOCK SYS A TEST SEL - STRUCT LATCH 1,3,5,7	856	
	DS A TEST ind - STRUCT LATCH PASSIVE range		
	DOCK SYS B TEST SEL - STRUCT LATCH 2,4,6,8		
	DS B TEST ind - STRUCT LATCH PASSIVE range		
18.4.7	Docking System Passive Test (Systems A & B)		
	DOCKING SYS TEST SEL (2) - PASSIVE HOOKS		
	DS TEST ind (2) - CLOSE range		Indicates passive hooks (8) closed.
	DOCKING SYS TEST SEL (2) - BODY LATCHES		
	DS TEST ind (2) - CLOSE range		Indicates body latches (3) closed.
	DOCKING SYS TEST SEL (2) - GUIDE RING RETR		
	DS TEST ind (2) - CLOSE range		Indicates guide ring retracted.
	DOCKING SYS TEST SEL (2) - OFF		Erroneous indications on panel 2 displays and PCM are possible if switch is in any passive test position.
18.4.8	Floodlight Operation		
	CAUTION		
	Do not place LIGHTING (1/2) sw directly to ON position. This can expose the control circuit diodes to excessive voltage		

STA/T STEP	PROCEDURE	PANEL	REMARKS
	LIGHTING (1 or 2) - START (3 sec min), then LIGHTING (1/2) - ON	815	The START position is not a continuous operating mode: Extended operation in the START mode will cause accelerated deterioration of the cathode and shorten floodlight life.

STA/T STEP	PROCEDURE	PANEL	REMARKS
	18.5 TELECOMMUNICATIONS SYSTEM		
	18.5.1 DM Speaker Box Operation		
	AUDIO 2 POWER - ON	818	
	Speaker Box	860	
	POWER - ON		
	SIGNAL - on (up)		
	XMIT/I'COM - as desired		XMIT and I'COM positions are momentary.
	VOLUME tw - as req (verify comm)		
	xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx		
	No comm		
	Speaker Box		
	POWER - OFF		
	SIGNAL - OFF		
	AUDIO 1 POWER - OFF	811	
	AUDIO 2 POWER - OFF	818	
	Disconnect Speaker Box from receptacle		
	Disconnect CCU from receptacle	811	
	Connect Speaker Box to receptacle		
	AUDIO 1 POWER - ON		
	Speaker Box	860	
	POWER - ON		
	SIGNAL - on (up)		
	XMIT/I'COM - as desired		
	VOLUME tw - as req (verify comm)		
	Still no comm		
	Speaker Box		
	POWER - OFF		
	SIGNAL - OFF		

NORMAL/BACKUP

STA/T STEP	PROCEDURE	PANEL	REMARKS
	AUDIO 1 POWER - OFF	811	
	Disconnect Speaker Box 860 from receptacle & stow		
	Unstow Speaker Box 960		For stowage, reference NASA-S-74-517.
	Connect Speaker Box to receptacle	818	
	AUDIO 2 POWER - ON		
	Speaker Box	960	
	POWER - ON		
	SIGNAL - on (up)		
	XMIT/I'COM - as desired		XMIT and I'COM positions are momentary.
	VOLUME tw - as req (verify comm)		
	Still no comm		
	Speaker Box		
	POWER - OFF		
	SIGNAL - OFF		
	AUDIO 2 POWER - OFF	818	
	Disconnect Speaker Box from receptacle and stow	960	
	Unstow CCU (2) & control Head (2) & connect		
	Unstow light weight head set (2) & connect to CCU control head	Soyuz TB	TB (transfer bag).
	Connect CCU's to receptacle on audio pnls	818	
	AUDIO 2 POWER - ON (verify comm)		
	AUDIO 1 POWER - ON (verify comm)	811	
	XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX		

NORMAL/BACKUP

STA/T STEP	PROCEDURE	PANEL	REMARKS
	18.5.2 DM TV Checkout		
	Select Basic, 5.6.1		
	Verify TV Camr mounted in launch position	CM Camr 1	
	Obtain and assemble TV camr assembly	DM	TV camera assembly consists of TV camera, monitor, cables and camera mount. For stowage, reference NASA-S-74-517.
	Connect TV cable to DM2 TV STATION receptacles	808	
	ALC sw - AVG GAMMA sw - LINEAR SYNC sw - SLAVE	DM Camr 2	
	NOTE One Camr must be selected MASTER, all other operating cameras must be SLAVE. If the Soyuz camr is operating, it must be MASTER.		
	Adjust camr lens (as req), & mount camr near hatch 3 (observe pin alignment mark)		
	TV MONITOR - ON	Camr mon	
	Obtain and assemble TV camr assembly		
	Connect TV cable to DM1 TV STATION receptacles	808	
	ALC sw - AVG GAMMA sw - LINEAR SYNC sw - SLAVE	DM camr 1	

STA/T	STEP	PROCEDURE	PANEL	REMARKS
		Adjust camr lens (as req) & mount camr near hatch 2 (observe pin alignment mark)		
		TV MONITOR - ON	Camr mon	
		CM/DM CAMR POWER - POWER	181	
		TV AMPL - ON		
		CM1 TV STATION POWER - ON		
		DM1 TV STATION POWER - ON	808	
		DM2 TV STATION POWER - ON		
		CAMR SYNC - CM/DM (verify)		
		Check monitors, adjust camr pointing & lens if req		
		NOTE • Camr selection and VTR management will be accomplished by STDN Commands. One light illuminates when camr is selected. • If VTR is recording, all intercom voice will be recorded on the VTR.		
		All crewmen don comm carrier assembly (CCA)		
ALL		MODE - VOX	6, 9, 10	
		VOX SENS tw - as req (≈7)		
		VOLUME tw - dcr (eliminate squeal)	98, 860	

STA/T	STEP	PROCEDURE	PANEL	REMARKS
		When TV Complete		
		DM1 TV STATION POWER - OFF	808	
		DM2 TV STATION POWER - OFF		
CP		CM1 TV STATION POWER - OFF	181	
		TV AMPL - BYPASS		
ALL		MODE - INTERCOM/PTT	6, 9, 10	
		18.5.3 TV Crew Transfers		
		Select Basic, 5.6.1		
		First transfer only		
		Remove TV camera assembly from RH rendezvous window, for later transfer to the Soyuz	CM Camr 2	TV camera assembly consists of TV camera, monitor, cables and camera mount.
		Remove & stow 150 mm lens & install 25 mm lens		For stowage, reference NASA-S-74-517.
		Verify TV camera mounted in launch position		
		Verify TV camera mounted near hatch 3 & connected to DM2 TV STA receptacles	808	
		Verify TV camera mounted near hatch 2 & connected to DM1 TV STA receptacles		
CP		CM/DM CAMR POWER - POWER	181	
		TV AMPL - ON		
		CM1 TV STATION POWER - ON		
		DM1 TV STATION POWER - ON	808	
		DM2 TV STATION POWER - ON		
		First transfer only		
		CAMR SYNC - CM/DM (verify)		
		Interim & last transfers only		
		CAMR SYNC - SOYUZ		
		TV POWER - ON	961	

TV CREW TRANSFERS

STA/T	STEP	PROCEDURE	PANEL	REMARKS
		Check monitors, adjust camera pointing and lens if req		
		NOTE • Camera selection and VTR management will be accomplished by STDN commands • If VTR is recording, all intercom voice will be recorded on VTR		
		All crewmen don comm carrier assembly (CCA)		
ALL		MODE - VOX	6, 9, 10	
		VOX SENS tw - as req (≈ 7)		
		VOLUME tw - decr (eliminate squeal)	98, 860, 960	
		First transfer only		
		TV camera assembly transferred to Soyuz		
		TV POWER - OFF (verify)	961	
		Connect TV Camr to TV receptacles		
		Adjust lens, as req	camr	
		ALC sw - AGC		
		GAMMA sw - LINEAR		
		SYNC sw - MASTER		

NORMAL/BACKUP

STA/T STEP	PROCEDURE	PANEL	REMARKS
	NOTE One camera must be selected MASTER, all other operating cameras must be SLAVE. If Soyuz camera operating, it must be MASTER.		
	Mount camera in Soyuz. (observe pin alignment mark)		
	TV MONITOR - ON	Camr mon	
	CAMR SYNC - SOYUZ	808	
	Advise CM crewman to select SLAVE	CM Camr 1	
	TV POWER - ON	961	
	Check monitor, adjust camr pointing & lens, as req		
	Relocate Soyuz camr as req		
	Interim & last transfers only		
	Relocate Soyuz camr as req		
	Last transfer only		
	Prior to Soyuz hatch closure		
	TV POWER - OFF		
	CAMR SYNC - CM/DM	808	
	Advise CM crewman to select MASTER ON CM TV Camr		
	Remove TV camera assembly and relocate the assembly in DM for later transfer into CM		
	After transferring TV camr assembly into CM, remove & stow extension adapter, and install required lens		

TV CREW TRANSFERS

STA/T	STEP	PROCEDURE	PANEL	REMARKS
CP		CM2 TV STATION POWER - OFF (verify)	181	
		Connect TV Camr to CM2 TV STATION receptacles		
		ALC sw - AVG	Camr	
		GAMMA sw - LINEAR		
		SYNC sw - SLAVE		
		Adjust lens - as req		
		Mount Camr (observe pin alignment mark)		
		TV Completed		
		DM1 TV STATION POWER - OFF	808	
		DM2 TV STATION POWER - OFF		
CP		CM1 TV STATION POWER - OFF	181	
		TV AMPL - BYPASS		
ALL		MODE - INTERCOM/PTT	6, 9, 10	
		CAMR SYNC - CM/DM	808	
		Last transfer only		
		CAMR SYNC - CM/DM (verify)		

NORMAL/BACKUP

STA/T STEP	PROCEDURE	PANEL	REMARKS
	18.5.4 Soyuz Operations		
1	16MM Data Acquisition Camera Initiation		
	Unstow 16MM DAC & associated cable	Soyuz	
	Attach cable to DAC	TC	Transfer container.
	Remove dust cover from UTILITY POWER receptacle (J1)	808	
	UTILITY POWER - OFF (verify)		
	Attach DAC cable to UTILITY POWER receptacle (J1)		
	UTILITY POWER - ON		
	Config DAC as req		
2	16MM Data Acquisition Camera Power Down		
	Configure DAC as req		
	UTILITY POWER - OFF		
	Detach DAC cable from UTILITY POWER receptacle (J1)		
	Replace dust cover on UTILITY POWER receptacle (J1)		
	Remove DAC power cable from DAC		
	Stow DAC & cable	Soyuz TC	
3	16MM Data Acquisition Camera Initiation Soyuz		
	Unstow DAC & cable	Soyuz	
	Attach power cable to DAC	TC	
	cb SOYUZ POWER DMB - open	815	
	Attach power cable to UTILITY POWER receptacle	961	
	cb SOYUZ POWER DMB - close	815	
	TV/UTILITY POWER - ON	961	
	Configure DAC as req		

STA/T STEP	PROCEDURE	PANEL	REMARKS
4	16MM Data Acquisition Camera Power Down Soyuz		
	cb SOYUZ POWER DMB - open	815	
	TV/UTIL POWER - OFF	961	
	Detach power cable from UTILITY POWER receptacle		
	Disconnect power cable from DAC		
	Stow DAC and power cable	Soyuz TC	
5	Soyuz Speaker Box Operation		
	Unstow speaker Box	960	For stowage, reference NASA-S-74-517.
	Transfer Speaker Box to Soyuz		
	Connect Speaker Box cable to AUDIO 2 receptacle	961	
	cb SOYUZ POWER DMB - Close	815	
	AUDIO POWER - ON	961	
	Speaker Box	960	
	POWER - ON		
	SIGNAL - ON		
	XMIT/I'COM - I'COM		
	VOLUME tw - Adj & verify comm		
	xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx		
	No comm		
	AUDIO POWER - OFF	961	
	Disconnect Speaker Box Cable from AUDIO 2 receptacle		

NORMAL/BACKUP

STA/T	STEP	PROCEDURE	PANEL	REMARKS
		Transfer to DM	DM	
		Stow Speaker Box		
		Unstow CCU (2), Control Head (2) & light weight head set (2) from D1 Connect & transfer to Soyuz		
		Connect CCU's to receptacles AUDIO 1 & 2	961	
		AUDIO POWER - ON, verify comm		
		xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx		
	6	VHF/FM terminate		
DP		PHONE/MIC CONNECT - OFF	10	
		cb VHF/FM XCVR DMA - open	815	

STA/T STEP	PROCEDURE	PANEL	REMARKS
	18.6 MECHANICAL SYSTEMS		
	18.6.1 DM Hatch Opening/Closing (2 & 3)		
	a. Opening DM Hatch from DM exterior Verify ΔP gage reads zero		No opening of DM hatch No. 3 is planned from the Soyuz side, however, a B tool is stowed on hatch No.2 & 3 and the capability exists.
	Retrieve tool B from hatch location Engage Tool B in PRESS EQUAL VALVE PRESS EQUAL VALVE - OPEN CM/DM ΔP ind (Hatch 2) or SOYUZ/DM ΔP ind (Hatch 3) reads zero (verify) Engage Tool B in hatch gear box Unlock & release hatch, rotating tool B ccw Swing hatch inward & engage in hold open latch		"Hold Open" retention devices are provided in the DM for hatches 2 and 3 which are hinged and open inward along the +Y axis.
	b. Opening DM hatch from the DM interior Verify ΔP gage reads ≈zero PRESSURE EQUAL VALVE - unlock & OPEN DM/CM ΔP ind (Hatch 2) or DM ΔP ind (Hatch 3) reads zero (verify) Actv handle rel - Pull & Rotate Actv handle - pull to stop Actv handle sel - U (unlatch) Actv handle - push to stop		Final equalization between the DM and tunnels No. 1 and No. 2 is accomplished by opening the hatch equalization valve.

NORMAL/BACKUP

STA/T STEP	PROCEDURE	PANEL	REMARKS
	xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx		
	Hatch will not release, one or several latches (not diametrically opposed) have not unlatched Remove hinge pip pin Separate hatch from DM hatch ring at hinge point Rotate hatch as req to release remaining latches Reattach hatch to hinge - insert pip-pin and lock Swing hatch inward & engage in hold open latch		
	Hatch will not release - All or diametrically opposed latches will not unlatch Retrieve DM tool kit - obtain tools W & 4 - snap together Remove DM hatch ring striker plates from unlatched latches Remove two (2) 3/16 inch & one (1) 1/4 inch torq-set screws from each striker plate Swing hatch inward & engage in hold open latch		For stowage, reference NASA-S-74-517.
	xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx		
c.	Closing DM hatch from DM interior (2 & 3) Disengage hatch from hold open latch Swing hatch to closed position		

DM HATCH OPENING (2 & 3)

STA/T STEP	PROCEDURE	PANEL	REMARKS
	Verify hatch is firmly positioned against sealing surface		
	Actv handle rel - Pull & Rotate		To free active handle for operation.
	Actv handle - pull to stop		Handle should move 80°.
	Actv handle sel - L (latch)		
	Actv handle - push to stop		Handle should move 60° to engage latches.
	Verify gear box disconnect socket is opposite L mark on hatch		
	Actv handle sel - stow		
	Actv handle - push to stowed position		Actuator handle release automatically locks handle in stowed position.
	Push manual gear box lock (chrome tab)		Verifies gear box lock engaged
d.	Closing DM hatch from the DM exterior (2 & 3)		Hatch No. 2 is the only DM hatch which is planned to be closed from the DM exterior. Tool B is, however, provided in Tunnel No. 2 if required.
	Disengage hatch from hold open latch		
	Swing hatch to closed position		
	Engage tool B in gear box socket		
	Pull hatch firmly against sealing surface		
	Rotate tool B cw		
	Remove and stow Tool B		
18.6.2	DM/Soyuz Umbilical Installation and Removal		
1	Umbilical Installation		
	cb SOYUZ POWER DMB - open	815	
	SOYUZ/DM CABLE PWR - off	SOYUZ	Verify with Soyuz that TV and camera cable power from Soyuz has been turned off.
	Open Umbilical Cover	Tunnel #2	
	Squeeze latch to release		
	Secure open with velcro		

NORMAL/BACKUP

STA/T	STEP	PROCEDURE	PANEL	REMARKS
		Disconnect Umbilical Connector P1 from stowage receptacle - pull to remove		Grip connector ears or lanyard and pull.
		Remove dust cap from Soyuz receptacle J1 - grip cap collar and pull		
		Install dust caps on DM P1 stowage receptacle - align, depress cap body, & push to install		
		Attach connector P1 (yellow to yellow) to receptacle J1, align, & push to connect		Self-locking.
		Install umbilicals P2 (black to black) and P3 (white to white)		
and		R following the preceding steps		
		Release Umbilical Cover, close, & latch		
		cb SOYUZ POWER DMB - close	815	
	2	Umbilical Removal	Tunnel #2	
		cb SOYUZ POWER DMB - open	815	
		Open Umbilical Cover, squeeze latch to release, secure open with velcro		
		Disconnect Umbilical Connector P1 from Soyuz receptacle J1 - pull to remove		Grip connector ears or lanyard and pull.
		Remove dust cap from DM P1 stowage receptacle - grip cap collar & pull		
		Install dust cap on Soyuz receptacle J1, align, depress cap body, & push to install		
		Attach connector P1 to DM P1 stowage receptacle, align, and push to connect		Self-locking.

DM/SOYUZ UMBILICAL INSTALLATION AND REMOVAL

STA/T STEP	PROCEDURE	PANEL	REMARKS
	Remove umbilicals P2 and P3 following the preceding steps Release Umbilical Cover, close, & latch		

Basic Date 20 June 1974 Change Date 15 Oct 1974 Page 19-1

19.0 ABORT PROCEDURES

During the ascent phase, an abort can be accomplished in an LES, RCS, or SPS mode. An abort in the LES mode is accomplished by utilizing the launch escape system, which has solid propellant motors mounted on a tower above the command module. During a normal mission, the launch escape tower is jettisoned approximately 17 seconds after second-stage booster ignition. After the launch escape tower is jettisoned, an abort can be accomplished in the RCS mode, or SPS mode, by first utilizing the service module RCS jets to translate away from the LV. The SPS engine will be utilized, on a MODE III and MODE IV abort, to place the CSM in the desired trajectory for landing (MODE III) or earth orbit (MODE IV).

19.1 LES ABORT MODES

An abort may be initiated automatically by the emergency detection system (EDS) when two LV engines fail, LV excessive rates are detected, breakup between IU and CSM, or manually when the commander's translation control is rotated to the full CCW position. Upon receipt of an abort signal, regardless of its source, the booster is cut off (if after T +40 seconds), the CM is separated from the SM, and simultaneous ignition of the launch escape and pitch control motors takes place. Firing of the pitch control motor is inhibited 61 seconds after lift-off. Cutoff of the booster engines is inhibited for the first 40 seconds after lift-off by circuitry in IU because of range safety restrictions. The LES motors provide thrust to propel the command module away from the launch pad or trajectory of the launch vehicle.

Certain events that occur during an abort are controlled automatically by controllers in the sequential events control system (SECS). The earth landing sequence controller (ELSC) contains high-altitude and low-altitude baroswitches. The opening of these baroswitches inhibit ELS operations and the closing initiates the operations. The high-altitude baroswitch controls automatic LES tower jettison, apex cover jettison, and drogue parachute mortar fire. The high-altitude baroswitch is designed to open at 38,500 feet and close at 24,000 feet. Because of venting lag, the high-altitude baroswitch will not open until 40,500 feet during ascent. On an abort initiated under 30,000 feet (low part of abort mode 1-B), the 24K feet baroswitch will remain closed and allow automatic LES tower jettison, apex cover jettison, and drogue parachute and main parachute

deployment on a timed sequence controlled by time-delay relays. On an abort initiated between 30,000 feet and 2 minutes 46 seconds, automatic LES tower jettison, apex cover jettison, and drogue parachute deployment are delayed until the command module descends to the closing altitude of the high-altitude baroswitch (24,900 to 21,500 feet).

The low-altitude (10K') baroswitch is closed at 10,000 feet, open at 18,000 feet. Opening of the low-altitude baroswitch will delay automatic deployment of the pilot-main parachutes until the command module descends to the closing altitude (10,950 to 9100 feet).

The LES abort is divided into three different modes as follows:

- Mode 1-A (launch pad to 61 seconds)
- Mode 1-B (61 seconds to 1 minute 47 seconds)
- Mode 1-C (1 minute 47 seconds to LES tower jettison)

During a Mode 1-A abort, CM RCS oxidizer automatically dumps overboard through an outlet in the aft heat shield. CM RCS fuel automatically dumps overboard through a similar outlet in the aft heat shield 5 seconds after oxidizer dump started, and requires about 11 seconds for depletion. CM RCS helium automatically begins purging the system 13 seconds after fuel dump started.

After the main parachutes disreef and a land impact is anticipated, during a Mode 1-B abort, manual initiation fires ten CM RCS jets to expend all propellant, followed by manually initiated helium expenditure through the jets to purge the system.

The auto abort capability due to two engines out or LV rates is switched off prior to S1B staging, and the crew must be ready to manually initiate an abort if these conditions arise. During a Mode 1-C abort (over 100K'), it is possible to jettison the LET and accomplish a normal entry provided certain conditions prevail. There must be sufficient TFF (100 sec) to perform the entry maneuver, a reliable attitude reference, and launch escape vehicle (LEV) rates must be within tolerance. If any of these conditions are not met, the LET must be retained to insure capture of the LEV with the heat shield oriented forward.

LES ABORT MODES

The altitude and velocity of the LEV is such that a possibility exists that it could enter the atmosphere canard and escape tower forward. The LEV would remain in this condition until descending below 100,000 feet and Mach 3.8. At this time a fast turnaround would occur which would be detrimental to crew safety. The crew will prevent canard forward capture by manual intervention shortly after abort initiation. A positive pitch rate of over 5° per second will be commanded and maintained until the canard starts trailing the CM upon descending to an altitude under 100,000 feet. Escape tower jettison and ELS activation will automatically occur at approximately 24,000 ft provided that the ELS AUTO sw is in the AUTO position.

The ELS decelerates the CM to a safe touchdown speed. Crew couch attenuators reduce the touchdown impact and start operating at approximately 15 G when they are unlocked. If they are not unlocked, a pin will shear in the lock at approximately 21 G and allow them to operate.

STA/T	STEP	PROCEDURE	PANEL	REMARKS
		19.1.1 Mode 1A LES Abort (00:00 - 01:01)		
AC	1	Abort initiation auto or manual THC - CCW	X X X X	If manual backup required for any auto event after abort initiation it must be performed after LE motor burnout (abort T +00:05) because of high G environment during LE motor burn.
CP		CM/SM SEP (both) - on (up)	X X X	Guarded. On position is momentary. If abort is initiated with CM/SM SEP switches, subsequent events may require manual initiation and must be performed after LE motor burnout.
		BECO (auto after T +00:40)	X X X	Request ground command BECO
00:00		Evnt Tmr rset and counting up (auto)	X X X	
		CM/SM deadface (auto)	X X	
		SM C/W lts - on	X X X	Because of switching transients, AC BUS 1 and 2 C/W lights will go on and MN BUS A and MN BUS B UV lights might go on if abort is initiated prior to T -01:00.
		MASTER ALARM pb/lt - on	X X X	
AC		CM RCS press (auto)	X X	

MODE 1A LES ABORT (00:00 - 01:01)

STA/T STEP	PROCEDURE	PANEL	REMARKS
AC	RCS cont trnfr (auto)	X	MN BUS TIE switches are set to AUTO by T -1 hour and then to ON at T -01:15. DC main buses must be energized to provide power for RCS transfer, propellant dump, and purge.
	Entry bats to main buses (auto if abort initiated prior to T -01:00)	X	
	CM RCS oxidizer dump (auto)	X	
	CM RCS isol vlvs close (auto)	X	
00:00.1	CM/SM sep (auto)	X	CM/SM umbilical and tension ties severed.
	LE & PC motors fire (auto)	X	
00:01.8	CM/SM sep pyro deadface (auto)	X	
00:05	CM RCS fuel dump (auto)	X	
	XXXXXXXXXXXXXXXXXXXXXXXXXXX	X	
AC	If abort initiated with CM/SM SEP (both) or if backup req for any auto evnt	X	

ABORT

STA/T	STEP	PROCEDURE	PANEL	REMARKS
		X		
AC		X EVNT TMR RSET - RSET		RSET position is momentary.
		X		
		X EVNT TMR START - START		START position is momentary.
		X		
CP		X CM RCS PRESS - on (up)		Guarded. On position is momentary.
		X		
		X RCS TRNFR - CM		CM position is momentary.
		X		
DP		X MN BUS TIE (2) - on (up)		
		X (verify)		
		X		
CP		X Verify PRPLNT DUMP -		
		X AUTO		
		X		
		X CM RCS PRPLNT (both) - OFF		OFF position is momentary.
		X		
AC		X LES MOT FIRE pb - push		Guarded. Pitch control motor will not fire if LES MOT FIRE pushbutton used as backup 1.8 seconds after abort initiation.
		X		
		XXXXXXXXXXXXXXXXXXXXXXXXXX		
			X	
00:11		Canard deploy (auto)	X No backup req	CNRD DPLY pushbutton should not be used as backup on Mode 1A. Since adverse attitudes and critical timing is involved, canard deployment at wrong time could be detrimental to crew safety. Launch escape vehicle will operate satisfactorily without canard deployment.
			X on Mode 1A	
			X	
			X	
			X	
			X	
CP	2	C/W CSM - CM	X	Extinguishes all SM C/W lights and allows CM RCS C/W lights to function.
			X	
	3	MASTER ALARM pb/lt -	X	
		push	X	
			X	

STA/T	STEP	PROCEDURE	PANEL	REMARKS
AC				
00:14		ELS logic arm (auto)		
		ELS AUTO - AUTO		
	4	ELS LOGIC - on (up)		Guarded.
		LES TWR jett (auto)		
CP		a. Docking ring sep		
		b. TWR attach nuts detonate	TWR JETT (both) - on (up)	Guarded. On position is momentary.
		c. SCS RCS disable	RCS CMD - OFF	OFF position is momentary.
		d. TWR jett motor fire		
AC				
00:14.4		Apex cover jett (auto)	APEX COVER JETT pb - push	Guarded.
00:16		Drogue chutes deploy (auto)	DROG DPLY pb - push (2 sec after apex cover jett)	Guarded.
		WARNING		
		Below alidade marker on altimeter, MN DPLY pb - push		Alidade set for 3800 feet true altitude prior to launch.

19.1.1 MODE 1A LES ABORT (00:00 - 01:01)

ABORT

STA/T	STEP	PROCEDURE	PANEL		REMARKS
00:18		CM RCS helium purge (auto)	X	CM RCS He DUMP pb - push	Guarded.
			X	CM PRPLNT DUMP - on (up)	Guarded. CM PRPLNT DUMP and PURG switches provide alternate means of initiating He dump.
			X	CM PRPLNT PURG - on (up)	Guarded.
CP			X		
≥10K'		CAB PRESS ind - 10 psia	X		2 Indication of main chute deploy altitude.
		Main chutes & VHF recovery antenna deploy (auto)	X		Main parachutes disreef in ≈15 seconds.
	5	MN DPLY pb - push	X		Guarded.
DP	6	Set up entry comm	X		
		VHF ANT - RECY	X		
		VHF AM A - SIMPLEX	X		If VHF AM B - SIMPLEX or VHF AM A - DUPLEX required, turn off beacon during period of communication.
		VHF BCN - ON	X		
AC		Xmit voice (VHF AM) reporting	X		Continue voice transmission until touchdown.
		Main chutes disreefed	X		
		Splash error	X		
		Crew status	X		
CP	7	Crew couch struts (4) - unlock	X		
DP	8	cb FLT/PL BAT BUS A, B & BAT C (3) - close	X		Connects battery bus A, B, and battery C to flight and postlanding bus.

STA/T	STEP	PROCEDURE	PANEL	REMARKS
DP	9	cb FLT/PL MNA - open	X X X	
	10	cb FLT/PL MNB - open	X X X	
AC	11	cb SPS PITCH (2) - open	X X	
	12	cb SPS YAW (2) - open	X X	
3K'	13	rh CAB PRESS RELF vlv - DUMP (safety latch off)	X X X X	Ensures minimum cabin-to-ambient negative ΔP for landing impact.
	14	FLOOD FIXED - POST LDG	X X X X	Provides power from flight and postlanding bus to one floodlight in LH couch area and one floodlight in center couch area.
	15	FLOOD DIM - 1 or 2	X X X X X	Position 1 provides power to two secondary floodlights, and position 2 provides power to two primary floodlights when FLOOD FIXED switch in POST LDG position and dc main buses deactivated.
CP	16	Verify RCS IND sel - CM 1	X X	Provides means of monitoring He pressure.
AC 800'	17	CAB PRESS RELF vlv (2) - CLOSE (safety latch off)	X X X X	Valves must be closed prior to touchdown to prevent water from entering CM.

ABORT

STA/T	STEP	PROCEDURE	PANEL	REMARKS
AC	18	ELS LOGIC - on (up) (verify)	X X X	
CP	19	CM RCS PRPLNT (both) - OFF	X X X	OFF position is momentary.
		CM RCS PRPLNT tb (both) - bp	X X X	Barber pole indicates at least one valve closed in each system.
AC	20	DIRECT O2 vlv - OPEN (CCW)	X X X	
DP	21	MN BUS TIE (2) - OFF	X X	Removes battery power from dc main buses.
		CAUTION	X X	
		MN BUS TIE switches must be left OFF to ensure that bats A, B & C are used to pwr postlanding sys only, & to prevent bat shorting caused by water entering CM feedthru connectors.	X X X X X X X X X X X X	
	22	cb BAT RLY BUS (2) - open	X X X	
	23	Postlanding check, sec 16	X X	

STA/T	STEP	PROCEDURE	PANEL	REMARKS
		19.1.2 Mode 1B LES Abort (01:01 - 01:47)		
AC	1	Abort initiation auto or manual THC - CCW	X X X X X	If manual backup required for any auto event after abort initiation, it must be performed after LE motor burnout (abort T +00:05) because of high G environment during LE motor burn.
		XXXXXXXXXXXXXXXXXXXXXXXXXX X		
CP		X CM/SM SEP (both) - on X (up) X		Guarded. On position is momentary. If abort initiated with CM/SM SEP switches, subsequent events may require manual initiation and must be performed after LE motor burnout.
		XXXXXXXXXXXXXXXXXXXXXXXXXX		
		BECO (auto)	X X Request ground X command BECO	
00:00		Evnt Tmr rset & counting up (auto)	X X X	
		CM/SM deadface (auto)	X X	
		SM C/W lts - on	X X	
DP		MASTER ALARM pb/lt - on	X X X	
AC		CM RCS press (auto)	X X	
		RCS cont trnfr (auto)	X X	
00:00.1		CM/SM sep (auto)	X	CM/SM umbilical and tension ties severed.

ABORT

STA/T	STEP	PROCEDURE	PANEL	REMARKS
AC		LE motor fire (auto)		
00:01		SCS/RCS enbl (auto)		
00:01.8		CM/SM sep pyro deadface (auto)		
00:05		If abort initiated with CM/SM SEP (both) or if backup req for any auto evnt		
		EVNT TMR RSET - RSET		RSET position is momentary.
		EVNT TMR START - START		START position is momentary.
CP		CM RCS PRESS - on (up)		Guarded. On position is momentary.
		RCS TRNFR - CM		CM position is momentary.
AC		LES MOT FIRE pb - push		Guarded.
CP		RCS CMD - ON		ON position is momentary.
AC 00:11		Canard deploy (auto)	CNRD DPLY pb - push (hold for 3 sec)	Guarded.
CP	2	C/W CSM - CM		Extinguishes all SM C/W lights and allows CM RCS lights to function.

MODE 1B LES ABORT (00:01 - 01:47)

STA/T	STEP	PROCEDURE	PANEL	REMARKS
DP	3	MASTER ALARM pb/lt - push	X X X X	
AC 00:14		ELS logic arm (auto)	X ELS LOGIC - on (up) X	Guarded.
		ELS AUTO - AUTO	X X	
24K'		LES TWR jett (auto)	X X	
CP		a. Docking ring sep	X X	
		b. TWR attach nuts detonate	X TWR JETT X (both) - on (up) X	Guarded. On position is momentary.
		c. SCS RCS disable	X RCS CMD - OFF X	OFF position is momentary.
		d. TWR jett mot fire	X X	
AC		Apex cover jett (auto)	X APEX COVER JETT X pb - push X	Guarded.
		Drogue chutes deploy (auto)	X DROG DPLY pb - push X (2 sec after X apex cover jett) X	Guarded.
23.5K'	4	Mon CAB PRESS ind - starts incr	X X If no incr by 17K' X rh CAB PRESS X RELF vlv - X DUMP (safety X latch off)	No increase indicates cabin pressure relief valve failure.

STA/T	STEP	PROCEDURE	PANEL	REMARKS
		X If still no incr		
CP		X CAB PRESS DUMP vlv - open (CCW)		
10K'		CAB PRESS ind - 10 psia	2	Indication of main chute deploy altitude.
		Main chutes & VHF recovery ant deploy (auto)		Auto deployment occurs between 10,950 feet and 9,100 feet. Parachutes disreef in ≈15 seconds.
AC	5	MN DPLY pb - push		Guarded.
	6	rh CAB PRESS RELF vlv - DUMP (safety latch off)		
		X If CM PRPLNT DUMP req CAUTION CM PRPLNT DUMP should be initiated immediately after main chute disreefing. If main or pyro bus lost, use RHCs for burn, not CM PRPLNT DUMP switch.		

STA/T	STEP	PROCEDURE	PANEL	REMARKS
		X CAB PRESS RELF vlv X (2) - CLOSE (safety X latch off) X X	If CAB PRESS DUMP vlv used to equalize ΔP, CAB PRESS DUMP vlv - close (CW)	
		X CM PRPLNT DUMP - on X (up) (dump burn is X audible) X		Guarded.
CP		X RCS IND sel - CM 1 X CM RCS He PRESS X ind - decr X X X	RCS IND sel - CM 2 CM RCS He PRESS ind - decr If no decr or RCS jets not firing	
AC,CP		X X X X X X X XXXXXXXXXXXXXXXXXXXXXXXXXXX	RHC (both) - Fire all RCS jets (except plus pitch) until prplnts are depleted X	One RHC positioned to command plus yaw and roll (excluding plus pitch) and other RHC positioned to command minus yaw, pitch and roll.
DP	7	Set up entry comm VHF ANT - RECY VHF AM A - SIMPLEX VHF BCN - ON	X X X X X	If VHF AM B - SIMPLEX or VHF AM A - DUPLEX required, turn off beacon during period of communication.
AC		Xmit voice (VHF AM) reporting Position	X X X	Continue voice transmission until touchdown.

STA/T	STEP	PROCEDURE	PANEL	REMARKS
AC		Main chutes	X	
		disreefed	X	
		Splash error	X	
		Crew status	X	
			X	
CP	8	Crew couch struts (4) -	X	
		unlock	X	
			X	
	9	(P21) Ground track	X	
		determination	X	
			X	
		a. Key V37E 21E	X	
			X	
		b. FL V04 N06	X	
		Option code 00002	X	
		CMC assumed option	X	
		0000X	X	Initially set to 00001 (this vehicle).
		Verify	X	
		R2 = 00001	X	
		PRO	X	
			X	
		c. FL V06 N34	X	
		GET Lat Long	X	Initial display will contain zeros (present time).
		00XXX. HRS	X	If not changed by astronaut, calculations will be
		000XX. MIN	X	based on present time.
		0XX.XX SEC	X	
			X	
		Accept PRO	X	State vector integrated to desired time.
		Reject Key V25E	X	
		Load	X	
		desired	X	
		GET Lat	X	
		Long	X	

STA/T	STEP	PROCEDURE	PANEL	REMARKS
CP	d.	FL V06 N43 Lat (+North) XXX.XX DEG Long (+East) XXX.XX DEG Alt XXXX.X NM XXXXXXXXXXXXXXXXXXXXXXXXXXX	X X X X X X X	Altitude above launch pad radius. At this point, alt/10, VI, and gamma available by keying N73E.
		X X If PRPLNT DUMP/BURN X when dump burn X complete X		Both CM RCS LOGIC and CM PRPLNT DUMP switches must be on to power CM PRPLNT PURG switch.
AC AC,CP		X CM PRPLNT PURG - on (up) (purge audible) X X X X X X X X X X	CM RCS He DUMP pb - push If RHC (both) used for prplnt dump burn RHC (both) - Fire all jets (except plus pitch)	Guarded. CM RCS He DUMP pushbutton should be used to initiate purge following normal dump operation if CM PRPLNT PURG switch fails to initiate purge. Visual fire from RCS engine nozzle extension surfaces after burn to depletion and during purge is expected and normal. One RHC positioned to command plus yaw and roll (excluding plus pitch) and other RHC positioned to command minus yaw, pitch and roll.
AC CP		X CAB PRESS RELF vlv (2) - BOOST/ENTR (safety latch off) X X XXXXXXXXXXXXXXXXXXXXXXXXXXX	If CAB PRESS DUMP vlv used to equalize ΔP, CAB PRESS DUMP vlv - open (CCW)	

ABORT

STA/T	STEP	PROCEDURE	PANEL	REMARKS
DP	10	cb FLT/PL BAT BUS A, B & BAT C (3) - close	X	Connects battery bus A, B, and battery C to flight and postlanding bus.
	11	cb FLT/PL MNA - open	X	
	12	cb FLT/PL MNB - open	X	
AC	13	cb SPS PITCH (2) - open	X	
	14	cb SPS YAW (2) - open	X	
		XXXXXXXXXXXXXXXXXXXXXXXXXXX		
		X		
		X If PRPLNT DUMP/BURN		
		X performed		
3K'		X rh CAB PRESS RELF vlv -		Ensures minimum cabin-to-ambient negative ΔP for
		X DUMP (safety latch		landing impact.
		X off)		
		X		
		XXXXXXXXXXXXXXXXXXXXXXXXXXX		
AC	15	FLOOD FIXED - POST LDG	X	Provides power from flight and postlanding bus to one floodlight in LH couch area and one floodlight in center couch area.
	16	FLOOD DIM - 1 or 2	X	Position 1 provides power to two secondary floodlights, and position 2 provides power to two primary floodlights when FLOOD FIXED switch in POST LDG position after dc main buses deactivated.

MODE 1B LES ABORT (00:01 - 01:47)

STA/T	STEP	PROCEDURE	PANEL	REMARKS
800'	17	CAB PRESS RELF vlv (2) - CLOSE (safety latch off)	If CAB PRESS DUMP vlv used to equalize ΔP, CAB PRESS DUMP vlv - close (CW)	Valves must be closed prior to touchdown to prevent water from entering CM.
CP				
AC	18	ELS LOGIC - on (up) (verify)		Guarded.
CP	19	CM RCS PRPLNT (both) - OFF CM RCS PRPLNT tb (both) - bp		OFF position is momentary. Barber pole indicates at least one valve closed in each system.
AC	20	DIRECT 02 vlv - OPEN (CCW)		
DP	21	MN BUS TIE (2) - OFF CAUTION MN BUS TIE switches must be left OFF to ensure that bats A, B and C are used to pwr postlanding sys only, & to prevent bat shorting caused by water entering CM feed-thru connectors.		Removes battery power from dc main buses.
DP	22	cb BAT RLY BUS (2) - open		
	23	Postlanding check, sec 16		

STA/T	STEP	PROCEDURE	PANEL	REMARKS
		19.1.3 Mode 1C LES Abort (01:47 - 02:51)		
AC	1	Abort initiation (auto or manual) THC - CCW	X X X X	If manual backup required for any auto event after abort initiation it must be performed after LE motor burnout (abort T +00:05) because of high G environment during LE motor burn.
CP		CM/SM SEP (both) - on (up)	X X X	Guarded. On position is momentary. If abort initiated with CM/SM SEP switches, subsequent events may require manual initiation and must be performed after LE motor burnout.
		BECO (auto)	X	Request ground command BECO
00:00		Evnt Tmr rset & counting up (auto)	X X X	
		CM/SM deadface (auto)	X X	
		SM C/W lts - on	X X	
DP		MASTER ALARM pb/lt - on	X X X	
AC		CM RCS press (auto)	X X	
		RCS cont trnfr (auto)	X X X	
00:00.1		CM/SM sep (auto)	X	CM/SM umbilical and tension ties severed.

STA/T	STEP	PROCEDURE	PANEL	REMARKS
AC		LE motor fire (auto)	X	
	00:01	SCS/RCS enable (auto)	X	
	00:01.8	CM/SM sep pyro deadface (auto)	X	
	00:05	If abort initiated with CM/SM SEP (both) or if backup req for any auto evnt		
	00:00	EVNT TMR RSET - RSET		RSET position is momentary.
		EVNT TMR START - START		START position is momentary.
CP		CM RCS PRESS - on (up)		Guarded. On position is momentary.
		RCS TRNFR - CM		CM position is momentary.
AC		LES MOT FIRE pb - push		Guarded.
CP		RCS CMD - ON		ON position is momentary.
AC	00:11	Canard deploy (auto)	X CNRD DPLY pb - push	Guarded.
CP	2	C/W CSM - CM	X	Extinguishes all SM C/W lights and allows CM RCS lights to function.

ABORT

STA/T	STEP	PROCEDURE	PANEL	REMARKS
DP	3	MASTER ALARM pb/lt - push	X X X	
CP	4	Mon LEV status GMBL LOCK lt - out Abort apogee >30 NM IMU gmbl lock can be avoided during manual cont FDAIs agree If all above conditions are met, go to 5; otherwise go to 18	X X X X X X X X X X X X X	
	5	TWR JETT (both) - on (up)	X X X	Guarded. On position is momentary.
		a. Docking ring sep	X X	
		b. TWR attach nuts detonate	X X X	
		c. TWR jett mot fire	X X	
AC	6	Damp rates	X X	
	7	Mnvr to entry att R 0°, P 135°, Y 0°	X X	

MODE 1C LES ABORT (01:47 - 02:51)

STA/T	STEP	PROCEDURE	PANEL	REMARKS
AC	8	BMAG MODE (3) - ATT 1/	X	
		RATE 2	X	
			X	
	9	ATT DBD - MAX	X	
			X	
	10	Set up for CM RCS sys 1	X	
		AUTO RCS CM 1	X	
		(6) - MNA/MNB	X	
			X	
		AUTO RCS CM 2	X	
		(6) - OFF	X	
			X	
	11	BMAG MODE (3) - RATE 2	X	Prevents FDAI roll bug jump.
			X	
	12	EMS FUNC - ENTRY	X	
			X	
	13	EMS MODE - NORM	X	
			X	
	14	When .05 G lt - on	X	
		.05 G sw - on (up)	X	
			X	
	15	EMS ROLL - on (up)	X	
			X	
	16	Maintain full lift	X	
			X	
50K'	17	Go to Earth Landing,	X	
		sec 15	X	

STA/T	STEP	PROCEDURE	PANEL	REMARKS
		(LET descent from step 4)		
AC	18	Establish and maintain minimum 5 to 10°/sec + pitch rate with RHC	X X X X X	Pitchup rate of at least 5 deg/sec should be maintained until canard and LET begin trailing CM upon descending below entry interface. SCS ATT mode is rate command in all three axes at this time and RHC maximum command is 7 deg/sec.
30K'		ELS AUTO - AUTO ELS LOGIC - on (up)	X X	
CP			X	
24K'		LES TWR jett (auto)	X X	
		a. Docking ring sep	X X	
		b. TWR attach nuts detonate	X TWR JETT X (both) - on (up) X	Guarded. On position is momentary.
		c. SCS RCS disable	X RCS CMD - OFF X	OFF position is momentary.
		d. TWR jett mot fire	X X	
AC		Apex cover jett (auto)	X APEX COVER JETT X pb - push X	Guarded.
		Drogue chutes deploy (auto)	X DROG DPLY pb - X push (2 sec after X apex cover jett)	Guarded.

MODE 1C LES ABORT (01:47 - 02:51)

STA/T	STEP	PROCEDURE	PANEL	REMARKS
AC				
23.5K'				
	19	Mon CAB PRESS ind - starts incr	If no incr by 17K' rh CAB PRESS RELF vlv - DUMP (safety latch off)	No increase indicates cabin pressure relief valve failure.
CP			If still no incr CAB PRESS DUMP vlv - open (CCW)	
10K'		CAB PRESS ind - 10 psia	2	Indication of main chute deploy altitude.
		Main chutes and VHF recovery ant deploy (auto)		Auto deployment occurs between 10,950 feet and 9,100 feet. Parachutes disreef in ≈15 seconds.
AC	20	MN DPLY pb - push		Guarded.
	21	CAB PRESS RELF vlv (2) - DUMP (safety latch off)		
DP	22	Set up entry comm VHF ANT - RECY VHF AM A - SIMPLEX VHF BCN - ON		If VHF AM B - SIMPLEX or VHF AM A - DUPLEX required, turn off beacon during period of communication.

ABORT

STA/T	STEP	PROCEDURE	PANEL	REMARKS
AC		Xmit voice (VHF AM)	X	Continue voice transmission until touchdown.
		reporting	X	
		Position	X	
		Main chutes	X	
		disreefed	X	
		Splash error	X	
		Crew status	X	
			X	
CP	23	Crew couch struts (4) -	X	
		unlock	X	
			X	
	24	(P21) Ground track	X	
		determination	X	
			X	
		a. Key V37E 21E	X	
			X	
		b. FL V04 N06	X	
		Option code 00002	X	
			X	
		CMC assumed option	X	
		0000X	X	Initially set to 00001 (this vehicle).
		Verify R2 =	X	
		00001	X	
		PRO	X	
			X	
		c. FL V06 N34	X	Initial display will contain zeros (present time).
		GET Lat Long	X	If not changed by astronaut, calculations will be
		00XXX. HRS	X	based on present time.
		000XX. MIN	X	
		0XX.XX SEC	X	
			X	

MODE 1C LES ABORT (01:47 - 02:51)

STA/T	STEP	PROCEDURE	PANEL	REMARKS
CP		Accept PRO	X	State vector integrated to desired time.
		Reject Key V25E	X	
		Load	X	
		desired	X	
		GET Lat	X	
		Long	X	
			X	
		d. FL V06 N43	X	
		Lat (+North)	X	
		XXX.XX DEG	X	
		Long (+East)	X	
		XXX.XX DEG	X	
		Alt XXXX.X NM	X	Altitude is above launch pad radius. At this point, alt/10, VI, and gamma is available by keying N73E.
			X	
			X	
DP	25	**cb FLT/PL BAT BUS A, B & BAT C (3) - close**	X	Connects battery bus A, B, and battery C to flight and postlanding bus.
			X	
	26	cb FLT/PL MNA - open	X	
			X	
			X	
	27	**cb FLT/PL MNB -** open	X	
			X	
			X	
	28	cb SPS PITCH (2) - open	X	
			X	
	29	cb SPS YAW (2) - open	X	
			X	
3K'	30	FLOOD FIXED - POST LDG	X	Provides power from flight and postlanding bus to one floodlight in LH couch area and one floodlight in center couch area.
			X	
			X	
			X	

STA/T	STEP	PROCEDURE	PANEL	REMARKS
AC	31	FLOOD DIM - 1 or 2		Position 1 provides power to two secondary floodlights and position 2 provides power to two primary floodlights when FLOOD FIXED switch is in POST LDG position and dc main buses deactivated.
800' CP	32	CAB PRESS RELF vlv (2) - CLOSE (safety latch off)	If CAB PRESS DUMP vlv used to equalize ΔP, CAB PRESS DUMP vlv - close (CW)	Valves must be closed prior to touchdown to prevent water from entering CM.
AC	33	ELS LOGIC - on (up) (verify)		Guarded.
	34	CM RCS PRPLNT (both) - OFF CM RCS PRPLNT tb (both) - bp		OFF position is momentary. Barber pole indicates at least one valve closed in each system.
	35	DIRECT 02 vlv - OPEN (CCW)		
DP	36	MN BUS TIE (2) - OFF CAUTION MN BUS TIE switches must be left OFF to ensure that bats A, B & C are used to pwr postlanding systems only, & to prevent bat shorting caused by water entering CM feed-thru connectors.		Removes battery power from dc main buses.

STA/T	STEP	PROCEDURE	PANEL	REMARKS
DP	37	cb BAT RLY BUS (2) - open	X X X	
	38	Postlanding check, sec 16	X X	

19.2 RCS/SPS ABORT MODES II, III, IV

Mode II, III, and IV aborts are manually initiated and utilize the SM RCS or SM RCS and SPS engines to provide CSM/SIVB separation and translation. After separation and CSM stabilization, the abort possibilities separate into three categories.

- CM/SM separation and coast-to-landing site (MODE II).
- Shaped trajectory abort utilizing an SPS variable ΔV maneuver to correct the trajectory for the desired landing site in the Atlantic Recovery Area (MODE IIIA & IIIB).
- Abort-to-earth-orbit utilizing the SPS engine to attain earth orbital altitude and velocity (MODE IV).

STA/T	STEP	PROCEDURE	PANEL	REMARKS
		19.2.1 Mode II RCS Abort (02:51 to Mode IIIA or IV)		
AC	1	THC - CCW (4.0 sec min)	X X X X X	Direct ullage commanded when THC placed CCW. THC must be left in CCW detent for 4.0 seconds to allow 3.0-second timer (adapter separation) and 0.8-second timer (RCS enable) to operate.
00:00		Evnt Tmr rset & counting up (auto)	X EVNT TMR RSET - X RSET X EVNT TMR START - X START	RSET position is momentary. START position is momentary.
		BECO (auto) LV ENG 1 - on	X Request ground X command BECO	
		Direct ullage started (auto)	X DIR ULL pb - push X X X	If auto direct ullage present (THC-CCW), DIR ULL pb must not be actuated (avoids tying together main bus A & B at DIR ULL pb).
00:03		Adapter sep (auto) LV ENG lt (1) - out	X CSM/LV SEP pb - X push	Guarded.
CP			X	
00:03.08		RCS/SCS enbl (auto)	X RCS CMD - ON	ON position is momentary.
		Key V82E	X	Calls R30 for meaningful display of N50.
		FL V16 N44	X	
		Ha XXXX.X NM	X	Apogee altitude.
		Hp XXXX.X NM	X	Perigee altitude.
		TFF XXBXX MIN-SEC	X	Time of free fall to 49.4 NM (300,000 ft).
			X	
AC	2	THC - ARMED, ctr, damp rates, then +X Check SM RCS tbs	X DIR ULL pb - push X X X	Automatic direct ullage terminated when THC returned to center.

ABORT

STA/T	STEP	PROCEDURE	PANEL	REMARKS
CP	3	Key N50E	X	
		Splash error	X	
		XXXX.X NM	X	Negative for undershoot, positive for overshoot.
		Hp XXXX.X NM	X	
		TFF XXBXX MIN-SEC	X	If TFF <100 seconds, maneuver-to-entry attitude must be initiated immediately and separation performed at entry attitude.
			X	
			X	
		If TFF <100 sec, go to 9	X	
AC			X	
00:24	4	Terminate +X trans	X	
			X	
	5	If TFF >2 min	X	
		Yaw 45° (out of	X	
		plane)	X	
		Start R&P mnvr to	X	
		entry att R 0°,	X	
		P 135°	X	
			X	
		If TFF <2 min	X	
		Start mnvr to	X	
		entry att	X	
		R 0°, P 135°, Y 0°	X	
			X	
	6	BMAG MODE (3) - ATT 1/	X	
		RATE 2	X	
			X	
	7	cb CSM/DM FNL SEP (2) -	X	
		close (pull lanyard)	X	
			X	
CP		CSM/DM FNL SEP (both)-	X	Guarded. On position is momentary. Jettisons docking ring.
		on (up)	X	
			X	

STA/T	STEP	PROCEDURE	PANEL		REMARKS
CP	8	CM/SM SEP (both) - on (up)	X X		Guarded. On position is momentary.
		CM/SM deadface (auto)	X		
		SM C/W lts - on	X		
DP		MASTER ALARM pb/lts - on	X X		
AC		CM RCS press (auto)	X X	CM RCS PRESS - on (up)	Guarded. On position is momentary.
		RCS cont trnfr - (auto)	X X	RCS TRNFR - CM	CM position is momentary.
		CM/SM sep (auto)	X X		CM/SM umbilical and tension ties severed (0.1 sec after CM/SM sep initiate).
		CM/SM sep pyro deadface (auto)	X X		
CP		C/W CSM - CM	X X		Extinguishes all SM C/W lights and allows CM RCS C/W lights to function.
DP		MASTER ALARM pb/lt - push	X X X		
AC	9	Start yaw mnvr to entry att Y 0°	X X X X		
	10	ATT DBD - MAX	X X		
	11	Note TFF	X X		Maneuver-to-entry attitude must be completed prior to TFF = 0 seconds.
01:40			X		
	12	Mnvr to entry att R 0°, P 135°, Y 0°	X X X		BEF, heads down, full lift.

19.2.1 MODE II RCS ABORT (02:51 TO MODE IIIA OR IV)

ABORT

STA/T	STEP	PROCEDURE	PANEL	REMARKS
AC	13	Set up for CM RCS sys 1	X	
		AUTO RCS CM 1	X	
		(6) - MNA or MNB	X	
		AUTO RCS CM 2	X	
		(6) - OFF	X	
			X	
	14	BMAG MODE (3) - RATE 2	X	Prevents roll bug jump when .05 G switch set to on.
			X	
	15	EMS FUNC - ENTRY	X	
			X	
	16	EMS MODE - NORM	X	
			X	
	17	When .05 G lt - on,	X	
		.05 G sw - on (up)	X	
			X	
	18	EMS ROLL - on (up)	X	
			X	
	19	Maintain full lift	X	
			X	
	20	Go to Earth Landing,	X	
		sec 15	X	

MODE II RCS ABORT (02:51 TO MODE IIIA OR IV)

STA/T	STEP	PROCEDURE	PANEL	REMARKS
		19.2.2 Mode IIIA SPS Abort (09:24 to Mode IIIB)		SPS posigrade burn to downrange recovery area.
AC	1	THC - CCW (4.0 sec min)	X	Direct ullage commanded when THC placed CCW. THC must be left in CCW detent for 4.0 seconds to allow 3.0-second timer (adapter separation) and 0.8-second timer (RCS enable) to operate.
00:00		Evnt Tmr rset & counting up (auto)	X EVNT TMR RSET - RSET X EVNT TMR START - START	RSET position is momentary. START position is momentary.
		BECO (auto)	X Request ground command SIVB BECO	
		LV ENG 1 lt - on Dir ullage started (auto)	X X DIR ULL pb - push	If auto direct ullage present (THC-CCW), DIR ULL pb must not be activated (avoids tying together main bus A & B at DIR ULL pb).
00:03		Adapter sep (auto) LV ENG 1 lt - out	X CSM/LV SEP pb - push	Guarded.
CP			X	
00:03.8		RCS/SCS enbl (auto) If not previously selected in boost Key V82E N62E VI XXXXX. FPS Hdot XXXXX. FPS Hpad XXXX.X NM	X RCS CMD - ON	ON position is momentary.

STA/T	STEP	PROCEDURE	PANEL	REMARKS
AC	2	THC - ARMED	X	
00:05		THC - neutral, damp	X DIR ULL pb - push	Automatic direct ullage terminated when THC returned to center.
		rates, then +X	X	
		Check SM RCS tbs	X	
		LV IND/GPI sw - GPI	X	
		If desired	X	
CP		Key N50E	X	
		ΔR XXXX.X NM	X	
		HP XXXX.X NM	X	
		TFF XXBXX MIN-SEC	X	
AC			X	
00:24		Terminate +X trans	X	
			X	
	3	Mnvr to burn att	X	
		R 180°, P 355°, Y 0°	X	SEF, heads down.
			X	
		BMAG MODE (3) - ATT 1/	X	
		RATE 2	X	
		RATE - LO	X	
			X	
	4	Verify SPS GMBL ind	X	
		(2) = SPS GMBL tw (2)	X	
		settings	X	
		EMS MODE - NORM	X	
01:50		Ullage	X	
		THC - +X (IGN + 1 sec)	X DIR ULL pb - push	
		ΔV THRUST A - NORM	X	Guarded.
02:05		SPS THRUST - DIR ON	X No SPS IGN	Lever lock.
			X ΔV THRUST B -	
			X NORM	
			X	

MODE IIIA SPS ABORT (09:24 TO MODE IIIB)

STA/T	STEP	PROCEDURE	PANEL	REMARKS
AC			X	
			X	If still no IGN
			X	THRUST ON pb -
			X	push
IGN+1SEC		RATE - HI	X	Bypasses noise problem in SCS gyro assemblies because of thrusting vibration levels and provides backup to auto selection of high rate in pitch and yaw TVC.
			X	
			X	
		Terminate ullage	X	
			X	
	5	VC = desired value	X	
		(ΔR = -200 NM)	X	
	or	TFF = 1+40	X	
		ΔV THRUST (2) - OFF	X	Guarded.
			X	
CP		KEY REL	X	
		FL V16 N44	X	
		Ha XXXX.X NM	X	
		Hp XXXX.X NM	X	
		TFF XXBXX MIN-SEC	X	
			X	
		If TFF >2 min	X	
		Yaw 45° (out of	X	
		plane) before	X	
		CM/SM sep	X	
			X	
		If TFF <2 min,	X	
		start mnvr to	X	Maneuver to entry attitude must be completed prior to TFF = 0 seconds.
		entry att	X	
		R 0°, P 115°, Y 0°	X	
			X	
		cb MNA & MNB BAT C (2) -	X	
		close	X	
			X	

ABORT

STA/T	STEP	PROCEDURE	PANEL	REMARKS
CP	6	CM/SM SEP (both) - on (up)	X X	Guarded. On position is momentary.
		CM/SM deadface (auto)	X	
		SM C/W lts - on	X	
		MASTER ALARM pb/lt - on	X X	
		CM RCS press (auto)	X X	CM RCS PRESS - on (up)	Guarded. On position is momentary.
		RCS cont trnfr (auto)	X X	RCS TRNFR - CM	CM position is momentary.
		CM/SM sep (auto)	X		CM/SM umbilical and tension ties severed (0.1 sec after sep initiate).
		CM/SM sep pyro dead face (auto)	X X X	
		C/W CSM - CM	X X		Extinguishes all SM C/W lights and allows CM RCS C/W lights to function.
DP		MASTER ALARM pb/lt - push	X X X	
CP	7	CSM/DM FNL SEP (2) - close (pull lanyard)	X X X	
		CSM/DM FNL SEP (both) - on (up)	X X X	Guarded. On position is momentary. Jettisons docking ring.
AC		ATT DBD - MAX	X X	
	8	Note TFF	X	
		Complete mnvr to entry att	X X	BEF, heads down, full lift.
		Set up for CM RCS sys 1	X	
		AUTO RCS SEL CM 1 (6) - MNA or MNB	X X	

MODE IIIA SPS ABORT (09:24 TO MODE IIIB)

STA/T	STEP	PROCEDURE	PANEL	REMARKS
AC		AUTO RCS SEL CM 2	X	
		(6) - OFF	X	
		BMAG MODE (3) - RATE 2	X	Prevents roll bug jump when .05 G switch is set to on.
			X	
	9	EMS MODE - STBY	X	
			X	
		EMS FUNC - ENTRY	X	
		EMS MODE - NORM	X	
		Maintain full lift to	X	
		.05 G	X	
			X	
	10	When .05 G lt - on,	X	
		.05 G sw - on (up)	X	
		EMS ROLL - on (up)	X	
			X	
	11	Fly max lift to 0.2 G	X	
		then roll left 55 deg	X	
		(LV South)	X	
50K'		Go to Earth Landing,	X	
		sec 15	X	

ABORT

STA/T	STEP	PROCEDURE	PANEL	REMARKS
		19.2.3 Mode IIIB SPS Abort (Mode IIIA to Insertion)		SPS retrograde burn to downrange recovery area.
AC	1	THC - CCW (4.0 sec min)	X X X X X	Direct ullage commanded when THC placed CCW. THC must be left in CCW detent for 4.0 seconds to allow 3.0-second timer (adapter separation) and 0.8-second timer (RCS enable) to operate.
00:00		Evnt Tmr rset & counting up (auto)	X EVNT TMR RSET - X RSET X EVNT TMR START - X START	RSET position is momentary. START position is momentary.
		BECO (auto)	X Request ground X command SIVB X BECO	
		LV ENG 1 lt - on	X	
		Dir ullage started (auto)	X DIR ULL pb - push X X X	If auto direct ullage present (THC-CCW), DIR ULL pb must not be activated (avoids tying together main bus A & B at DIR ULL pb).
00:03		Adapter sep (auto) LV ENG 1 lt - out	X CSM/LV SEP pb - X push	Guarded.
CP			X	
00:03.8		RCS/SCS enbl (auto)	X RCS CMD - ON	ON position is momentary.
		If not previously selected in boost	X X	
		Key V82E	X	Calls R30 for meaningful display of N50.
		FL V16 N44	X	
		Ha XXXX.X NM	X	Apogee altitude.
		Hp XXXX.X NM	X	Perigee altitude.
		TFF XXBXX MIN-SEC	X X X	Time of free fall to 49.4 NM (300,000 ft).

STA/T	STEP	PROCEDURE	PANEL	REMARKS
AC	2	THC - ARMED	X	
00:05		THC - neutral, damp	X DIR ULL pb - push	Automatic direct ullage terminated when THC returned to center.
		rates, then +X	X	
		Check SM RCS tbs	X	
		LV IND/GPI sw - GPI	X	
			X	
CP	3	Key N50E	X	
			X	
		ΔR XXXX.X NM	X	Splash error (ΔR), negative for undershoot, positive for overshoot.
			X	
		Hp XXXX.X NM	X	
		TFF XXBXX MIN-SEC	X	If TFF <100 seconds, maneuver to entry attitude immediately.
			X	
AC			X	
00:24		Terminate +X trans	X	
			X	
	4	ΔR > -200 NM)	X	
		Mnvr to retro att	X	
		R 180, P 198, Y 0	X	BEF, heads up.
			X	
		Obtain retro update	X	
		BMAG MODE (3) - ATT 1/	X	
		RATE 2	X	
		RATE - LO	X	
			X	
	5	Verify SPS GMBL ind	X	
		(2) = SPS GMBL tw (2)	X	
		settings	X	
		EMS MODE - NORM	X	

ABORT

STA/T	STEP	PROCEDURE		PANEL	REMARKS
AC			X		
01:50		Ullage	X		
		THC - +X (IGN + 1 sec)	X	DIR ULL pb - push	
		ΔV THRUST A - NORM	X		Guarded.
			X		
02:05		SPS THRUST - DIR ON	X	No SPS IGN	Lever lock.
			X	ΔV THRUST B -	
			X	NORM	
			X		
			X	If still no IGN	
			X	THRUST ON pb -	
			X	push	
IGN+1SEC		RATE - HI	X		Bypasses noise problem in SCS gyro assemblies because of thrusting vibration levels and provides backup to auto selection of high rate in pitch and yaw TVC.
			X		
			X		
		Terminate ullage	X		
			X		
	6	VC = desired value	X		
		(ΔR = -200 NM)	X		
	or	TFF = 1+00	X		
		ΔV THRUST (2) - OFF	X		
			X		
		If TFF >2 min	X		
		Yaw 45° (out of	X		
		plane) before	X		
		CM/SM sep	X		
			X		
		If TFF <2 min, start	X		
		mnvr to entry att	X		Maneuver to entry attitude must be completed prior to TFF = 0 seconds.
		R 0°, P 115°, Y 0°	X		
			X		
		cb MNA & MNB BAT C (2) -	X		
		close	X		

MODE IIIB SPS ABORT (MODE IIIA TO INSERTION)

STA/T	STEP	PROCEDURE	PANEL	REMARKS
CP	7	CM/SM SEP (both) - on (up)	X X	Guarded. On position is momentary.
		CM/SM deadface (auto)	X	
		SM C/W lts - on	X	
		MASTER ALARM pb/lt - on	X X	
		CM RCS press (auto)	X CM RCS PRESS - on X (up)	Guarded. On position is momentary.
		RCS cont trnfr (auto)	X RCS TRNFR - CM X	CM position is momentary.
		CM/SM sep (auto)	X	**CM/SM umbilical and tension ties severed (0.1 sec after sep initiate).**
		CM/SM sep pyro deadface (auto)	X **X** **X**	
		C/W CSM - CM	X X	**Extinguishes all SM C/W lights and allows CM RCS C/W lights to function.**
DP		MASTER ALARM pb/lt - push	X X X	
CP	8	cb CSM/DM FNL SEP (2) - close (pull lanyard)	X X X	
		CSM/DM FNL SEP (both) - on (up)	X X X	Guarded. On position is momentary. Jettisons docking ring.
AC		ATT DBD - MAX	X X	
	9	Note TFF	X	
		Complete mnvr to entry att	X X	BEF, heads down, full lift.
		Set up for CM RCS sys 1	X	
		AUTO RCS SEL CM 1	X	
		(6) - MNA or MNB	X	

19.2.3 MODE IIIB SPS ABORT (MODE IIIA TO INSERTION)

ABORT

STA/T	STEP	PROCEDURE	PANEL		REMARKS
AC		AUTO RCS SEL CM 2	X		
		(6) - OFF	X		
		BMAG MODE (3) - RATE 2	X		Prevents roll bug jump when .05 G switch is set to on.
			X		
	10	EMS MODE - STBY	X		
		EMS FUNC - ENTRY	X		
		EMS MODE - NORM	X		
		Maintain full lift to	X		
		.05 G	X		
			X		
	11	When .05 G lt - on,	X		
		.05 G sw - on (up)	X		
		EMS ROLL - on (up)	X		
			X		
	12	Fly max lift to 0.2 G	X	If TFF C/O	
		then roll left 55 deg	X	before ΔR = -140	
		(LV South)	X	at 0.2 G, roll	
			X	left 90° (LV South)	
			X		
50K'		Go to Earth Landing,	X		
		sec 15	X		

STA/T	STEP	PROCEDURE	PANEL		REMARKS
		19.2.4 Mode IV SPS Abort (09:34 to Insertion)			
AC	1	THC - CCW (4.0 sec min)	X		Direct ullage commanded when THC placed CCW. THC must be left in CCW detent for 4.0 seconds to allow 3.0-second timer (adapter separation) and 0.8-second timer (RCS enable) to operate.
00:00		Evnt Tmr rset & counting up (auto)	X	EVNT TMR RSET - RSET	RSET position is momentary.
			X	EVNT TMR START - START	START position is momentary.
		BECO (auto)	X	Request ground command SIVB BECO	
		LV ENG 1 lt - on	X		
		Direct ullage started (auto)	X	DIR ULL pb - push	If auto direct ullage present (THC-CCW), DIR ULL pb must not be activated (avoids tying together main bus A & B at DIR ULL pb).
00:03		Adapter sep (auto)	X	CSM/LV SEP pb - push	Guarded.
		LV ENG 1 lt - out	X		
CP			X		
00:03.8		RCS/SCS enbl (auto)	X	RCS CMD - ON	ON position is momentary.
	2	LV IND/GPI sw - GPI	X		
AC	3	THC - ARMED, ctr, damp rates, then +X	X	DIR ULL pb - push	Automatic direct ullage terminated when THC returned to center.
		Check SM RCS tbs	X		

ABORT

STA/T	STEP	PROCEDURE	PANEL	REMARKS
CP	4	Key V82E N62E	X	
		FL V16 N62	X	
		VI XXXXX FPS	X	
		Hdot XXXXX FPS	X	
		Hpad XXXX.X NM	X	
AC			X	
00:24	5	Terminate +X trans	X	
			X	
	6	If pitch profile burn	X	SEF, heads down. Slight movement of the GPI indicator (4) will be observed if SCS TVC (2) - RATE CMD.
		mnvr to desired burn	X	
		attitude	X	
			X	
	7	Obtain insertion update	X	
			X	
	8	BMAG MODE (3) - ATT 1/	X	
		RATE 2	X	
			X	
	9	RATE - LO	X	
			X	
	10	Verify SPS GMBL ind	X	
		(2) = SPS GMBL tw (2)	X	
		settings	X	
			X	
	11	EMS MODE - NORM	X	
			X	
	12	ΔV THRUST A - NORM	X	Guarded.
			X	
	13	Perform burn	X	-H DOT, burn ASAP; +H DOT, burn at 1:30.
		If Pitch Profile Burn	X	
AC		Start ullage (IGN	X	
		-15 sec)	X	

MODE IV SPS ABORT (09:34 TO INSERTION

STA/T STEP	PROCEDURE	PANEL	REMARKS
AC		X	
<1:30	SPS THRUST - DIR ON	X If no SPS IGN	Lever lock.
		X ΔV THRUST B-NORM	
		X If still no SPS IGN	
		X THRUST ON pb-push	
	SCS TVC PITCH-RATE CMD	X	
	RATE - HI	X	Bypasses noise problem in SCS gyro assemblies because of thrusting vibration levels and provides backup to auto selection of high rate in pitch and yaw TVC.
		X	
		X	
	Terminate ullage -	X	
	IGN + 1 sec	X	
	BMAG MODE PITCH -	X	
	RATE 1	X	
	Fly H DOT to zero with	X	
	MTVC	X	
	Trim yaw with tw	X	
	Burn to desired VI	X If H DOT >|100|	
		X Key Rel to N44	
		X (-H DOT) Burn	
		X to Hp >70 NM	
		X + 4 sec	
		X (+H DOT) Burn	
		X to Ha >200 NM,	
		X then Apogee	
		X kick	
	Go to 14	X	
		X	
or	If Fixed Att Burn	X	
01:50	Start ullage	X	

ABORT

STA/T	STEP	PROCEDURE	PANEL	REMARKS
02:05		SPS THRUST - DIR ON	X If no SPS IGN	
			X ΔV THRUST B-NORM	
			X If still no SPS IGN	
			X THRUST ON pb-push	
		Terminate ullage -	X If still no SPS IGN	
		IGN + 1 sec	X and Mode IV <200	
		Burn to VC	X fps or Apogee	
		Go to 14	X Kick <400 fps	
			X Burn RCS	
	14	ΔV THRUST (2) - OFF	X	
		on VI or VC	X	
			X	
	15	SPS THRUST - NORM	X	Lever lock.
			X	
	16	EMS MODE - STBY	X	
		SECO +40 sec	X	
		Status from ground	X	
			X	
	17	SAFE ORBIT	X	
CP		PRO (exit R30)	X	
		Key V37E 00E	X	
			X	
	18	Postorbital Insertion	X	
		Check, 3.2	X	

STA/T	STEP	PROCEDURE	PANEL	REMARKS
		20.0 UNDOCKED EMERGENCY PROCEDURES		
		Emergency procedures provide the crew with the necessary steps to quickly alleviate situations that have (or will) become both crew-hazardous and time-critical. These procedures require instant reaction on the part of the crew to prevent the conditions from becoming worse. In most instances the conditions are physically sensed by the crew rather than brought to their attention by the caution and warning system or voice communication from STDN.		
		20.1 PAD EMERGENCY PROCEDURES		
		20.1.1 Rapid Hatch Opening		To accomplish rapid hatch opening after engaging latches, hatch must be configured for rapid egress as shown in Cabin Closeout, 2.1.6.
CP	1	Gear box sel - UNLATCH (verify)	Side hatch	
	2	Actr handle rel - push or squeeze		
	3	Actr handle - opr (until hatch is unlatched)		Lock pin will be sheared. About 5 cycles of actuator operation will open hatch.
		If hatch fails to open GN2 ratchet handle - opr GN2 vlv handle - unlock & push (outbd)		

STA/T	STEP	PROCEDURE	PANEL	REMARKS
		20.2 UNDOCKED FLIGHT EMERGENCY PROCEDURES		
		20.2.1 Fire/Smoke in CM During Boost		
CP	1	CAB FANS - OFF (verify)	2	
DP	2	**Monitor EPS indicators for excess current** Immediately remove pwr from affected bus to prevent further damage to critical systems	3	
	3	If in abort mode I or II SUIT COMPR 1 (or 2) - on good ac bus	4	
	4	If in abort mode III & affected bus is MNA (or B)		
AC		TVC GMBL DR (2) - 2 (or 1)	1	
DP		INV 1 (or 2) AC1 (or 2) - OFF	3	
		INV 2 (or 1) AC1 (or 2) - on (up)		Powers both ac buses with inverter from good main bus.
AC	5	rh CAB PRESS RELF vlv - DUMP (safety latch off)	325	
	6	Continue appropriate abort		
		20.2.2 Fire/Smoke in CM - Orbital Operations		
		a. Suited Crew		
CP		CAB FANS - OFF (verify)	2	
DP		Monitor EPS indicators for excess current. Immediately remove pwr from affected bus to prevent further damage to critical systems	3	

STA/T	STEP	PROCEDURE	PANEL	REMARKS
DP		SUIT COMPR 1 (or 2) - on good ac bus	4	
		Fire extinguisher - use as appropriate		Water dispenser used on all open nonelectrical fires. Foam fire extinguisher used on fires behind panels, closed compartments, and electrical fires.
		Fire out		
		WARNING Combustion products may be toxic. Smoke should be removed from cab per Contam in CM, 20.2.5 (step 3b), before removing helmets.		
		Fire persists		
		Dump cabin as follows		
AC		SUIT RETURN vlv - close (push) (verify)	380	
CP		EMER CAB PRESS sel - OFF (verify)	351	
AC		REPRESS PKG vlv - OFF (verify)	326	
ALL		PGA - visual integrity check		
AC,CP		rh CAB PRESS RELF vlv - DUMP (safety latch off) until	325	Provides controlled cabin dump until suit circuit pressure verified.
		CAB PRESS ind 3.0 psia, then	2	
		to BOOST/ENTR	325	
		SUIT PRESS ind - holding >3.5 psia (verify)	2	
AC		rh CAB PRESS RELF vlv - DUMP	325	
CP		&/or CAB PRESS DUMP vlv - open (CCW)	Side hatch	
		CAB PRESS ind - 0.0 psia for 6 min	2	Time period is a function of equipment oxygen exposure and saturation level.

STA/T	STEP	PROCEDURE	PANEL	REMARKS
AC		rh CAB PRESS RELF vlv - NORM (safety latch on) & CAB	325	
CP		PRESS DUMP vlv - close (CW)	Side hatch	
		WARNING Do not repress cab until fire source removed. Reignition may occur with additional damage. If condition lasts longer than 10 minutes, gly circulation & temp cont must be re-established.		
	b.	Unsuited or Partially Suited Crew		
ALL		Don emer 02 mask (refer to Oper of Emer 02 Masks, 5.4.14)		
CP		CAB FANS - OFF (verify)	2	
DP		SUIT COMPR (both) - OFF	4	
		Monitor EPS indicators for excess current. Immediately remove pwr from affected bus to prevent further damage to critical systems	3	
		Fire extinguisher - use as appropriate		Water dispenser used on all open nonelectrical fires. Foam fire extinguisher used on fires behind panels, closed compartments, and electrical fires.
		Fire out		
		WARNING Combustion products may be toxic. Smoke should be removed from cab per Contam in CM, 20.2.5 (step 3b), before removing 02 masks.		

STA/T	STEP	PROCEDURE	PANEL	REMARKS
		Fire persists		
ALL		Don PGA except helmet (refer to PGA Mode Changes, 5.4.6)		02 connections red-to-red and blue-to-blue. Use 02 masks as long as possible.
AC		DIRECT 02 vlv - OPEN (CCW)	7	Purges suit inlet manifold, suit hoses, and PGA portion of suit circuit.
ALL		Remove emer 02 mask & don helmet		
CP		SUIT FLOW vlv (3) - FULL FLOW	300,301,302	
DP		SUIT COMPR 1 (or 2) - AC1 (or AC2)	4	
AC		DIRECT 02 vlv - close (CW)	7	
CP		EMER CAB PRESS sel - OFF	351	
ALL		PGA - visual integrity check		
AC		rh CAB PRESS RELF vlv - DUMP (safety latch off) until	325	Provides controlled cabin dump until suit circuit pressure verified.
CP		CAB PRESS ind 3.0 psia, then to BOOST/ENTR	2	
		SUIT PRESS ind - holding >3.5 psia (verify)		
AC		rh CAB PRESS RELF vlv - DUMP	325	
CP		&/or CAB PRESS DUMP vlv - open (CCW)	Side hatch	
		CAB PRESS ind - 0.0 psia for 6 min	2	Time period is a function of equipment oxygen exposure and saturation level.
AC		rh CAB PRESS RELF vlv - NORM (safety latch on) & CAB	325	
CP		PRESS DUMP vlv - close (CW)	Side hatch	

STA/T	STEP	PROCEDURE	PANEL	REMARKS
		WARNING Do not repress cab until fire source removed. Reignition may occur with additional damage. If condition lasts longer than 10 minutes, gly circulation and temp cont must be re-established.		
		20.2.3 Fire/Smoke in CM During Entry		
	1	CAB FANS - OFF (verify)	2	
DP	2	Monitor EPS indicators for excess current. Immediately remove pwr from affected bus to prevent further damage to critical systems	3	
AC	3	RHC PWR DIR (both) - MNA/MNB, & maintain att if req	1	
	4	If affected bus is MNA		
DP		INV 1 ACl - OFF INV 2 ACl - on (up)	3	Powers both ac buses with inverter being powered from good dc main bus, providing ac power for suit compressors and SCS.
		Set up for CM/RCS sys 2(1)		System 1 is normal and system 2 is redundant.
AC		AUTO RCS A/C ROLL (4) - OFF AUTO RCS CM 1 (2) (6) - OFF AUTO RCS CM 2 (1) (6) - MNB	8	

STA/T	STEP	PROCEDURE	PANEL	REMARKS
	5	If affected bus is MNB		
DP		INV 2 AC2 - OFF INV 1 AC2 - on (up)	3	Powers both ac buses with inverter being powered from good dc main bus, providing ac power for suit compressors and SCS.
		Set up for CM/RCS sys 2 (1) AUTO RCS A/C ROLL (4) - OFF AUTO RCS CM 1 (2) (6) - OFF AUTO RCS CM 2 (1) (6) - MNA	8	
AC	6	rh CAB PRESS RELF vlv - DUMP (safety latch off)	325	
	7	Continue entry		
	20.2.4	AC BUS 1(2) OVLD, AC BUS 1(2) & MN BUS A(B) UV Lights On		Whenever AC BUS 1(2) light and AC BUS 1(2) OVERLOAD light are both on, inverter must be disconnected from AC BUS 1(2) within 5 seconds to preclude inverter failure.
DP		INV 1 (2 or 3) AC1 (AC2) - OFF	3	Inverter removed from AC BUS 1(2).
		Go to EPS Malfunction, Pwr Distr, Symptom 1, 1a, & 1b		Malfunction procedures will be found in Flight Data File (FDF)
	20.2.5	Contamination in CM		Types, sources, and amount of contamination are not defined. The very existence of contamination in CM is treated as an emergency.
ALL	1	Don emer 02 mask &/or PGA immediately (refer to Oper of Emer 02 Masks, 5.4.14 and PGA Mode Changes, 5.4.6)		
	2	Evaluate contam level, & isolate or correct source of contam		

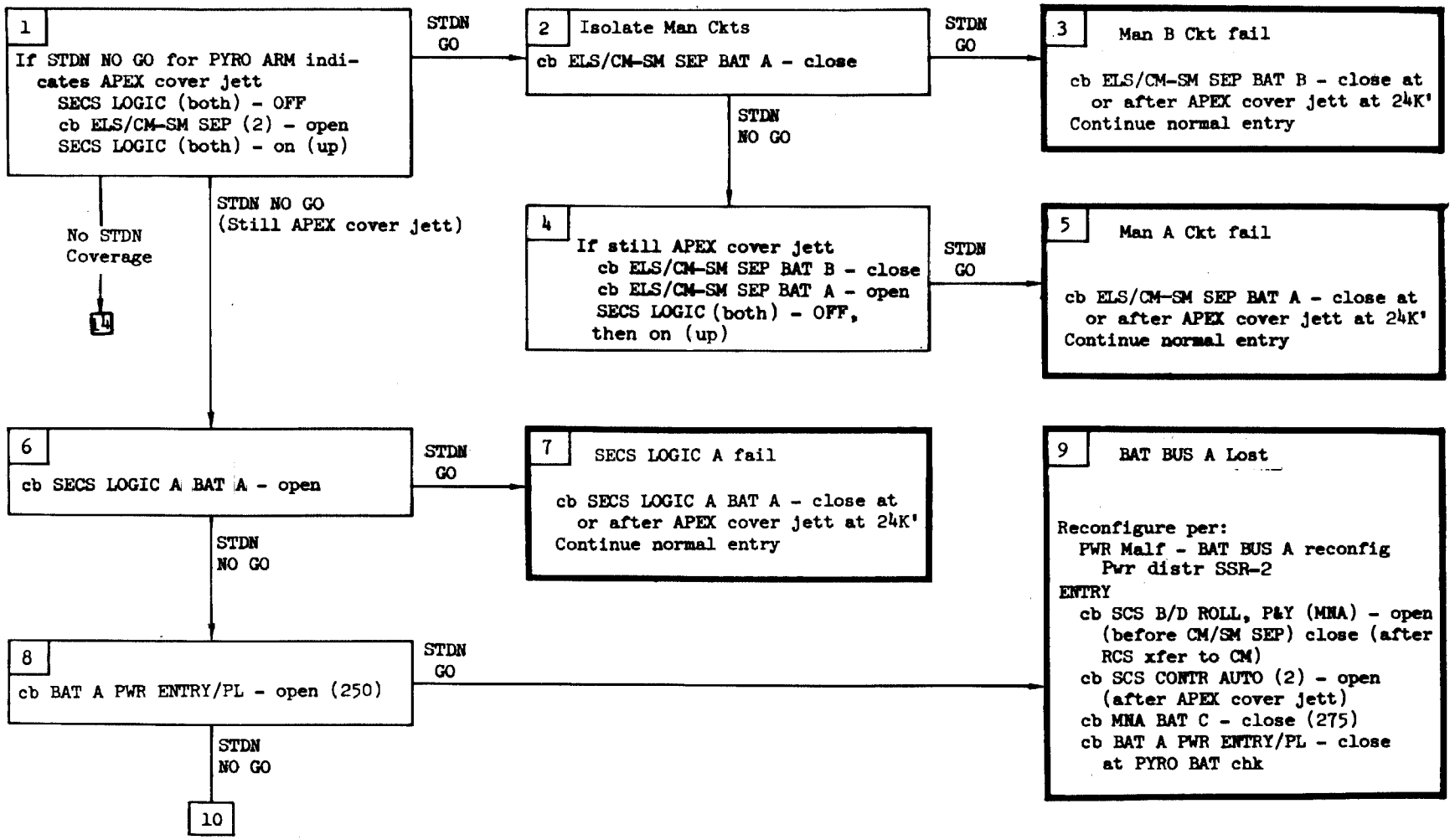
STA/T	STEP	PROCEDURE	PANEL	REMARKS
	3	If contam persists		
ALL		a. Accept contam level in cab		Slow removal of contamination accomplished with WASTE STOW valve (panel 252) in VENT position.
		Retain 02 mask or remain in PGA		
AC		If in PGA, adjust DIRECT 02 vlv	7	
CP		for SUIT CAB ΔP >2 in. H20	2	
		b. Dump & repress cab		
ALL		Retain or don PGA (refer to PGA Mode Changes, 5.4.6)		
		PGA - visual integrity check		
		Perform CM Press Dump, 5.4.11		
		Perform CM Repress, 5.4.8a		
	20.2.6	Contamination in Suit (Suited Crewman)		Contamination originates within suit circuit if, after purging with oxygen, contamination still present.
DP	1	SUIT COMPR 2 - AC1	4	
	2	SUIT COMPR 1 - OFF		
AC	3	DIRECT 02 vlv - OPEN (CCW) for 1 min, then close (CW)	7	
	4	If condition persists		
DP		SUIT COMPR 2 - OFF	4	
AC		DIRECT 02 vlv - close (CW)	7	
ALL		Doff helmet		
		Don emer 02 mask (refer to Oper of Emer 02 Masks, 5.4.14)		
		Determine contam cause		

CONTAMINATION IN SUIT (SUITED CREWMAN)

STA/T	STEP	PROCEDURE	PANEL	REMARKS
	20.2.7	LET Fails to Jettison		
	a.	Tower Legs Cut/No jett mot ign		
AC		LES MOT FIRE pb - push	1	Guarded.
		If tower jett successful		
CP		TWR JETT (both) - OFF (ctr)	2	Guarded.
		Continue mission		
		If tower jett unsuccessful		
		TWR JETT (both) - OFF (ctr)		Guarded.
		Report to STDN & go for orbit		
	b.	No Response to TWR JETT Switches		
		Verify the following		
AC		cb SECS ARM (2) - close	8	
		cb SECS LOGIC (2) - close		
		cb EDS (all) - close		
		SECS LOGIC (both) - on (up)		Lever lock.
		SECS PYRO ARM (2) - on (up)		Lever lock.
		EDS PWR - on (up)	7	
CP		TWR JETT (both) - on (up)	2	Guarded. On (up) position is momentary.
		If tower jett successful		
		TWR JETT (both) - OFF (ctr)		
		Continue mission		
		If tower jett unsuccessful		
		TWR JETT (both) - OFF (ctr)		
		Report to STDN & go for orbit		

STA/T STEP	PROCEDURE	PANEL	REMARKS

20.2.8 Emergency Safe of Apex Cover Jett



EMERGENCY SAFE OF APEX COVER JETT

STA/T STEP	PROCEDURE	PANEL	REMARKS

8

10

cb SECS LOGIC A BAT A - close
cb BAT A PWR ENTRY/PL - close
cb SECS LOGIC B BAT B - open

STDN GO → **11** SECS LOGIC B fail

cb SECS LOGIC B BAT B - close at or after APEX cover jett at 24K'
Continue normal entry

STDN NO GO

12

cb BAT B PWR ENTRY/PL - open (250)

STDN GO → **13** BAT BUS B Lost

Reconfigure per:
PWR Malf - BAT BUS B reconfig
Pwr Distr SSR-2
ENTRY
cb SCS B/D ROLL, P&Y (MNB) - open (before CM/SM SEP) close (after RCS xfer to CM)
cb SCS CONTR AUTO (2) - open (after APEX cover jett)
cb MNB BAT C - close (275)
cb BAT B PWR ENTRY/PL - close at PYRO BAT chk

STDN NO GO

1

14

If still APEX cover jett
cb BAT B PWR ENTRY/PL - close
ELS AUTO - MAN
ELS LOGIC - OFF
SECS LOGIC (both) - OFF
cb SECS LOGIC (2) - open
cb SECS ARM (2) - open
cb PYRO A&B/SEQ A&B (2) - open (250)
DC IND sel - PYRO BAT A&B
DC VOLTS ind - 0 vdc
Remove both closeout panels beneath pnl 276 (tool E)
Cut and tape all wires to connector P545 (white tagged "Cut")
Replace closeout panels
cb PYRO A&B/SEQ A&B (2) - close

DC IND sel - PYRO BAT A&B
DC VOLTS ind - >35.0 vdc
DC IND sel - MNA
cb ELS/CM-SM SEP (2) - close
cb SECS LOGIC (2) - close
cb SECS ARM (2) - open (verify)
DO NOT ARM PYRO BUSSES

Continue normal entry except
Perform CM RCS Pressurization & CM/SM Separation, 14.1.4 & 14.2, together at which time arm pyros as follows:
SECS PYRO B ARM - SAFE (verify)
SECS PYRO A ARM - on (up)
To jett APEX cover at 24K'
SECS PYRO B ARM - on (up)

Continue normal entry

20.2.8 **EMERGENCY SAFE OF APEX COVER JETT**

STA/T	STEP	PROCEDURE	PANEL	REMARKS
		20.2.9 One Y Strut Will Not Fully Extend and Lock		The other Y strut should be extended and locked as the following operations are performed.
AC	1	Break lockwire on one Y strut adjustment jam nut of affected Y strut		
	2	Using tool F, unscrew jam nut		
	3	Disengage washer key so that strut bearing pad will turn		
	4	Screw strut bearing pad inboard until strut can be extended and locked		
	5	Replace washer key, & tighten jam nut		Lockwire and key are not required for water landing.
		20.2.10 SM RCS Jet Failed On		
	1	Change to other control mode		Either SC CONT (if in G&N or SCS) or THC (if in G&N) used to select other mode (CMC or SCS), not controlling jets.
	2	RHC PWR DIR (both) - MNA/MNB	1	
		RHC - null SC rates using dir RCS		
		AUTO RCS (16) - OFF	8	
		If condition persists		
		AUTO RCS (16) - MNA or MNB (as req)		
		MAN ATT (3) - ACCEL CMD	1	
		Null SC rates		
		cb SCS DIR ULL (2) - open	8	
		RHC PWR DIR (both) - OFF	1	

STA/T	STEP	PROCEDURE	PANEL	REMARKS
		If condition persists		
CP		SM RCS PRPLNT (affected quad) - CLOSE	2	CLOSE position is momentary.
	20.2.11	CM RCS Fails to Pressurize or Feed Propellant		
	1	Verify elect for pressurization		
		cb EPS BAT BUS (2) - close	229	
DP		cb PYRO A&B/SEQ A&B (2) - close	250	
AC		cb SECS ARM (2) - close	8	
		SECS PYRO ARM (2) - on (up)		Lever lock.
		SECS LOGIC (both) - on (up)		Lever lock.
CP	2	Cycle CM RCS PRESS - on (up)	2	Guarded.
	3	Verify elect to CM RCS prplnt vlvs		
DP		cb EPS GRP 1 & 3 (4) - close	229	
AC		cb RCS PRPLNT ISOL (2) - close	8	
CP	4	Cycle CM RCS PRPLNT (both) - on (up)	2	
	5	Open He and prplnt crossfeed		
		cb EPS GRP 5 (2) - close	229	
AC		cb RCS LOGIC (2) - close	8	
		CM RCS LOGIC - on (up)	1	
		CM PRPLNT DUMP - on (up) (momentarily) then OFF		Guarded. Once interconnected, systems cannot be isolated.

STA/T STEP	PROCEDURE	PANEL	REMARKS
	20.2.12 FC 1 (2,3) C&W Light On		Fuel cell 1 (2,3) light may be illuminated by the following, less time critical failures: FC SKIN TEMP ind - >475°F or <360°F FC COND EXH TEMP ind - >175°F or <150°F FC pH HI tb - bp FC RAD TEMP LO tb - bp (<-30°F) FC O2 (H2) FLOW - HI (O2 >1.276 #/hr, H2 >.161 #/hr) (SKIN TEMP, COND EXH TEMP, AND FLOW can be verified by meters on panel 3.)
DP	Check FC REACS tb (all)	3	
	If FC 1 (2,3) REACS tb - gray		
	Perform malfunction procedure Fuel cell symptom 1		Malfunction procedures are in the Flight Data File (FDF).
	If FC 1 (2,3) REACS tb - bp		If barber pole, rapid crew reaction is required to prevent fuel cell loss: <20 seconds after H2 valve closure <90 seconds after O2 valve closure.
	FC 1 (2,3) REACS - on (up)		On (up) position is momentary.
	If FC 1 (2,3) REACS tb still bp & flow ~0 CAUTION When open circuiting one of three fuel cells ensure remaining fuel cells configured with one on each main bus		
	FC 1 (2,3) MNA & MNB - OFF		Removes fuel cell from main buses.
	Perform malfunction procedure Fuel cell symptom 1h		Malfunction procedures are in the Flight Data File (FDF).

STA/T	STEP	PROCEDURE	PANEL	REMARKS
		20.3 POSTLANDING EMERGENCY PROCEDURES		
		20.3.1 Fire/Smoke in CM During Postlanding		
	a.	Stable I		
ALL		Don emer 02 mask (refer to Oper of Emer 02 Masks, 5.4.14)	2	
AC		DIRECT 02 vlv - close (CW) (verify)	7	
CP		cb BAT A,B,C PWR ENTRY/PL (3) - open	250	
		cb PYRO A/SEQ A - open		
		cb PYRO B/SEQ B - open		
		Fire extinguisher - use as appropriate		Water dispenser used on all open nonelectrical fires. Foam fire extinguisher used on fires behind panels, closed compartments, and electrical fires.
		&/or Egress CM (refer to Stable I Water Egress Procedure, 16.4.2)		
	b.	Stable II		
ALL		Don emer 02 mask (refer to Oper of Emer 02 Masks, 5.4.14)		
AC		DIRECT 02 vlv - close (CW) (verify)	7	
CP		Fire extinguisher - use as appropriate		Water dispenser used on all open nonelectrical fires. Foam fire extinguisher used on fires behind panels. closed compartments, and electrical fires.
		Upright CM to Stable I (refer to Postlanding Stabilization, Floating Inverted, 16.1) & proceed to step a		
		If CM fails to upright Perform Stable II Water Egress Procedure, 16.4.3		

STA/T	STEP	PROCEDURE	PANEL	REMARKS
		21.0 DOCKED EMERGENCY PROCEDURES		
		21.1 CSM/DM DOCKED EMERGENCY PROCEDURES		
		21.1.1 Forward Hatch Cannot Be Re-Installed		
CP ALL	1	Position hatch & depress tunl Don PGA, 5.4.6, thermal gloves, & check suit circuit, 5.4.5		
CP		Verify CAB PRESS ind - 4.7-5.3 psia Verify O2 FLOW ind - 0.4-0.6 lb/hr	2	
		Position fwd hatch against tunl hatch seal interface misaligning the hatch indicator arrows by 30° in either direction		
		While pushing hatch firmly against tunl hatch seal interface		
		TUNL VENT vlv - TUNL VENT	12	
		Wait one min, then place TUNL VENT vlv - DM/CM ΔP		
		Monitor DM/CM ΔP ind and verify ΔP ≈ 2.5 psid. If ΔP ≠2.5 psid, recycle DM TUNL VENT vlv until ΔP ind is ≈2.5 psid		When DM/CM ΔP indicator indicates ≈2.5 psid, hatch should be held immobile against seal by ΔP.
		Continue monitoring DM/CM ΔP ind for 1 min after reaching ≈2.5 psid & verify no detectable change in ΔP ind		This constitutes a hatch seal integrity check.
		xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx		
		DM/CM ΔP ind - press diff decr Monitor CAB PRESS ind & O2 FLOW ind	2	

STA/T	STEP	PROCEDURE	PANEL	REMARKS
CP		If CAB PRESS ind & 02 FLOW ind remain stable, DM hatch is probably not integral	2	
		If CAB PRESS ind decr & 02 FLOW ind incr, CM fwd hatch is probably not integral		
		Press tunl using PRESS EQUAL vlv	Fwd hatch	
		Remove fwd hatch, 5.7.1		
		Check for foreign object(s) jammed in tunl/hatch, seal interface, or hatch seal damage		
		Reposition fwd hatch against hatch seal interface		
		Reinitiate tunl depress & hatch seal integrity check		
		xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx		
	2	Perform DM Jettison & Separation, 4.4		
	3	Perform the following ≈1 hr prior to CM/SM separation to raise CM press to maximum design press of 8.6 psid		
AC		CAB PRESS RELF vlv (2) - CLOSE	325	
CP		REPRESS PKG vlv - OFF	326	
		EMER CAB PRESS sel - OFF	351	
		CAB REPRESS vlv - OPEN (CW)		
		REPRESS 02 VLV - CLOSE	601	

FORWARD HATCH CANNOT BE RE-INSTALLED

STA/T	STEP	PROCEDURE	PANEL	REMARKS
CP		When CAB PRESS ind - 8.6 psia	2	
		CAB REPRESS vlv - OFF (CCW)	351	
		REPRESS PKG vlv - FILL	326	
	4	Begin entry prep, 14.1		
60K'		REPRESS O2 VLV - OPEN	601	Guarded. Provides an additional 3 psia in ≈1-minute period.
AC	50K'	Report CM stable		
		xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx		
		CM unstable		
CP		RCS CMD - OFF	2	OFF position is momentary.
AC	40K'	APEX COVER JETT pb - push	1	Guarded.
		DROG DPLY pb - push		Guarded.
		(2 sec after apex cover jett)		
		xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx		
30K'		ELS LOGIC - on (up)		Guarded.
		ELS AUTO - AUTO		
24K'		SCS RCS disable (auto)		
		xxxxxxxxxxxxxxxxx		
CP		RCS CMD - OFF	2	OFF position is momentary.
		xxxxxxxxxxxxxxxxx		
		Apex cover jett (auto)		The apex cover will be jettisoned at 24K feet plus 0.4 second.
		xxxxxxxxxxxxxxxxxxxxxxxxxxxxxx		
AC		APEX COVER JETT pb - push	1	Guarded.
		xxxxxxxxxxxxxxxxxxxxxxxxxxxxxx		

21.1.1

FORWARD HATCH CANNOT BE RE-INSTALLED

EMERGENCY

STA/T	STEP	PROCEDURE	PANEL	REMARKS
		Drogue chutes deployed (auto)		Drogue parachutes deployed at 24K feet plus 2.0 seconds. The CM may be very unstable until the drogue chutes disreef in ≈11 seconds.
AC		DROG DPLY pb - push	1	Guarded.
		If no drogue deployment ELS AUTO - MAN Stabilize CM with direct RCS		
	5K'	MN DPLY pb - push ELS AUTO - AUTO		Guarded.
CP				
10K'		CAB PRESS ind - 10 psia	2	Indication of main chute deploy altitude.
		Main chutes & VHF recovery antenna deploy (auto)		Auto deployment occurs between 10,950 and 9,100 feet. Parachutes disreef in ≈15 seconds after pilot mortars fire.
		MN DPLY pb - push		Guarded.
		CAUTION Exercise care in handling fwd hatch as it will be at a high temperature.		

FORWARD HATCH CANNOT BE RE-INSTALLED

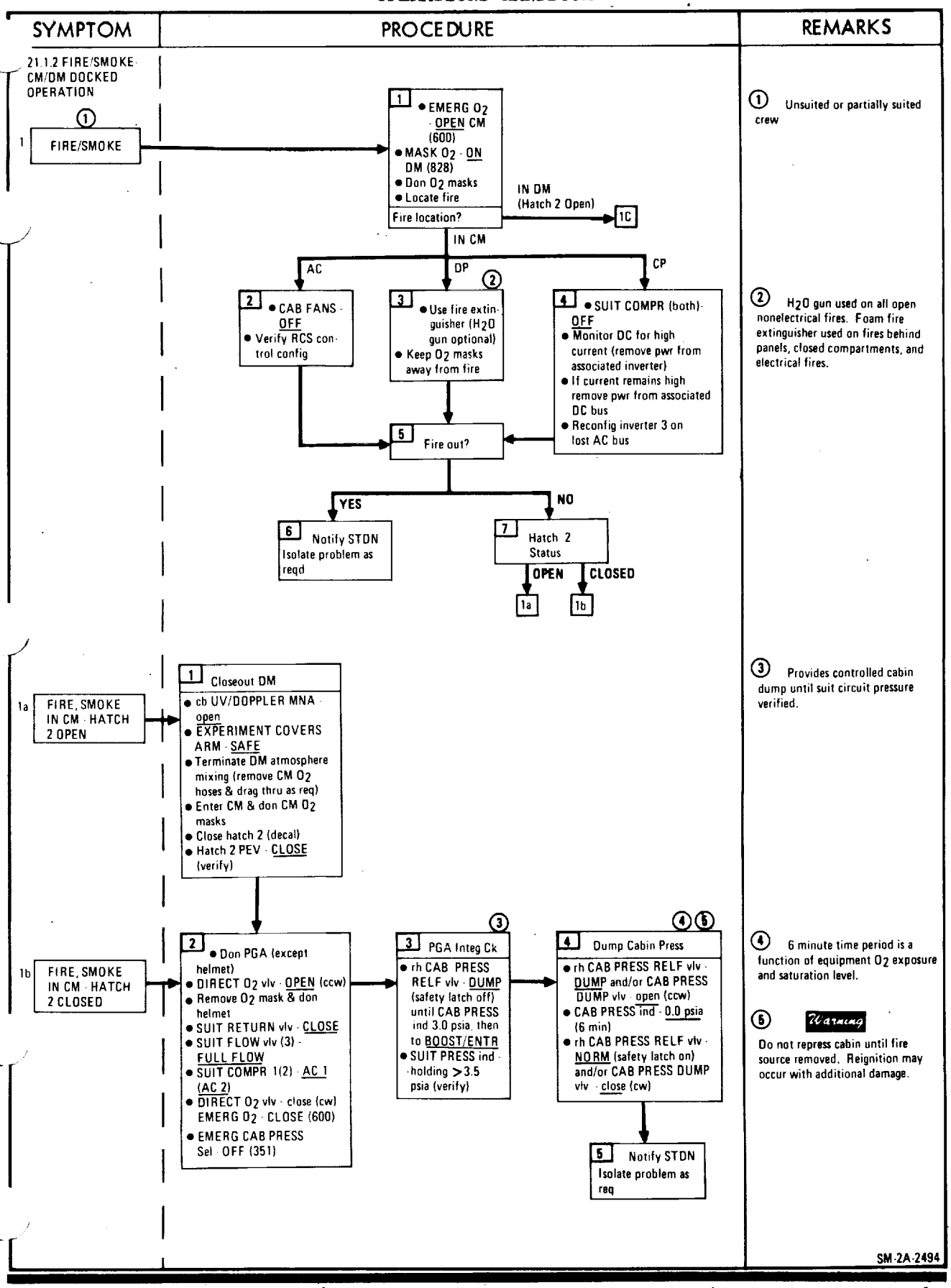
STA/T	STEP	PROCEDURE	PANEL	REMARKS
+20 sec		Immediately following main parachute disreefing, CP must egress from center couch and position himself in an optimum stance to support the fwd hatch (≈85 lbs)		
		When CP in position CAB PRESS DUMP vlv - open (CCW) (full open)	Side hatch	
		As press equalization allows fwd hatch to move, retrieve hatch & stow	Fwd hatch	
		CAB PRESS DUMP vlv - close (CW)	Side hatch	
DP		Set up entry comm VHF ANT - RECY VHF AM A - SIMPLEX VHF BCN - ON	3	If VHF AM B - SIMPLEX or VHF AM A - DUPLEX required, turn off beacon during period of transmission.
AC		Transmit voice (VHF AM) reporting Position Main chutes disreefed Splash error Crew status		Continue voice transmission until touchdown.
		Crew couch struts (4) - unlock		
DP		cb FLT/PL BAT BUS A, B, & BAT C (3) - close	275	
		cb FLT/PL MNA & B (2) - open		
CDR 3K'		cb SPS PITCH, YAW (4) - open	8	

21.1.1 FORWARD HATCH CANNOT BE RE-INSTALLED

EMERGENCY

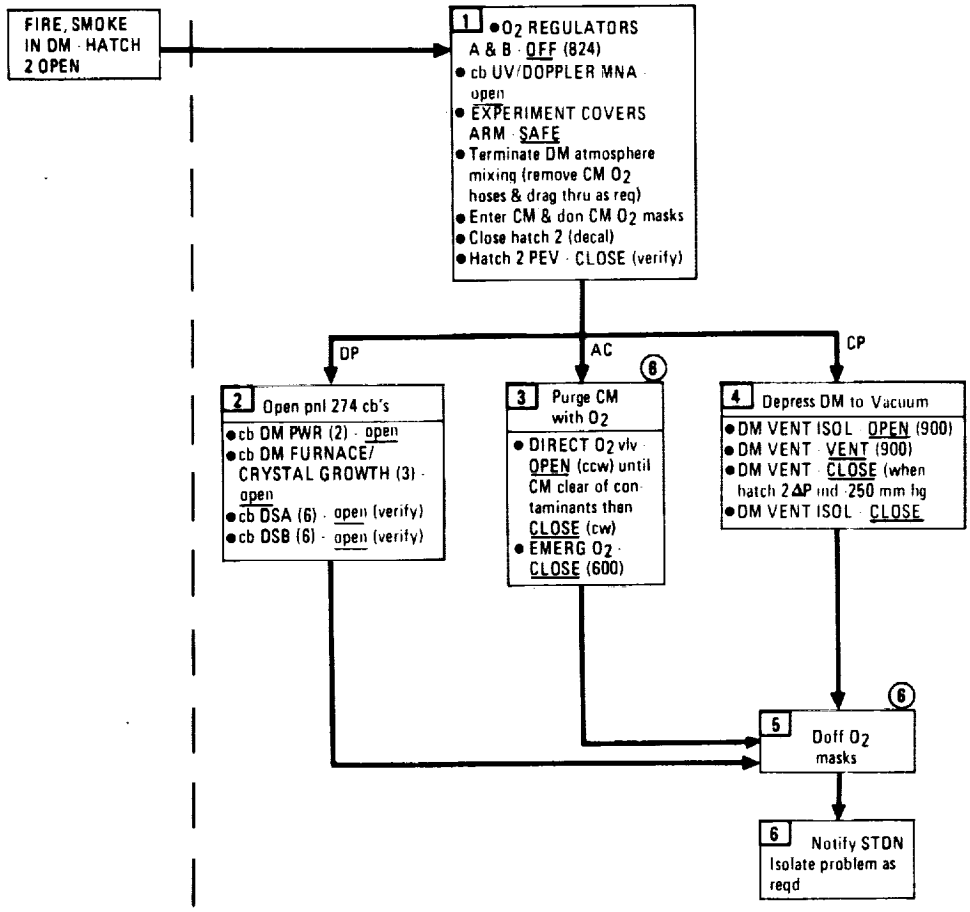
STA/T	STEP	PROCEDURE	PANEL	REMARKS
AC		FLOOD FIXED - POST LDG	8	Provides power from flight and postlanding bus to one floodlight in LH couch area and one floodlight in center couch area. Minimize floodlight use during postlanding. Maximum utilization should be 9.6 hours per 48-hour period.
		FLOOD DIM - 1 or 2		Position 1 provides power to two secondary floodlights and position 2 provides power to two primary floodlights when FLOOD FIXED switch in POST LDG position after dc main buses deactivated.
800'				
CP		CM RCS PRPLNT (both) - OFF	2	OFF position is momentary.
		CM RCS PRPLNT tb (both) - bp		Barber pole indicates at least one propellant isolation valve (fuel or oxidizer) closed in each particular system 1 or 2.
AC		DIRECT O2 vlv - OPEN (CCW)	7	
DP		MN BUS TIE (2) - OFF	5	Removes battery power from dc main buses A and B.
		CAUTION MN BUS TIE switches must be left in the OFF position to ensure bat A, B, & C are used to pwr postlanding bus only, & to prevent bat shorting caused by water entering the CM feed-thru connectors.		
		cb BAT RLY BUS (2) - open Postlanding Check, sec 16		

FORWARD HATCH CANNOT BE RE-INSTALLED


SYMPTOM
PROCEDURE
REMARKS
21.1.2 FIRE/SMOKE CM/DM DOCKED OPERATION
1 FIRE/SMOKE
1 • EMERG O2 · OPEN CM (600)
• MASK O2 · ON DM (828)
• Don O2 masks
• Locate fire
Fire location?
IN DM (Hatch 2 Open)
1C
IN CM
AC
DP
CP
2 • CAB FANS · OFF
• Verify RCS control config
3 • Use fire extinguisher (H2O gun optional)
• Keep O2 masks away from fire
4 • SUIT COMPR (both) · OFF
• Monitor DC for high current (remove pwr from associated inverter)
• If current remains high remove pwr from associated DC bus
• Reconfig inverter 3 on lost AC bus
5 Fire out?
YES
NO
6 Notify STDN
Isolate problem as reqd
7 Hatch 2 Status
OPEN
CLOSED
1a
1b
1a FIRE, SMOKE IN CM · HATCH 2 OPEN
1 Closeout DM
• cb UV/DOPPLER MNA · open
• EXPERIMENT COVERS ARM · SAFE
• Terminate DM atmosphere mixing (remove CM O2 hoses & drag thru as req)
• Enter CM & don CM O2 masks
• Close hatch 2 (decal)
• Hatch 2 PEV · CLOSE (verify)
1b FIRE, SMOKE IN CM · HATCH 2 CLOSED
2 • Don PGA (except helmet)
• DIRECT O2 vlv · OPEN (ccw)
• Remove O2 mask & don helmet
• SUIT RETURN vlv · CLOSE
• SUIT FLOW vlv (3) · FULL FLOW
• SUIT COMPR 1(2) · AC 1 (AC 2)
• DIRECT O2 vlv · close (cw) EMERG O2 · CLOSE (600)
• EMERG CAB PRESS Sel · OFF (351)
3 PGA Integ Ck
• rh CAB PRESS RELF vlv · DUMP (safety latch off) until CAB PRESS ind 3.0 psia, then to BOOST/ENTR
• SUIT PRESS ind · holding >3.5 psia (verify)
4 Dump Cabin Press
• rh CAB PRESS RELF vlv · DUMP and/or CAB PRESS DUMP vlv · open (ccw)
• CAB PRESS ind · 0.0 psia (6 min)
• rh CAB PRESS RELF vlv · NORM (safety latch on) and/or CAB PRESS DUMP vlv · close (cw)
5 Notify STDN
Isolate problem as req
① Unsuited or partially suited crew
② H2O gun used on all open nonelectrical fires. Foam fire extinguisher used on fires behind panels, closed compartments, and electrical fires.
③ Provides controlled cabin dump until suit circuit pressure verified.
④ 6 minute time period is a function of equipment O2 exposure and saturation level.
⑤ Warning
Do not repress cabin until fire source removed. Reignition may occur with additional damage.
SM-2A-2494

SYMPTOM	PROCEDURE	REMARKS

21.1.2 FIRE/SMOKE CM/DM DOCKED OPERATION (CONT)



(6) *Warning*
Combustion products may be toxic. Smoke should be removed from cabin before removing O_2 masks.

SM-2A-2495

STA/T STEP	PROCEDURE	PANEL	REMARKS
	21.1.3 Time Critical Undocking & Separation		
	Go to DM Jettison & Separation, 4.4		
	21.1.4 Abnormal Vehicle Dynamics		
	Go to SM RCS Jet Failed On, 20.2.10		
	or For abnormal vehicle dynamics during SPS burn		
	If contingency not corrected by normal/backup procedures, discontinue burn.		
	Complete burn using RCS if practical		
	Go to G&C Malf 1		Malfunction procedures are located in flight data file.
	21.2 DM/SOYUZ DOCKED EMERGENCY PROCEDURES		
	21.2.1 Time Critical Undocking & Separation		
1	If hatch 3 closed, go to 3		Mixed crew returns permissible for time critical situations when crews are isolated in DM with hatch 3 closed.
	or Transfer to DM from SOYUZ		
	S J-BOX		
	AUDIO POWER - OFF	S J-BOX	
	Disconnect CCU		
	Enter DM		
	AUDIO 2 POWER - ON (verify)	818	
	Remove DM/SOYUZ Ventilation Duct		
	Deactivate DM/SOYUZ Umbilicals		Except for drag through, DM/Soyuz umbilical
	cb SOYUZ POWER DMB - open	815	disconnect not required.
	Verify SOYUZ/DM CABLE PWR off	Soyuz	Verify with Soyuz that TV and Comm Cable power from Soyuz has been turned off.

STA/T STEP	PROCEDURE	PANEL	REMARKS
	Remove Umbilicals (3) (if time permits)		
2	Close Hatch 3, 18.6.1 (step 3)		
3	Vent Tunl 2 & Check Hatch 3 Integrity, 18.3.6, (if time permits)		Tunnel 2 venting not required.
4	Undocking with Soyuz, CM Active, 18.1.2 Separate to safe distance		Undocking with crew in DM permitted.
5	Purge/Vent DM to 290 mm Hg		
	02 PURGE PRESS RELF vlv - AUTO	828	
	PRESS RELF VLV REF - VACUUM	824	
	02 PURGE vlv - OPEN (ccw)		
	02 PART PRESS ind (2) - 300 mm Hg	815	
	02 PURGE vlv - close (cw)	824	
	PRESS RELF VLV REF - DM		
	02 PURGE PRESS RELF - CLOSE	828	
	LOW PRESS RELF vlv - AUTO		
	PRESS RELF VLV REF - VACUUM	824	
	CAB PRESS ind - 290 mm Hg	815	
	PRESS RELF VLV REF - DM	824	
	LOW PRESS RELF vlv - CLOSE	828	
6	Open Hatch 2, 18.6.1 Transfer to CM.		
21.2.2	Fire, Smoke, Contaminants/DM at Soyuz Pressure		
	Refer to FDF, Joint Operations Checklist.		
21.2.3	Fire, Smoke Contaminants/DM at CM Pressure		
	Refer to FDF, Joint Operations Checklist.		
21.2.4	Rapid Loss of DM Pressure		
	Refer to FDF, Joint Operations Checklist.		

RAPID LOSS OF DM PRESSURE

APPENDIX A

CM PANEL ILLUSTRATIONS AND CONTROL/INDICATOR CONFIGURATION LIST FOR CSM 111

This section contains CM panel illustrations and a control/indicator configuration list for CSM 111. Panel illustrations present the location of the displays and controls as they appear on the panels in the CM. The control/indicator configuration list provides the configuration of the CM displays and controls prior to backup crew cabin ingress, at lift-off, docked to Soyuz, and entry preparation. Entry preparation is defined as those functions that are required to be performed to place the vehicle in a posture to perform a deorbit burn. Those talkbacks (tb) are included which reflect the last position selected of spring-loaded switches. (Talkback indicators that are operated by sensors will not be listed.) The CSM control/indicator configuration list presents the panels in numerical sequence. The switches are not to be sequentially positioned as listed.

NOMENCLATURE	CSM CONTROL/INDICATOR CONFIGURATION				
	PRIOR TO BACKUP CREW CABIN INGRESS	AT LIFTOFF	DOCKED TO SOYZU	ENTRY PREPARATION	
	PANEL 1				
EMS FUNC	OFF	ΔV	OFF	ΔV	
EMS MODE	STBY	STBY	STBY	STBY	
GTA sw	off (down)	off (down)	off (down)	N/A	
EMS GTA COVER	Secure	Secure	N/A	N/A	
CMC ATT	IMU	IMU	IMU	IMU	
FDAI SCALE	5/1	5/5	5/1	5/1	
FDAI SEL	1/2	1/2	1/2	1/2	
FDAI SOURCE	CMC	CMC	CMC	CMC	
ATT SET	GDC	GDC	GDC	GDC	
MAN ATT ROLL	RATE CMD	RATE CMD	RATE CMD	RATE CMD	
MAN ATT PITCH	ACCEL CMD	ACCEL CMD	RATE CMD	RATE CMD	
MAN ATT YAW	RATE CMD	RATE CMD	RATE CMD	RATE CMD	
LIM CYCLE	OFF	OFF	OFF	OFF	
ATT DBD	MIN	MIN	MAX	MIN	
RATE	HI	HI	HI	LO	
THC PWR	OFF	on (up)	OFF	on (up)	
RHC PWR NORM 1	OFF	AC/DC	OFF	AC/DC	
RHC PWR NORM 2	OFF	AC/DC	OFF	AC/DC	
RHC PWR DIR 1	OFF	MNA/MNB	OFF	MNA/MNB	
RHC PWR DIR 2	OFF	MNA/MNB	OFF	MNA/MNB	
SC CONT	SCS	SCS	SCS	CMC	
CMC MODE	FREE	FREE	FREE	FREE	
BMAG MODE ROLL	RATE 2	RATE 1	RATE 1	RATE 2	
BMAG MODE PITCH	RATE 2	RATE 1	RATE 1	RATE 2	
BMAG MODE YAW	RATE 2	RATE 1	RATE 1	RATE 2	
SPS THRUST	NORM (locked)	NORM (locked)	NORM (locked)	NORM (locked)	
ΔV THRUST A	OFF (guarded)	OFF (guarded)	OFF (guarded)	NORM	
ΔV THRUST B	OFF (guarded)	OFF (guarded)	OFF (guarded)	NORM	
SCS TVC PITCH	RATE CMD	AUTO	RATE CMD	RATE CMD	
SCS TVC YAW	RATE CMD	AUTO	RATE CMD	RATE CMD	

GMBL MOT P1	OFF	OFF	OFF	OFF	
GMBL MOT P2	OFF	OFF	OFF	OFF	
GMBL MOT Y1	OFF	OFF	OFF	OFF	
GMBL MOT Y2	OFF	OFF	OFF	OFF	
ATVC GAIN	LO	LO	HI	HI	
ELS LOGIC	OFF (guarded)	OFF (guarded)	OFF (guarded)	OFF (guarded)	
ELS AUTO	MAN	MAN	MAN	MAN	
CM RCS LOGIC	OFF	on (up)	OFF	on (up)	
CM PRPLNT DUMP	OFF (guarded)	OFF (guarded)	OFF (guarded)	OFF (guarded)	
CM PRPLNT PURG	off (guarded)	off (guarded)	off (guarded)	off (guarded)	
IMU CAGE	off (down) (guarded)	off (down) (guarded)	off (down) (guarded)	off (down) (guarded)	
EMS ROLL	OFF	OFF	OFF	OFF	
.05 G sw	OFF	OFF	OFF	OFF	
Pc IND sw	Pc	Pc	Pc	Pc	
LV IND/GPI sw	SIVB	SIVB	GPI	GPI	
TVC GMBL DR PITCH	AUTO	AUTO	AUTO	AUTO	
TVC GMBL DR YAW	AUTO	AUTO	AUTO	AUTO	
EVNT TMR RSET	up (ctr)	up (ctr)	up (ctr)	up (ctr)	
EVNT TMR START	ctr	ctr	ctr	ctr	
EVNT TMR MIN	ctr	ctr	ctr	ctr	
EVNT TMR SEC	ctr	ctr	ctr	ctr	
PANEL 2					
PL VENT VLV	push (lock)	push (lock)	push (lock)	push (lock)	
PROBE EXTD/REL	OFF (guarded)	OFF (guarded)	OFF (guarded)	off (guarded)	
PROBE EXTD/REL A tb	gray	gray	gray	gray	
PROBE EXTD/REL B tb	gray	gray	gray	gray	
PROBE RETR PRIM	OFF	OFF	OFF	OFF	
PROBE RETR SEC	OFF	OFF	OFF	OFF	
GUIDE RING A	off (ctr) (RETR*)	off (ctr) (RETR*)	off (ctr) (RETR*)	off (ctr) (RETR*)	
GUIDE RING B	off (ctr) (RETR*)	off (ctr) (RETR*)	off (ctr) (RETR*)	off (ctr) (RETR*)	
STRUCT LATCH A	off (ctr) (OPEN*) (guarded)	off (ctr) (OPEN*) (guarded)	off (ctr) (CLOSE*)** (guarded)	off (ctr) (OPEN*) (guarded)	

*Identifies last momentary position switched to.
**(OPEN*) When docking performed with CSM passive

PANELS 1 AND 2

NOMENCLATURE	CSM CONTROL/INDICATOR CONFIGURATION			
	PRIOR TO BACKUP CREW CABIN INGRESS	AT LIFTOFF	DOCKED TO SOYUZ	ENTRY PREPARATION
PANEL 2 (CONT)				
STRUCT LATCH B	off (ctr) (OPEN*) (guarded)	off (ctr) (OPEN*) (guarded)	off (ctr) (OPEN*) (guarded)	off (ctr) (OPEN*) (guarded)
CAPTURE LATCH A	off (down)	off (down)	off (down)	off (down)
CAPTURE LATCH B	off (down)	off (down)	off (down)	off (down)
BACKUP PASSIVE A	off (ctr) (RESET*) (guarded)	off (ctr) (RESET*) (guarded)	off (ctr) (RESET*) (guarded)	off (ctr) (RESET*) (guarded)
BACKUP PASSIVE B	off (ctr) (RESET*) (guarded)	off (ctr) (RESET*) (guarded)	off (ctr) (RESET*) (guarded)	off (ctr) (RESET*) (guarded)
MSN TMR	STOP	START	START	START
SM RCS PSM He	ctr (CLOSE*)	ctr (CLOSE*)	ctr (OPEN*)	ctr (CLOSE*)
RCS IND sel	PSM	SMD	PSM	SMD
SM RCS PSM He tb	bp	bp	gray	bp
SM RCS PSM MANF ISOL	ctr (CLOSE*)	ctr (OPEN*)	ctr (OPEN*)	ctr (OPEN*)
SM RCS PSM MANF ISOL tb	bp	gray	gray	gray
UP TLM CM	BLOCK	BLOCK	BLOCK	BLOCK
CM RCS PRESS	off (down) (guarded)	off (down) (guarded)	off (down) (guarded)	off (down) (guarded)
SM RCS IND sw	He TK TEMP	He TK TEMP	He TK TEMP	He TK TEMP
SM RCS QUAD A He	ctr (CLOSE*)	ctr (OPEN*)	ctr (CLOSE*)	ctr (OPEN*)
SM RCS QUAD A He tb	bp	gray	bp	gray
SM RCS QUAD B He	ctr (CLOSE*)	ctr (OPEN*)	ctr (CLOSE*)	ctr (OPEN*)
SM RCS QUAD B He tb	bp	gray	bp	gray
SM RCS QUAD C He	ctr (CLOSE*)	ctr (OPEN*)	ctr (CLOSE*)	ctr (OPEN*)
SM RCS QUAD C He tb	bp	gray	bp	gray
SM RCS QUAD D He	ctr (CLOSE*)	ctr (OPEN*)	ctr (CLOSE*)	ctr (OPEN*)
SM RCS QUAD D He tb	bp	gray	bp	gray
SM RCS A PSM PRPLNT	ctr (CLOSE*)	ctr (CLOSE*)	ctr (OPEN*)	ctr (CLOSE*)

GMBL MOT P1	OFF	OFF	OFF	OFF	
GMBL MOT P2	OFF	OFF	OFF	OFF	
GMBL MOT Y1	OFF	OFF	OFF	OFF	
GMBL MOT Y2	OFF	OFF	OFF	OFF	
ATVC GAIN	LO	LO	HI	HI	
ELS LOGIC	OFF (guarded)	OFF (guarded)	OFF (guarded)	OFF (guarded)	
ELS AUTO	MAN	MAN	MAN	MAN	
CM RCS LOGIC	OFF	on (up)	OFF	on (up)	
CM PRPLNT DUMP	OFF (guarded)	OFF (guarded)	OFF (guarded)	OFF (guarded)	
CM PRPLNT PURG	off (guarded)	off (guarded)	off (guarded)	off (guarded)	
IMU CAGE	off (down) (guarded)	off (down) (guarded)	off (down) (guarded)	off (down) (guarded)	
EMS ROLL	OFF	OFF	OFF	OFF	
.05 G sw	OFF	OFF	OFF	OFF	
Pc IND sw	Pc	Pc	Pc	Pc	
LV IND/GPI sw	SIVB	SIVB	GPI	GPI	
TVC GMBL DR PITCH	AUTO	AUTO	AUTO	AUTO	
TVC GMBL DR YAW	AUTO	AUTO	AUTO	AUTO	
EVNT TMR RSET	up (ctr)	up (ctr)	up (ctr)	up (ctr)	
EVNT TMR START	ctr	ctr	ctr	ctr	
EVNT TMR MIN	ctr	ctr	ctr	ctr	
EVNT TMR SEC	ctr	ctr	ctr	ctr	
PANEL 2					
PL VENT VLV	push (lock)	push (lock)	push (lock)	push (lock)	
PROBE EXTD/REL	OFF (guarded)	OFF (guarded)	OFF (guarded)	off (guarded)	
PROBE EXTD/REL A tb	gray	gray	gray	gray	
PROBE EXTD/REL B tb	gray	gray	gray	gray	
PROBE RETR PRIM	OFF	OFF	OFF	OFF	
PROBE RETR SEC	OFF	OFF	OFF	OFF	
GUIDE RING A	off (ctr) (RETR*)	off (ctr) (RETR*)	off (ctr) (RETR*)	off (ctr) (RETR*)	
GUIDE RING B	off (ctr) (RETR*)	off (ctr) (RETR*)	off (ctr) (RETR*)	off (ctr) (RETR*)	
STRUCT LATCH A	off (ctr) (OPEN*) (guarded)	off (ctr) (OPEN*) (guarded)	off (ctr) (CLOSE*)** (guarded)	off (ctr) (OPEN*) (guarded)	

*Identifies last momentary position switched to.
**(OPEN*) When docking performed with CSM passive

PANELS 1 AND 2

NOMENCLATURE	CSM CONTROL/INDICATOR CONFIGURATION			
	PRIOR TO BACKUP CREW CABIN INGRESS	AT LIFTOFF	DOCKED TO SOYUZ	ENTRY PREPARATION
PANEL 2 (CONT)				
STRUCT LATCH B	off (ctr) (OPEN*) (guarded)	off (ctr) (OPEN*) (guarded)	off (ctr) (OPEN*) (guarded)	off (ctr) (OPEN*) (guarded)
CAPTURE LATCH A	off (down)	off (down)	off (down)	off (down)
CAPTURE LATCH B	off (down)	off (down)	off (down)	off (down)
BACKUP PASSIVE A	off (ctr) (RESET*) (guarded)	off (ctr) (RESET*) (guarded)	off (ctr) (RESET*) (guarded)	off (ctr) (RESET*) (guarded)
BACKUP PASSIVE B	off (ctr) (RESET*) (guarded)	off (ctr) (RESET*) (guarded)	off (ctr) (RESET*) (guarded)	off (ctr) (RESET*) (guarded)
MSN TMR	STOP	START	START	START
SM RCS PSM He	ctr (CLOSE*)	ctr (CLOSE*)	ctr (OPEN*)	ctr (CLOSE*)
RCS IND sel	PSM	SMD	PSM	SMD
SM RCS PSM He tb	bp	bp	gray	bp
SM RCS PSM MANF ISOL	ctr (CLOSE*)	ctr (OPEN*)	ctr (OPEN*)	ctr (OPEN*)
SM RCS PSM MANF ISOL tb	bp	gray	gray	gray
UP TLM CM	BLOCK	BLOCK	BLOCK	BLOCK
CM RCS PRESS	off (down) (guarded)	off (down) (guarded)	off (down) (guarded)	off (down) (guarded)
SM RCS IND sw	He TK TEMP	He TK TEMP	He TK TEMP	He TK TEMP
SM RCS QUAD A He	ctr (CLOSE*)	ctr (OPEN*)	ctr (CLOSE*)	ctr (OPEN*)
SM RCS QUAD A He tb	bp	gray	bp	gray
SM RCS QUAD B He	ctr (CLOSE*)	ctr (OPEN*)	ctr (CLOSE*)	ctr (OPEN*)
SM RCS QUAD B He tb	bp	gray	bp	gray
SM RCS QUAD C He	ctr (CLOSE*)	ctr (OPEN*)	ctr (CLOSE*)	ctr (OPEN*)
SM RCS QUAD C He tb	bp	gray	bp	gray
SM RCS QUAD D He	ctr (CLOSE*)	ctr (OPEN*)	ctr (CLOSE*)	ctr (OPEN*)
SM RCS QUAD D He tb	bp	gray	bp	gray
SM RCS A PSM PRPLNT	ctr (CLOSE*)	ctr (CLOSE*)	ctr (OPEN*)	ctr (CLOSE*)

SM RCS A PSM PRPLNT tb	bp	bp	gray	bp
SM RCS B PSM PRPLNT	ctr (CLOSE*)	ctr (CLOSE*)	ctr (OPEN*)	ctr(CLOSE*)
SM RCS B PSM PRPLNT tb	bp	bp	gray	bp
SM RCS C PSM PRPLNT	ctr (CLOSE*)	ctr (CLOSE*)	ctr (OPEN*)	ctr (CLOSE*)
SM RCS C PSM PRPLNT tb	bp	bp	gray	bp
SM RCS D PSM PRPLNT	ctr (CLOSE*)	ctr (CLOSE*)	ctr (OPEN*)	ctr (CLOSE*)
SM RCS D PSM PRPLNT tb	bp	bp	gray	bp
SM RCS A PRPLNT	ctr (CLOSE*)	ctr (OPEN*)	ctr (CLOSE*)	ctr (OPEN*)
SM RCS A PRIM PRPLNT tb	bp	gray	bp	gray
SM RCS SEC PRPLNT tb	bp	gray	bp	gray
SM RCS B PRPLNT	ctr (CLOSE*)	ctr (OPEN*)	ctr (CLOSE*)	ctr (OPEN*)
SM RCS B PRIM PRPLNT tb	bp	gray	bp	gray
SM RCS B SEC PRPLNT tb	bp	gray	bp	gray
SM RCS C PRPLNT	ctr (CLOSE*)	ctr (OPEN*)	ctr (CLOSE*)	ctr (OPEN*)
SM RCS C PRIM PRPLNT tb	bp	gray	bp	gray
SM RCS C SEC PRPLNT tb	bp	gray	bp	gray
SM RCS D PRPLNT	ctr (CLOSE*)	ctr (OPEN*)	ctr (CLOSE*)	ctr (OPEN*)
SM RCS D PRIM PRPLNT tb	bp	gray	bp	gray
SM RCS D SEC PRPLNT tb	bp	gray	bp	gray
SM RCS A ENG PKG HTRS	OFF	OFF	1	1
SM RCS B ENG PKG HTRS	OFF	OFF	1	1
SM RCS C ENG PKG HTRS	OFF	OFF	1	1
SM RCS D ENG PKG HTRS	OFF	OFF	1	1
RCS CMD	ctr (OFF*)	ctr (OFF*)	ctr (OFF*)	ctr (OFF*)
RCS TRNFR	ctr (SM*)	ctr (SM*)	ctr (SM*)	ctr (SM*)
CM RCS 1 PRPLNT	ctr (OFF*)	ctr (on, up*)	ctr (on, up*)	ctr (on, up*)
CM RCS 1 PRPLNT tb	bp	gray	gray	gray
CM RCS 2 PRPLNT	ctr (OFF*)	ctr (on, up*)	ctr (on, up*)	ctr (on, up*)
CM RCS 2 PRPLNT tb	bp	gray	gray	gray
RCS A SEC FUEL PRESS	ctr (OPEN*)	ctr (CLOSE*)	as req	as req
RCS B SEC FUEL PRESS	ctr (OPEN*)	ctr (CLOSE*)	as req	as req
RCS C SEC FUEL PRESS	ctr (OPEN*)	ctr (CLOSE*)	as req	as req
RCS D SEC FUEL PRESS	ctr (OPEN*)	ctr (CLOSE*)	as req	as req
EDS AUTO	OFF	on (up)	OFF	OFF

*Identifies last momentary position switched to.
**(OPEN*) When docking performed with CSM passive

PANEL 2

NOMENCLATURE	CSM CONTROL/INDICATOR CONFIGURATION				
	PRIOR TO BACKUP CREW CABIN INGRESS	AT LIFTOFF	DOCKED TO SOYUZ	ENTRY PREPARATION	
	PANEL 2 (CONT)				
CSM/DM FNL SEP 1	off (down) (guarded)	off (down) (guarded)	off (down) (guarded)	off (down) (guarded)	
CSM/DM FNL SEP 2	off (down) (guarded)	off (down) (guarded)	off (down) (guarded)	off (down) (guarded)	
SIVB/DM SEP	off (down) (guarded)	off (down) (guarded)	off (down) (guarded)	off (down) (guarded)	
CM/SM SEP 1	off (down) (guarded)	off (down) (guarded)	off (down) (guarded)	off (down) (guarded)	
CM/SM SEP 2	off (down) (guarded)	off (down) (guarded)	off (down) (guarded)	off (down) (guarded)	
PRPLNT DUMP	AUTO	AUTO	RCS CMD	RCS CMD	
2 ENG OUT sw	AUTO	AUTO	OFF	OFF	
LV RATES sw	AUTO	AUTO	OFF	OFF	
TWR JETT 1	AUTO (guarded)	AUTO (guarded)	OFF (ctr) (guarded)	OFF (ctr) (guarded)	
TWR JETT 2	AUTO (guarded)	AUTO (guarded)	OFF (ctr) (guarded)	OFF (ctr) (guarded)	
LV GUID sw	IU	IU	IU	IU	
MAIN REL	off (down) (guarded)	off (down) (guarded)	off (down) (guarded)	off (down) (guarded)	
MSN TMR HRS	ctr	ctr	ctr	ctr	
MSN TMR MIN	ctr	ctr	ctr	ctr	
MSN TMR SEC	ctr	ctr	ctr	ctr	
C/W NORM	NORM	BOOST	ACK	NORM	
C/W CSM	CSM	CSM	CSM	CSM	
C/W PWR	1	1	1	1	
C/W LAMP TEST	ctr	ctr	ctr	ctr	
CAB FANS	OFF	OFF	OFF	OFF	

H2 HTRS 1	AUTO	AUTO	AUTO	off (ctr)	
H2 HTRS 2	AUTO	AUTO	AUTO	off (ctr)	
CRYO PRESS IND sw	1	SRG	SRG	SRG	
O2 HTRS 1	AUTO	AUTO	AUTO	off (ctr)	
O2 HTRS 2	AUTO	AUTO	AUTO	off (ctr)	
H2 FANS 1	OFF	OFF	OFF	OFF	
H2 FANS 2	OFF	OFF	OFF	OFF	
ECS IND sel	PRIM	PRIM	PRIM	PRIM	
RAD FLOW CONT AUTO	AUTO	AUTO	AUTO	AUTO	
ECS RAD tb	gray	gray	gray	gray	
RAD FLOW CONT PWR	off (ctr)	off (ctr)	PWR	PWR	
RAD MAN SEL	RAD 1	RAD 1	RAD 1	RAD 1	
RAD PRIM HTR	off (ctr)	off (ctr)	off (ctr)	off (ctr)	
RAD SEC HTR	OFF	OFF	OFF	OFF	
POT H2O HTR	OFF	OFF	ON	OFF	
SUIT H2O ACCUM AUTO	ctr	1	1	1	
SUIT H2O ACCUM ON	ctr	ctr	ctr	ctr	
S57	off (ctr)	off (ctr)	off (ctr)	off (ctr)	
SEC COOL EVAP	off (ctr)	off (ctr) (RSET*)	off (ctr) (RSET*)	off (ctr) (EVAP*)	
SEC COOL PUMP	AC2	AC2	off (ctr)	off (ctr)	
H2O QTY IND sw	POT	POT	WASTE	WASTE	
GLY EVAP IN TEMP	MAN	MAN	AUTO	AUTO	
GLY EVAP STM AUTO	MAN	MAN	AUTO	AUTO	
GLY EVAP STM INCR	ctr	ctr (vlv partially open)	ctr	ctr	
GLY EVAP H2O FLOW	off (ctr)	off (ctr)	AUTO	AUTO	
CAB TEMP	MAN	MAN	MAN	MAN	
CAB TEMP tw	N/A	N/A	N/A	N/A	
PANEL 3					
VHF ANT	SM LEFT	SM LEFT	as req	SM LEFT	
SPS INJ VLV A1 ind	CLOSE	CLOSE	CLOSE	CLOSE	
SPS INJ VLV A2 ind	CLOSE	CLOSE	CLOSE	CLOSE	
SPS INJ VLV B3 ind	CLOSE	CLOSE	CLOSE	CLOSE	

*Identifies last momentary position switched to.

PANEL 2

NOMENCLATURE	CSM CONTROL/INDICATOR CONFIGURATION				
	PRIOR TO BACKUP CREW CABIN INGRESS	AT LIFTOFF	DOCKED TO SOYUZ	ENTRY PREPARATION	
	PANEL 3				
SPS INJ VLV B4 ind	CLOSE	CLOSE	CLOSE	CLOSE	
FC 1 RAD	off (ctr) (NORM*)	off (ctr) (NORM*)	off (ctr) (NORM*)	off (ctr) (NORM*)	
FC 1 RAD tb	gray	gray	gray	gray	
FC 2 RAD	off (ctr) (NORM*)	off (ctr) (NORM*)	off (ctr) (NORM*)	off (ctr) (NORM*)	
FC 2 RAD tb	gray	gray	gray	gray	
FC 3 RAD	off (ctr) (NORM*)	off (ctr) (NORM*)	off (ctr) (NORM*)	off (ctr) (NORM*)	
FC 3 RAD tb	gray	gray	gray	gray	
FC 1 HTRS	on (up)	on (up)	on (up)	OFF	
FC 2 HTRS	on (up)	on (up)	on (up)	OFF	
FC 3 HTRS	on (up)	on (up)	on (up)	OFF	
FC IND sel	1	1	1	1	
SPS QTY TEST	ctr	ctr	ctr	ctr	
OXID FLOW VLV INCR	NORM	NORM	NORM	NORM	
OXID FLOW VLV PRIM	PRIM	PRIM	PRIM	PRIM	
PUG MODE	NORM	NORM	NORM	NORM	
FC 1 PURG	OFF	OFF	OFF	OFF	
FC 2 PURG	OFF	OFF	OFF	OFF	
FC 3 PURG	OFF	OFF	OFF	OFF	
FC 1 MNA	OFF	ctr (on,up*)	ctr (on, up*)	ctr (on, up*)	
FC 1 MNA tb	bp	gray	gray	gray	
FC 2 MNA	ctr (on, up*)	ctr (on, up*)	ctr (on, up*)	ctr (on, up)	
FC 2 MNA tb	gray	gray	gray	gray	
FC 3 MNA	OFF	OFF	OFF	OFF	
FC 3 MNA tb	bp	bp	bp	bp	
MNA RSET	ctr (RSET*)	ctr (RSET*)	ctr (RSET*)	ctr (RSET*)	
SPS He VLV 1	AUTO	AUTO	AUTO	AUTO	
SPS He VLV 1 tb	bp	bp	bp	bp	

SPS He VLV 2	AUTO	AUTO	AUTO	AUTO
SPS He VLV 2 tb	bp	bp	bp	bp
SPS LINE HTRS	OFF	OFF	ON	OFF
SPS PRESS IND sw	He	He	as desired	as desired
FC 1 REACS	ctr (on, up*)	ctr (on, up*)	ctr (on, up*)	ctr on, up*)
FC 1 REACS tb	gray	gray	gray	gray
FC 2 REACS	ctr (on, up*)	ctr (on, up*)	ctr (on, up*)	ctr (on, up*)
FC 2 REACS tb	gray	gray	gray	gray
FC 3 REACS	ctr (on, up*)	ctr (on, up*)	ctr (on, up*)	ctr (on, up*)
FC 3 REACS tb	gray	gray	gray	gray
FC 1 MNB	OFF	OFF	OFF	OFF
FC 1 MNB tb	bp	bp	bp	bp
FC 2 MNB	OFF	OFF	OFF	OFF
FC 2 MNB tb	bp	bp	bp	bp
FC 3 MNB	OFF	ctr (onk up*)	ctr (on, up*)	ctr (on, up*)
FC 3 MNB tb	bp	gray	gray	gray
MNB RSET	ctr (RSET*)	ctr (RSET*)	ctr (RSET*)	ctr (RSET*)
DC IND sel	MNA	MNA	MNA	MNA
BAT CHG	OFF	OFF	OFF	OFF
S BD XPNDR	OFF	PRIM	PRIM	PRIM
S BD PWR AMPL PRIM	PRIM	PRIM	PRIM	PRIM
S BD PWR AMPL HI	off (ctr)	HI	LO	HI
PWR AMPL tb	bp	gray	bp	gray
S BD MODE VOICE	VOICE	VOICE	VOICE	VOICE
S BD MODE PCM	PCM	PCM	PCM	PCM
S BD MODE RNG	RNG	RNG	RNG	RNG
S BD AUX TAPE	ctr	ctr	ctr	ctr
S BD AUX TV	ctr	ctr	ctr	ctr
UP TLM DATA	DATA	DATA	DATA	DATA
UP TLM CMD	OFF	NORM	NORM	NORM
S BD ANT OMNI A	C	C	A	C
S BD ANT	B	B	A/C	A/C

*Identifies last momentary position switched to.

PANEL 3

NOMENCLATURE	CSM CONTROL/INDICATOR CONFIGURATION				
	PRIOR TO BACKUP CREW CABIN INGRESS	AT LIFTOFF	DOCKED TO SOYUZ	ENTRY PREPARATION	
PANEL 3 (CONT)					
VHF AM SQLCH A tw	noise +1	noise +1	noise +1	noise +1	
VHF AM A	off (ctr)	off (ctr)	off (ctr)	SIMPLEX	
VHF AM B	off (ctr)	DUPLEX	off (ctr)	off (ctr)	
VHF AM RCV	off (ctr)	off (ctr)	off (ctr)	off (ctr)	
VHF BCN	OFF	OFF	OFF	OFF	
VHF RNG	OFF	OFF	OFF	OFF	
S BD SQLCH	ENBL	ENBL	ENBL	ENBL	
FC REAC VLVS	NORM	LATCH	NORM	NORM	
H2 PURG LINE HTR	OFF	OFF	OFF	OFF	
VHF AM SQLCH B tw	noise +1	noise +1	noise +1	noise +1	
TAPE RCDR PCM	PCM/ANLG	PCM/ANLG	PCM/ANLG	PCM/ANLG	
TAPE RCDR RCD	RCD	RCD	RCD	RCD	
TAPE RCDR FWD	off (ctr)	FWD	FWD	FWD	
TAPE MOTION tb	bp	gray	(STDN command)	gray	
SCE PWR	NORM	NORM	NORM	NORM	
PMP PWR	NORM	NORM	NORM	NORM	
PCM BIT RATE	HI	HI	LO	LO	
INV 1	MNA	MNA	MNA	MNA	
INV 2	MNB	MNB	MNB	MNB	
INV 3	OFF	OFF	OFF	OFF	
INV 1 AC1	on (up)	on (up)	on (up)	on (up)	
INV 2 AC1	OFF	OFF	OFF	OFF	
INV 3 AC1	OFF	OFF	OFF	OFF	
AC1 RSET	ctr (RSET*)	ctr (RSET*)	ctr (RSET*)	ctr (RSET*)	
INV 1 AC2	OFF	OFF	OFF	OFF	
INV 2 AC2	on (up)	on (up)	on (up)	on (up)	
INV 3 AC2	OFF	OFF	OFF	OFF	
AC2 RSET	ctr (RSET*)	ctr (RSET*)	ctr (RSET*)	ctr (RSET*)	
AC IND sel	BUS 2 ØC	BUS 2 ØC	BUS 2 ØC	BUS 2 ØC	

PANEL 4					
SPS GAUGING	OFF	OFF	OFF	OFF	
TELCOM GRP 1	AC1	AC1	AC1	AC1	
TELCOM GRP 2	AC2	AC2	AC2	AC2	
GLY PUMPS	2 AC1	1 AC1	1 AC1	1 AC1	
SUIT COMPR 1	OFF	AC1	AC1	AC1	
SUIT COMPR 2	OFF	OFF	OFF	OFF	
cb SUIT COMPR AC1 ØA	close	close	close	close	
cb SUIT COMPR AC1 ØB	close	close	close	close	
cb SUIT COMPR AC1 ØC	close	close	close	close	
cb SUIT COMPR AC2 ØA	close	close	close	close	
cb SUIT COMPR AC2 ØB	close	close	close	close	
cb SUIT COMPR AC2 ØC	close	close	close	close	
cb GLY PUMPS AC1 ØA	close	close	close	close	
cb GLY PUMPS AC1 ØB	close	close	close	close	
cb GLY PUMPS AC1 ØC	close	close	close	close	
cb GLY PUMPS AC2 ØA	close	close	close	close	
cb GLY PUMPS AC2 ØB	close	close	close	close	
cb GLY PUMPS AC2 ØC	close	close	close	close	
PANEL 5					
FC 1 PUMPS	AC1	AC1	AC1	AC1	
FC 2 PUMPS	AC2	AC2	AC2	AC2	
FC 3 PUMPS	AC2	AC2	AC2	AC2	
G/N PWR	OFF	AC1	AC1	AC1	
MN BUS TIE BAT A/C	OFF	on (up)	OFF	on (up)	
MN BUS TIE BAT B/C	OFF	on (up)	OFF	on (up)	
BAT CHGR	AC1	AC1	AC1	AC1	
NONESS BUS	OFF	OFF	OFF	OFF	
cb SNSR SIG MN A	close	close	close	close	
cb SNSR SIG MN B	close	close	close	close	
cb SNSR SIG AC 1	close	close	close	close	

*Identifies last momentary position switched to.

NOMENCLATURE	CSM CONTROL/INDICATOR CONFIGURATION				
	PRIOR TO BACKUP CREW CABIN INGRESS	AT LIFTOFF	DOCKED TO SOYUZ	ENTRY PREPARATION	
PANEL 5 (CONT)					
cb SNSR SIG AC 2	close	close	close	close	
cb C/W MN A	close	close	close	close	
cb C/W MN B	close	close	close	close	
cb 74	open	open	open	open	
cb INV CONT 1 bat rly bus	close	close	close	close	
cb INV CONT 2 bat rly bus	close	close	close	close	
cb INV CONT 3 bat rly bus	close	close	close	close	
cb DC SNSR UNIT A bat rly bus	close	close	close	close	
cb DC SNSR UNIT B bat rly bus	close	close	close	close	
cb AC SNSR UNIT 1 bat rly bus	close	close	close	close	
cb AC SNSR UNIT 2 bat rly bus	close	close	close	close	
cb BAT RLY BUS BAT A	close	close	close	close	
cb BAT RLY BUS BAT B	close	close	close	close	
cb 66	(N/A) open	(N/A) open	(N/A) open	(N/A) open	
INTGL LTS	on (cw)	as desired	as desired	as desired	
FLOOD LTS	OFF (full dim or brt)	OFF (full dim or brt)	OFF (full dim or brt)	OFF (full dim or brt)	
FLOOD DIM	1	1	1	1	
FLOOD FIXED	OFF	OFF	OFF	OFF	
cb RAD CONTR AC 1	close	close	close	close	
cb RAD CONTR AC 2	close	close	close	close	
cb RAD CONT/HTRS MN A	close	close	close	close	
cb RAD CONT/HTRS MN B	close	close	close	close	
cb RAD HTRS OVLD BAT A	open	open	open	open	
cb RAD HTRS OVLD BAT B	open	open	open	open	
cb BAT CHGR BAT A	close	close	close	close	

PANEL 5

cb BAT CHGR BAT B	close	close	close	close	close
cb BAT CHGR MN A	close	close	close	close	close
cb BAT CHGR MN B	close	close	close	close	close
cb BAT CHGR AC PWR	close	close	close	close	close
cb ESS INST MN A	close	close	close	close	close
cb ESS INST MN B	close	close	close	close	close
cb NONESS INST noness bus	open	open	open	open	open
cb SCI EQUIP SEB 1 noness bus	open	open	open	open	open
cb SCI EQUIP SEB 2 noness bus	open	open	open	open	open
cb SCI EQUIP HATCH noness bus	open	open	open	open	open
cb POT H2O HTR MN A	close	close	close	close	close
cb POT H2O HTR MN B	close	close	close	close	close
cb H2O ACCUM MN A	close	close	close	close	close
cb H2O ACCUM MN B	close	close	close	close	close
cb WASTE/POT H2O XDUCR MN A	close	close	close	close	close
cb WASTE/POT H2O XDUCR MN B	close	close	close	close	close
cb ECS PRESS XDUCR 1 MN A	close	close	close	close	close
cb ECS PRESS XDUCR 1 MN B	close	close	close	close	close
cb ECS PRESS XDUCR 2 MN A	open	open	close	close	close
cb ECS PRESS XDUCR 2 MN B	close	close	close	close	close
cb ECS TEMP XDUCR MN A	close	close	close	close	close
cb ECS TEMP XDUCR MN B	close	close	close	close	close
cb SEC COOL AC 1	close	close	close	close	close
cb SEC COOL AC 2	close	close	close	close	close
cb SEC COOL RAD HTR MN A	close	close	close	close	close
cb SEC COOL XDUCR MN A	close	close	close	close	close
cb SEC COOL XDUCR MN B	close	close	close	close	close
cb WASTE DUMP HTRS MN A	open	open	open	open	open
cb WASTE DUMP HTRS MN B	open	open	open	open	open
cb CAB FANS AC 1 ØA	close	close	close	close	close
cb CAB FANS AC 1 ØB	close	close	close	close	close
cb CAB FANS AC 1 ØC	close	close	close	close	close
cb AC UTIL AC 2 ØA	open	open	open	open	open
cb AC UTIL AC 2 ØB	open	open	open	open	open

NOMENCLATURE	CSM CONTROL/INDICATOR CONFIGURATION				
	PRIOR TO BACKUP CREW CABIN INGRESS	AT LIFTOFF	DOCKED TO SOYUZ	ENTRY PREPARATION	
PANEL 5 (CONT)					
cb AC UTIL AC 2 ØC	open	open	open	open	
cb G/N PWR AC 1	close	close	close	close	
cb G/N PWR AC 2	close	close	close	close	
cb G/N IMU MN A	close	close	close	close	
cb G/N IMU MN B	close	close	close	close	
cb GN HTR MN A	close	close	close	close	
cb GN HTR MN B	close	close	close	close	
cb GN CMPTR MN A	close	close	close	close	
cb GN CMPTR MN B	close	close	close	close	
cb GN OPT MN A	close	close	close	close	
cb GN OPT MN B	close	close	close	close	
PANEL 6					
MODE	INTERCOM/PTT	INTERCOM/PTT	INTERCOM/PTT	INTERCOM/PTT	
VOX SENS tw	5	as req	as req	as req	
PWR	OFF	AUDIO/TONE	AUDIO	AUDIO/TONE	
MASTER VOL tw	5	as req	5.0	as req	
VHF FM/PAD COMM	T/R	OFF	OFF	OFF	
VHF FM/PAD COMM VOL tw	5	as desired	as desired	as desired	
S BD	T/R	T/R	T/R	T/R	
S BD VOL tw	5	as req	5.3	as req	
VHF AM	T/R	T/R	OFF	TT/R	
VHF AM VOL tw	5	as req	5.0	as req	
AUDIO CONT	NORM	NORM	NORM	NORM	
SUIT PWR	OFF	on (up)	OFF	on (up)	
CM/RMTE INTERCOM	OFF	T/R	RMTE	OFF	
CM/RMTE INTERCOM VOL tw	decr	decr	incr	decr	

PANEL 7					
EDS PWR	OFF	on (up)	OFF	OFF	
TVC SERVO PWR 1	OFF	AC1/MNA	AC1/MNA	AC1/MNA	
TVC SERVO PWR 2	OFF	AC2/MNB	AC2/MNB	AC2/MNB	
FDAI/GPI PWR	OFF	BOTH	BOTH	BOTH	
LOGIC 2/3 PWR	on (up)	on (up)	on (up)	on (up)	
ELEC PWR	OFF	GDC/ECA	GDC/ECA	GDC/ECA	
SIG CONDR/DR BIAS PWR 1	OFF	AC1	AC1	AC1	
SIG CONDR/DR BIAS PWR 2	OFF	AC2	AC2	AC2	
BMAG 1 PWR	WARM UP	ON	ON	ON	
BMAG 2 PWR	WARM UP	ON	ON	ON	
DIRECT 02 v1v	partially OPEN (ccw)	partially OPEN (ccw)	close (cw)	close (cw)	
PANEL 8					
cb SCS TVC AC1	close	close	close	close	
cb SCS AC1	close	close	close	close	
cb SCS AC2	close	close	close	close	
AUTO RCS A/C ROLL A1	OFF	OFF	OFF	OFF	
AUTO RCS A/C ROLL C1	OFF	OFF	OFF	OFF	
AUTO RCS A/C ROLL A2	OFF	OFF	OFF	OFF	
AUTO RCS A/C ROLL C2	OFF	OFF	OFF	OFF	
AUTO RCS B/D ROLL B1	OFF	MNA	MNA	MNA	
AUTO RCS B/D ROLL D1	OFF	MNB	MNB	MNB	
AUTO RCS B/D ROLL B2	OFF	MNA	MNA	MNA	
AUTO RCS B/D ROLL D2	OFF	MNB	MNB	MNB	
AUTO RCS PITCH A3	OFF	MNB	OFF	MNB	
AUTO RCS PITCH C3	OFF	MNA	MNB	MNA	
AUTO RCS PITCH A4	OFF	MNA	MNA	MNA	
AUTO RCS PITCH C4	OFF	MNB	OFF	MNB	
AUTO RCS YAW B3	OFF	MNA	OFF	MNA	
AUTO RCS YAW D3	OFF	MNB	MNB	MNB	
AUTO RCS YAW B4	OFF	MNB	MNA	MNB	
AUTO RCS YAW D4	OFF	MNA	OFF	MNA	

PANELS 5 THRU 8

NOMENCLATURE	CSM CONTROL/INDICATOR CONFIGURATION				
	PRIOR TO BACKUP CREW CABIN INGRESS	AT LIFTOFF	DOCKED TO SOYUZ	ENTRY PREPARATION	
PANEL 8 (CONT)					
cb SCS ECA/TVC AC2	close	close	close	close	
cb SCS DIR ULL MNA	close	close	open	open	
cb SCS DIR ULL MNB	close	close	open	open	
cb SCS CONTR DIR 1 MNA	close	close	close	close	
cb SCS CONTR DIR 1 MNB	close	close	close	close	
cb SCS CONTR DIR 2 MNA	close	close	close	close	
cb SCS CONTR DIR 2 MNB	close	close	close	close	
cb SCS A/C ROLL MNA	close	close	close	close	
cb SCS A/C ROLL MNB	close	close	close	close	
cb SCS B/D ROLL MNA	close	close	close	close	
cb SCS B/D ROLL MNB	close	close	close	close	
cb SCS PITCH MNA	close	close	open	close	
cb SCS PITCH MNB	close	close	close	close	
cb SCS YAW MNA	close	close	open	close	
cb SCS YAW MNB	close	close	close	close	
NUMERICS LTS	as desired	as desired	as desired	as desired	
FLOOD LTS	OFF (full dim or full BRT)	OFF (full dim or full BRT)	OFF (full dim or full BRT)	OFF (full dim or full BRT)	
INTGL LTS	as desired	as desired	as desired	as desired	
cb ORDEAL AC2	close	close	close	close	
cb ORDEAL MNB	close	close	close	close	
cb SCS CONTR AUTO MNA	close	close	close	close	
cb SCS CONTR AUTO MNB	close	close	close	close	
cb SCS LOGIC 1/2 MNA	close	close	open	close	
cb SCS LOGIC 3/4 MNA	close	close	close	close	
cb SCS LOGIC 1/4 MNB	close	close	open	close	
cb SCS LOGIC 2/3 MNB	close	close	close	close	
cb SCS SYS MNA	close	close	close	close	
cb SCS SYS MNB	close	close	close	close	
FLOOD DIM	1	1	1	1	

FLOOD FIXED	OFF	OFF	OFF	OFF
FLOAT BAG 1 L	VENT (locked)	VENT (locked)	VENT (locked)	VENT (locked)
FLOAT BAG 2 R	VENT (locked)	VENT (locked)	VENT (locked)	VENT (locked)
FLOAT BAG 3 CTR	VENT (locked)	VENT (locked)	VENT (locked)	VENT (locked)
SECS LOGIC 1	OFF (locked)	on (up) (locked)	OFF (locked)	OFF (locked)
SECS LOGIC 2	OFF (locked)	on (up) (locked)	OFF (locked)	OFF (locked)
SECS PYRO A ARM	SAFE (locked)	on (up) (locked)	SAFE (locked)	SAFE (locked)
SECS PYRO B ARM	SAFE (locked)	on (up) (locked)	SAFE (locked)	SAFE (locked)
cb CM RCS 1 HTR MNA	open	open	open	open
cb CM RCS 2 HTR MNB	open	open	open	open
cb SM RCS PRIM A/C HTRS MNB	close	close	close	close
cb SM RCS PRIM B/D HTRS MNA	close	close	close	close
cb SM RCS SEL A/C HTRS MNA	close	close	close	close
cb SM RCS SEC B/D HTRS MNB	close	close	close	close
cb RCS PRPLNT ISOL MNA	close	close	close	close
cb RCS PRPLNT ISOL MNB	close	close	close	close
cb RCS LOGIC MNA	close	close	open	open
cb RCS LOGIC MNB	close	close	open	open
cb EMS MNA	close	close	close	close
cb EMS MNB	close	close	close	close
cb DOCK PROBE MNA	open	open	open	open
cb DOCK PROBE MNB	open	open	open	open
cb SPS GAUGING MNA	open	open	open	open
cb SPS GAUGING MNB	open	open	open	open
cb SPS GAUGING AC1	open	open	open	open
cb SPS GAUGING AC2	open	open	open	open
cb SPS He VLV MNA	close	close	close	close
cb SPS He VLV MNB	close	close	close	close
cb SPS PITCH 1 BAT A	open	close	close	close
cb SPS PITCH 2 BAT B	close	close	close	close
cb SPS YAW 1 BAT A	open	close	close	close

PANEL 8

NOMENCLATURE	CSM CONTROL/INDICATOR CONFIGURATION				
	PRIOR TO BACKUP CREW CABIN INGRESS	AT LIFTOFF	DOCKED TO SOYUZ	ENTRY PREPARATION	
PANEL 8 (CONT)					
cb SPS YAW 2 BAT B	close	close	close	close	
cb SPS PILOT VLVS A MNA	close	close	close	close	
cb SPS PILOT VLVS B MNB	close	close	close	close	
cb FLOAT BAG 1 BAT A	open	open	open	open	
cb FLOAT BAG 2 BAT B	open	open	open	open	
cb FLOAT BAG 3 FLT/PL	open	open	open	open	
cb SECS LOGIC A BAT A	open	close	close	close	
cb SECS LOGIC B BAT B	open	close	close	close	
cb SECS ARM A BAT A	open	close	open	open	
cb SECS ARM B BAT B	open	close	open	open	
cb EDS 1 BAT A	close	close	open	open	
cb EDS 2 BAT C	close	close	open	open	
cb EDS 3 BAT B	close	close	open	open	
cb ELS/CM SM SEP BAT A	close	close	open	open	
cb ELS/CM SM SEP BAT B	close	close	open	open	
cb PL VENT FLT/PL	close	close	open	open	
PANEL 9					
MODE	INTERCOM/PTT	INTERCOM/PTT	INTERCOM/PTT	INTERCOM/PTT	
VOX SENS tw	5	as req	as req	as req	
PWR	OFF	AUDIO/TONE	AUDIO	AUDIO/TONE	
MASTER VOL tw	5	as req	5.0	as req	
INTERCOM	T/R	T/R	OFF	T/R	
INTERCOM VOL tw	5	as req	4.2	as req	
VHF FM/PAD COMM	T/R	OFF	OFF	OFF	
VHF FM/PAD COMM VOL tw	5	as desired	as desired	as desired	
S BD	T/R	T/R	OFF	OFF	
S BD VOL tw	5	as req	4.4	as req	

VHF AM	T/R	T/R	OFF	T/R	
VHF AM VOL tw	5	as req	5.4	as req	
AUDIO CONT	NORM	NORM	NORM	NORM	
SUIT PWR	OFF	on (up)	OFF	on (up)	
VHF RNG	NORM	NORM	NORM	NORM	
PANEL 10					
MODE	INTERCOM/PTT	INTERCOM/PTT	INTERCOM/PTT	INTERCOM/PTT	
VOX SENS tw	5	as req	as req	as req	
PWR	OFF	AUDIO/TONE	AUDIO/TONE	AUDIO/TONE	
MASTER VOL tw	5	as req	as desired	as req	
VHF FM/PAD COMM	T/R	OFF	OFF	OFF	
VHF FM/PAD COMM VOL tw	5	as desired	as desired	as desired	
INTERCOM	T/R	T/R	T/R	T/R	
INTERCOM VOL tw	5	as req	as desired	as req	
S BD	T/R	T/R	T/R	T/R	
S BD VOL tw	5	as req	as desired	as req	
VHF AM	T/R	T/R	OFF	T/R	
VHF AM VOL tw	5	as req	as desired	as req	
AUDIO CONT	NORM	NORM	NORM	NORM	
SUIT PWR	OFF	on (up)	OFF	on (up)	
PHONE/MIC CONNECT	OFF	OFF	ON	OFF	
PANEL 12					
TUNL VENT vlv	OFF	DM/CM ΔP	DM/CM ΔP	OFF	
PANEL 13					
FDAI 1	INRTL	INRTL	INRTL	INRTL	
FDAI 2	INRTL	INRTL	INRTL	INRTL	
EARTH/LUNAR	PWR OFF	PWR OFF	PWR OFF	EARTH	
ALT SET cont	88 NM	88 NM	121 NM	121 NM	
LIGHTING	OFF	OFF	OFF	OFF	
MODE	HOLD/FAST	HOLD/FAST	HOLD/FAST	HOLD/FAST	
SLEW	ctr	ctr	ctr	ctr	

PANELS 8 THRU 13

NOMENCLATURE	CSM CONTROL/INDICATOR CONFIGURATION				
	PRIOR TO BACKUP CREW CABIN INGRESS	AT LIFTOFF	DOCKED TO SOYUZ	ENTRY PREPARATION	
PANEL 15					
COAS PWR	OFF	OFF	OFF	OFF	
UTIL PWR	OFF	OFF	OFF	OFF	
PL BCN LT	off (ctr)	off (ctr)	off (ctr)	off (ctr)	
DYE MARKER	off (down) (guarded)	off (down) (guarded)	off (down) (guarded)	off (down) (guarded)	
PL VENT	OFF	OFF	OFF	OFF	
PANEL 16					
S1	off (ctr)	off (ctr)	off (ctr)	off (ctr)	
UTIL PWR	OFF	OFF	OFF	OFF	
COAS PWR	OFF	OFF	OFF	OFF	
PANEL 98					
XMIT/ICOM	off (ctr)	off (ctr)	off (ctr)	off (ctr)	
POWER	OFF	OFF	POWER	OFF	
VOL tw	as req	as req	as req	as req	
SPEAKER/HEADSET	as req	HEADSET	SPEAKER	HEADSET	
PANEL 100					
UTIL PWR	OFF	OFF	OFF	OFF	
FLOOD DIM	1	1	1	1	
FLOOD FIXED	OFF	OFF	OFF	OFF	
G/N OPT PWR	OFF	OFF	OFF	on (up)	
G/N IMU PWR	on (up) (guarded)	on (up) (guarded)	OFF	on (up) (guarded)	
S3	off (ctr)	off (ctr)	off (ctr)	off (ctr)	
NUMERICS LTS	as desired	as desired	as desired	as desired	

FLOOD LTS INTGL LTS	OFF (full dim or full BRT) as desired	OFF (full dim or full BRT) as desired	OFF (full dim or full BRT) as desired	ON as desired	
PANEL 101					
SYS TEST (LH) SYS TEST (RH) CM RCS HTRS WASTE H2O DUMP URINE DUMP S6	5 B OFF OFF OFF off (down)	5 B OFF HTR A HTR A off (down)	5 B OFF HTR A HTR A off (down)	5 B OFF OFF OFF off (down)	
PANEL 122					
OPT ZERO OPT TELTRUN OPT COUPLING OPT MODE OPT SPEED COND LAMPS UP TLM	ZERO SLAVE TO SXT DIR MAN LO ON ACPT	ZERO SLAVE TO SXT DIR MAN LO ON ACPT	ZERO SLAVE TO SXT DIR MAN LO ON ACPT	ZERO SLAVE TO SXT RSLV CMC LO ON ACPT	
PANEL 162					
SCI PWR	OFF	OFF	OFF	OFF	
PANEL 163					
SCI/UTIL PWR	OFF	OFF	OFF	OFF	
PANEL 164					
S1 (Located behind closeout panel and will be set at panel closeout)	OFF	OFF	OFF	OFF	
PANEL 165					
EPE COOLING vlv	COOL (cw)	COOL (cw)	BYPASS (ccw)	BYPASS (ccw)	

NOMENCLATURE	CSM CONTROL/INDICATOR CONFIGURATION				
	PRIOR TO BACKUP CREW CABIN INGRESS	AT LIFTOFF	DOCKED TO SOYUZ	ENTRY PREPARATION	
PANEL 181					
TV STA SEL CM/REMOTE	UP TLM	UP TLM	UP TLM	UP TLM	
TV STA SEL CM1/CM2	UP TLM	UP TLM	UP TLM	UP TLM	
CM/DM CAMR PWR	OFF	POWER	as req	OFF	
CM1 TV STA PWR	OFF	ON	as req	OFF	
TV MONITOR PWR	OFF	OFF	as req	OFF	
TV AMPL	BYPASS	ON	as req	BYPASS	
CM2 TV STA PWR	OFF	OFF	as req	OFF	
PANEL 201					
AC UTIL PWR	OFF	OFF	OFF	OFF	
PANEL 225					
cb PCM TLM ac GRP 1	close	close	close	close	
cb PCM TLM ac GRP 2	close	close	close	close	
cb FLT BUS MNA	close	close	close	close	
cb FLT BUS MNB	close	close	close	close	
cb PMP PRIM FLT BUS	close	close	close	close	
cb PMP AUX FLT BUS	close	close	close	close	
cb VHF/CREW AUDIO L FLT/PL	close	close	close	close	
cb VHF/CREW AUDIO CTR FLT/PL	close	close	close	close	
cb VHF/CREW AUDIO R FLT/PL	close	close	close	close	
cb UDL FLT BUS	close	close	close	close	
cb ATSF SYSTEM FLT BUS	open	open	close	open	
cb ATSF SYSTEM ac GRP 2	open	open	close	open	
cb S BD XMTR/DSE FLT BUS	close	close	close	close	

cb S BD XMTR/DSE ac GRP 1	close	close	close	close	
cb CTE MNA	close	close	close	close	
cb CTE MNB	close	close	close	close	
cb 15	open	open	open	open	
cb SIG CONDR FLT BUS	close	close	close	close	
cb S BD PWR AMPL 1 FLT BUS	close	close	close	close	
cb S BD PWR AMPL 1 ac GRP 1	close	close	close	close	
cb S BD PWR AMPL 2 FLT BUS	close	close	close	close	
cb S BD PWR AMPL 2 ac GRP 2	close	close	close	close	
PANEL 226					
cb FC 1 PUMPS AC	close	close	close	close	
cb FC 1 RAD/REACS bat rly bus	close	close	close	close	
cb FC 1 BUS CONT bat rly bus	close	close	close	close	
cb FC 1 PURGE mna	close	close	close	close	
cb 45	open	open	open	open	
cb CRYO H2 HTR 1 MNA	close	close	close	close	
cb CRYO H2 HTR 2 MNB	close	close	close	close	
cb FC 2 PUMPS AC	close	close	close	close	
cb FC 2 RAD/REACS bat rly bus	close	close	close	close	
cb FC 2 BUS CONT bat rly bus	close	close	close	close	
cb FC 2 PURG mnb	close	close	close	close	
cb 02 TK 1 100W HTR MNA	close	close	close	close	
cb 02 TK 2 100W HTR MNB	close	close	close	close	
cb 43	open	open	open	open	
cb FC 3 PUMPS AC	close	close	close	close	
cb FC 3 RAD/REACS bat rly bus	close	close	close	close	
cb FC 3 BUS CONT bat rly bus	close	close	close	close	
cb FC 3 PURG mnb	close	close	close	close	
cb 02 TK 1 50W HTR MNB	close	close	close	close	
cb 02 TK 2 50W HTR MNA	close	close	close	close	
cb 44	open	open	open	open	

PANELS 181 THRU 226

NOMENCLATURE	CSM CONTROL/INDICATOR CONFIGURATION				
	PRIOR TO BACKUP CREW CABIN INGRESS	AT LIFTOFF	DOCKED TO SOYUZ	ENTRY PREPARATION	
PANEL 226 (CONT)					
cb CRYO FAN TK 1 AC1 ØA	close	close	close	close	
cb CRYO FAN TK 1 AC1 ØB	close	close	close	close	
cb CRYO FAN TK 1 AC1 ØC/SCE	close	close	close	close	
cb CRYO FAN TK 2 AC2 ØA	close	close	close	close	
cb CRYO FAN TK 2 AC2 ØB	close	close	close	close	
cb CRYO FAN TK 2 AC2 ØC/SCE	close	close	close	close	
cb COAS/TUNL LTG MNA	close	close	close	close	
cb COAS/TUNL LTG MNB	close	open	close	close	
cb FLOOD LTG MNA	close	close	close	close	
cb FLOOD LTG MNB	close	close	close	close	
cb FLOOD LTS FLT/PL	close	close	close	close	
cb NUM/INTGL LTG LEB AC2	close	close	close	close	
cb NUM/INTGL LTG L MDC AC1	close	close	close	close	
cb NUM/INTGL LTG R MDC AC1	close	close	close	close	
cb RUN/EVA LTG AC1	close	close	close	close	
cb RUN/EVA LTG AC2	close	close	close	close	
PANEL 227					
SCI PWR	OFF	OFF	OFF	OFF	
PANEL 229					
cb EPS GRP 1 MNA	close	close	close	close	
cb EPS GRP 1 MNB	close	close	close	close	
cb EPS GRP 2 MNA	close	close	close	close	
cb EPS GRP 2 MNB	close	close	close	close	
cb EPS GRP 3 MNA	close	close	close	close	
cb EPS GRP 3 MNB	close	close	close	close	

cb EPS GRP 4 MNA	close	close	close	close	
cb EPS GRP 4 MNB	close	close	close	close	
cb EPS GRP 5 MNA	close	close	close	close	
cb EPS GRP 5 MNB	close	close	close	close	
cb UTIL R/L STA MNA	close	close	close	close	
cb UTIL LEB MNB	close	close	close	close	
cb EPS BAT BUS A	close	close	close	close	
cb EPS BAT BUS B	close	close	close	close	
cb TMRS MNA	close	close	close	close	
cb TMRS MNB	close	close	close	close	
cb SPS LINE HTRS MNA	close	close	close	close	
cb SPS LINE HTRS MNB	close	close	close	close	
cb 02 VAC-ION PUMPS MNA	open	open	open	open	
cb 02 VAC-ION PUMPS MNB	open	open	open	open	
cb MN REL PYRO A	open	open	open	open	
cb MN REL PYRO B	open	open	open	open	
PANEL 230					
UV ABSORPTION PWR	OFF	OFF	as req	OFF	
UV ABSORPTION LAMPS	OFF	OFF	as req	OFF	
cb EXP COVERS MNA	close	close	close	open	
cb EXP COVERS MNB	close	close	close	open	
EXP COVERS ARM	SAFE	SAFE	SAFE	SAFE	
EXP COVERS TIE DOWN	off (down) (guarded)	off (down) (guarded)	off (down) (guarded)	off (down) (guarded)	
X-RAY LV PWR	OFF	OFF	as req	OFF	
X-RAY PURGE	ctr	ctr	as req	ctr	
UV COVER	ctr	ctr	as req	ctr (CLOSE*)	
He GLOW COVER	ctr	ctr	as req	ctr (CLOSE*)	
EUV COVER	ctr	ctr	as req	ctr (CLOSE*)	
X-RAY COVER	ctr	ctr	as req	ctr (CLOSE*)	
X-RAY HV PWR	off (ctr)	off (ctr)	as req	off (ctr)	
X-RAY BU PURGE	ctr (guarded)	ctr (guarded)	as req	ctr (guarded)	
HGA PITCH cont	0°	0°	as req	0°	

PANELS 226 THRU 230

* Identifies last position selected

NOMENCLATURE	CSM CONTROL/INDICATOR CONFIGURATION				
	PRIOR TO BACKUP CREW CABIN INGRESS	AT LIFTOFF	DOCKED TO SOYUZ	ENTRY PREPARATION	
		PANEL 230 (CONT)			
HGA YAW cont	180°	180°	as req	180°	
ATSF PWR AMPL	off (ctr)	off (ctr)	l	off (ctr)	
ATSF XPNDR	off (ctr)	off (ctr)	PRIM	off (ctr)	
HGA ANT PWR	OFF	OFF	on (up)	OFF	
HGA ANT SERVO ELECT	PRIM	PRIM	PRIM	PRIM	
HGA ANT BEAM	WIDE	WIDE	NARROW	WIDE	
HGA ANT TRACK	AUTO	AUTO	REACQ	AUTO	
HELIUM GLOW	OFF	OFF	as req	OFF	
HELIUM GLOW He INHIBIT	ctr	ctr	as req	ctr	
EUV TELESCOPE PWR	OFF	OFF	as req	OFF	
EUV TELESCOPE DET	ctr	ctr	as req	ctr	
OMNI SEL	UP TLM	MAN	UP TLM	UP TLM	
TRDC	BYPASS	ON	as req	BYPASS	
UP TLM	up tlm (ctr)	up tlm (ctr)	up tlm (ctr)	up tlm (ctr)	
PCM RELAY	OFF	OFF	ON	OFF	
RLY MODE CONT	UP TLM	UP TLM	UP TLM	UP TLM	
RLY MODE TV CONT	UP TLM	UP TLM	UP TLM	UP TLM	
RLY MODE DATA PCM CONT	UP TLM	UP TLM	UP TLM	UP TLM	
RLY MODE DATA RT/PB CONT	UP TLM	UP TLM	UP TLM	UP TLM	
DOPPLER RECEIVER	OFF	OFF	as req	OFF	
PWR AMPL CONT	UP TLM	UP TLM	UP TLM	UP TLM	
HGA SCAN	NORMAL (guarded)	NORMAL (guarded)	INHIBIT (guarded)	NORMAL (guarded)	
ATSF RELAY SQUELCH	OFF	OFF	ON	OFF	
		PANEL 250			
cb BAT BUS A TO PYRO BUS	open	open	open	open	
cb PYRO A/SEQ A pyro bat a	close	close	open	close	
cb BAT BUS B TO PYRO BUS	open	open	open	open	
cb PYRO B/SEQ B pyro bat b	close	close	open	close	

cb BAT A PWR ENTRY/PL	close	close	close	close	
cb BAT B PWR ENTRY/PL	close	close	close	close	
cb BAT C PWR ENTRY/PL	close	close	close	close	
cb BAT C TO BAT BUS A	open	open	open	open	
cb BAT C TO BAT BUS B	open	open	open	open	
cb BAT C BAT CHGR/EDS 2	close	close	close	close	
PANEL 251					
OVBD DRAIN vlv	OFF	OFF	OFF	OFF	
PANEL 252					
BAT VENT vlv	VENT	VENT	VENT	VENT	
WASTE STOW VENT vlv	CLOSE	VENT	CLOSE	CLOSE	
PANEL 274					
cb ELECTROPHORESIS/ COVERS MNA	close	close	close	open	
cb ELECTROPHORESIS/ COVERS MNB	close	close	close	open	
cb DM FURNACE/CRYSTAL GROWTH 1 - MNA	open	open	as req	open	
cb DM FURNACE/CRYSTAL GROWTH 2 - MNA	open	open	as req	open	
cb DM FURNACE/CRYSTAL GROWTH 3 - MNA	open	open	as req	open	
cb UV/DOPPLER MNA	open	open	as req	open	
cb He GLOW MNB	open	open	as req	open	
cb EUV MNB	open	open	as req	open	
cb X-RAY MNA	open	open	as req	open	
cb VIDEO RCDR MNA	close	close	close	open	
cb VIDEO CAMR/MON MNA	close	close	close	open	
cb DS A IND LOGIC MNA	open	open	close	open	
cb DS A IND PWR AC1	open	open	close	open	
cb DS A CONTROL BAT A	open	open	open	open	
cb DS A MOTORS AC1 ØA	open	open	open	open	
cb DS A MOTORS AC1 ØB	open	open	open	open	

NOMENCLATURE	CSM CONTROL/INDICATOR CONFIGURATION				
	PRIOR TO BACKUP CREW CABIN INGRESS	AT LIFTOFF	DOCKED TO SOYUZ	ENTRY PREPARATION	
PANEL 274 (CONT)					
cb DS A MOTORS AC1 ØC	open	open	open	open	
cb DM POWER MNA	open	open	close	open	
cb DM POWER MNB	open	open	close	open	
cb DS B IND LOGIC MNB	open	open	close	open	
cb DS B IND PWR AC2	open	open	close	open	
cb DS B CONTROL BAT B	open	open	open	open	
cb DS B MOTORS AC2 ØA	open	open	open	open	
cb DS B MOTORS AC2 ØB	open	open	open	open	
cb DS B MOTORS AC2 ØC	open	open	open	open	
TUNL LTS	OFF	OFF	OFF	OFF	
EXT RUN/EVA LTS	OFF	OFF	OFF	OFF	
EXT RNDZ LTS	OFF	OFF	OFF	OFF	
SM RCS QUAD A HTRS	OFF	OFF	PRIM	PRIM	
SM RCS QUAD B HTRS	OFF	OFF	PRIM	PRIM	
SM RCS QUAD C HTRS	OFF	OFF	PRIM	PRIM	
SM RCS QUAD D HTRS	OFF	OFF	PRIM	PRIM	
PANEL 275					
cb MNA BAT BUS A	close	close	close	close	
cb MNA BAT C	open	open	open	close	
cb MNB BAT C	open	open	open	close	
cb MNB BAT BUS B	close	close	close	close	
cb FLT/PL BAT BUS A	open	open	open	open	
cb FLT/PL BAT BUS B	open	open	open	open	
cb FLT/PL BAT C	open	open	open	open	
cb FLT/PL MNA	close	close	close	close	
cb FLT/PL MNB	close	close	close	close	
cb INV 1 MNA	close	close	close	close	
cb INV 2 MNB	close	close	close	close	

cb INV 3 MNA cb INV 3 MNB	close close	close close	close close	close close	
PANEL 276					
CB 1 INST PWR CONT ess inst bus CB 2 INST PWR CONT ess inst bus CB 3 INST PWR CONT ess inst bus CB 4 INST PWR CONT ess inst bus	close close close close	close close close close	close close close close	close close close close	
PANEL 277					
cb CSM/DM FNL SEP A BAT A cb CSM/DM FNL SEP B BAT B	open open	open open	open open	open open	
PANEL 278					
cb UPR SYS COMPR 1 bat bus a cb UPR SYS COMPR 2 bat bus b cb SIVB/DM SEP PYRO A cb SIVB/DM SEP PYRO B	open open close close	open open close close	open open open open	open open open open	
PANEL 300					
rh SUIT FLOW	FULL FLOW	FULL FLOW	FULL FLOW	FULL FLOW	
PANEL 301					
lh SUIT FLOW	FULL FLOW	FULL FLOW	FULL FLOW	FULL FLOW	

PANELS 274 THRU 301

NOMENCLATURE	CSM CONTROL/INDICATOR CONFIGURATION				
	PRIOR TO BACKUP CREW CABIN INGRESS	AT LIFTOFF	DOCKED TO SOYUZ	ENTRY PREPARATION	
PANEL 302					
ctr SUIT FLOW	FULL FLOW	FULL FLOW	FULL FLOW	FULL FLOW	
PANEL 303					
PRIM CAB TEMP vlv SEC CAB TEMP vlv	COLD (cw) MAX COOL (CW)	COLD (cw) MAX COOL (CW)	COLD (cw) as desired	as desired as desired	
PANEL 304					
DRINK H2O SUP vlv H2O gun probe safety H2O gun probe fire extg vlv	OFF (cw) push lock lock closed	OFF (cw) push lock lock closed	ON (ccw) push lock lock closed	OFF (cw) push lock lock closed	
PANEL 305					
FOOD PREP COLD H2O vlv FOOD PREP HOT H2O vlv	rel rel	rel rel	rel rel	rel rel	
PANEL 306					
MSN TMR EVNT TMR RSET EVNT TMR START EVNT TMR MIN EVNT TMR SEC MSN TMR HRS MSN TMR MIN MSN TMR SEC	START UP (ctr) ctr ctr ctr ctr ctr ctr	START UP (ctr) ctr ctr ctr ctr ctr ctr	START UP (ctr) ctr ctr ctr ctr ctr ctr	START UP (ctr) ctr ctr ctr ctr ctr ctr	

PANEL 325					
rh CAB PRESS RELF vlv	BOOST/ENTR	BOOST/ENTR	NORM	NORM	
lh CAB PRESS RELF vlv	BOOST/ENTR	BOOST/ENTR	NORM	NORM	
PRIM GLY TO RAD	NORM (in)	BYP (pull)	NORM (in)	NORM (in)	
PANEL 326					
REPRESS PKG 02 vlv	OFF	ON	OFF	ON	
SM 02 SUP vlv	ON	ON	ON	ON	
SRG TK 02 vlv	ON	ON	ON	ON	
GLY RSVR IN vlv	OPEN	OPEN	CLOSE	CLOSE	
GLY RSVR BYP vlv	CLOSE	CLOSE	OPEN	OPEN	
GLY RSVR OUT vlv	OPEN	OPEN	CLOSE	CLOSE	
PANEL 350					
CO2 CSTR DIVERT vlv	ctr	ctr	ctr	ctr	
PANEL 351					
MN REG A	OPEN	OPEN	OPEN	OPEN	
MN REG B	OPEN	OPEN	OPEN	OPEN	
H2O/GLY TK REG sel	BOTH	BOTH	BOTH	BOTH	
H2O/GLY TK RELF sel	BOTH	BOTH	BOTH	BOTH	
EMER CAB PRESS sel	OFF	OFF	BOTH	BOTH	
CAB REPRESS vlv	OFF (ccw)	OFF (ccw)	OFF (ccw)	OFF (ccw)	
PANEL 352					
WASTE TK SERV vlv	CLOSE	CLOSE	CLOSE	CLOSE	
PRESS RELF sel	RELF	RELF	RELF	RELF	
POT TK IN vlv	CLOSE	as req	OPEN	OPEN	
WASTE TK IN vlv	AUTO	AUTO	AUTO	AUTO	
PANEL 375					
02 SRG TK RELF vlv	OPEN (cw)	OPEN (cw)	OPEN (cw)	OPEN (cw)	

NOMENCLATURE	CSM CONTROL/INDICATOR CONFIGURATION				
	PRIOR TO BACKUP CREW CABIN INGRESS	AT LIFTOFF	DOCKED TO SOYUZ	ENTRY PREPARATION	
PANEL 376					
PLVC sw	NORM	NORM	NORM	NORM	
PANEL 377					
GLY TO RAD SEC vlv	BYP	BYP	BYP	BYP	
PANEL 378					
PRIM GLY ACCUM vlv	open (ccw)	open (ccw)	open (ccw)	open (ccw)	
PANEL 379					
PRIM ACCUM FILL vlv	OFF	OFF	OFF	OFF	
PANEL 380					
DEMAND REG sel	BOTH	BOTH	BOTH	BOTH	
SUIT TEST vlv	OFF	OFF	OFF	OFF	
SUIT RETURN vlv	close (push)	close (push)	open (pull)	open (pull)	
PANEL 382					
SUIT FLOW RELF	OFF	OFF	OFF	OFF	
GLY EVAP IN TEMP vlv	MIN (ccw) (push)	MIN (ccw) (push)	As req	As req	
SUIT HT EXCH SEC GLY	FLOW	FLOW	FLOW	FLOW	
SEC EVAP H2O CONT	AUTO	AUTO	OFF	AUTO	
PRIM EVAP H2O CONT	AUTO	AUTO	AUTO	AUTO	
H2O ACCUM 1	RMTE	RMTE	RMTE	RMTE	
H2O ACCUM 2	RMTE	RMTE	RMTE	RMTE	

PANEL 400					
TELEMETRY PWR INTRLVR PWR VTR PWR HEADWHEEL DR MOT TAPE MODE TAPE DRIVE TAPE HEAD CLEAN LAMP TEST	OFF OFF OFF ctr ctr ctr NORM STATUS	ON ON ON ctr ctr ctr NORM STATUS	ON ON ON as req as req as req NORM STATUS	OFF OFF OFF ctr ctr ctr NORM STATUS	
PANEL 600					
EMER 02 VLV	CLOSE	CLOSE	CLOSE	CLOSE	
PANEL 601					
REPRESS 02 VLV	CLOSE (guarded)	CLOSE (guarded)	CLOSE (guarded)	CLOSE (guarded)	
PANEL 602					
REPRESS 02 RELF VLV	OPEN (cw)	OPEN (cw)	OPEN (cw)	OPEN (cw)	
FWD HATCH					
PRESS EQUAL vlv Actr handle sel Actr handle rel	CLOSE stowed locked	CLOSE stowed locked	OPEN stowed locked	CLOSE stowed locked	

NOMENCLATURE	CSM CONTROL/INDICATOR CONFIGURATION			
	PRIOR TO BACKUP CREW CABIN INGRESS	AT LIFTOFF	DOCKED TO SOYUZ	ENTRY PREPARATION
SIDE HATCH				
CAB PRESS DUMP vlv	close (cw)	close (cw)	close (cw)	close (cw)
Gearbox sel	LATCH	LATCH	LATCH	LATCH
Actr handle sel	L (latch)	U (unlatch)	L (latch)	L (latch)
BPC jett knob	180° from BPC JETT decal	Arrow on knob pointing to BPC JETT decal	180° from BPC JETT decal	180° from BPC JETT decal
Lockpin rel knob	UNLOCK	LOCK	UNLOCK	UNLOCK
GN2 vlv handle	neutral	push (outboard)	neutral	neutral
Lockpin ind	flush	flush	flush	flush

ORIGINAL DOCUMENT CONTAINS FOLDOUTS THAT ARE NOT REPRODUCIBLE